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CHAPTER 1

Introduction

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Unisphere Online Help

Unisphere is a HTML5 web-based application that allows you to configure and manage PowerMax, VMAX All Flash, and VMAX storage systems. The term Unisphere incorporates "Unisphere for PowerMax" for the management of PowerMax and All Flash storage systems running PowerMaxOS 5978, and "Unisphere for VMAX" for the management of VMAX All Flash and VMAX storage systems running HYPERMAX OS 5977 and Enginuity OS 5876.

Click here in order to access blog posts and videos that provide an overview of Unisphere functionality.

A HTML5 based Unisphere provides a number of advantages:

- improved security
- modern user interface
- reduced application response times

Unisphere supports the following tasks which are available from the items on the side panel and blue title bar:

The side panel has the following items when the All Systems view is selected:

- HOME - View system view dashboard of all storage systems being managed.
- PERFORMANCE - Monitors and manages storage system performance data (Dashboards, Charts, Analyze, Heatmap, Reports, Plan, Real Time traces, and Performance Database management). Refer to Understanding Performance Management on page 522 for more information.
- VMWARE - Views all the relevant storage related objects to an ESXi server and also provides the ability to help troubleshooting storage performance related issues to the ESXi server. Refer to Understanding Unisphere support for VMware on page 756 for more information.
- DATABASES - Monitors and troubleshoots database performance issues. Refer to Introduction on page 728 for more information.
- EVENTS - Includes Alerts and Job List.
- SUPPORT - Displays support information.

Click to set preferences. Refer to Managing settings on page 48 for more information.

Click to hide the side panel and click it again to display the side panel.

Click HOME to return to the All Systems view.

The side panel has the following items when the storage system specific view is selected:

- HOME - View system view dashboard of all storage systems being managed.
- DASHBOARD - View the following dashboards for a selected storage system: Capacity and Performance, System Health, Storage Group compliance, Capacity, and Replication.
- STORAGE - Manage storage (storage groups, service levels, templates, SRPs, volumes, external storage, VVols, FAST policies, tiers, thin pools, disk groups and
VLUN migration). Refer to Understanding Storage Management on page 92 for more information.

- **HOSTS** - Manage hosts (hosts, masking views, port groups, initiators, XtremSW Cache Adapters, PowerPath Hosts, Mainframe, and CU images). Refer to Understanding Host Management on page 296 for more information.

- **DATA PROTECTION** - Manage data protection (storage groups, device groups, SRDF groups, migrations, virtual witness, open replicator, SRDF/A DSE pools, TimeFinder SNAP pools, and RecoverPoint systems). Refer to Understanding Data Protection Management on page 352 for more information.

- **PERFORMANCE** - Monitors and manages storage system performance data (Dashboards, Charts, Analyze, Heatmap, Reports, Plan, Real Time traces, and Performance Database management). Refer to Understanding Performance Management on page 522 for more information.

- **SYSTEM** - Includes Hardware, Symmetrix Properties, File (eNAS), and iSCSI.

- **EVENTS** - Includes Alerts, Job List, and Audit log.

- **SUPPORT** - Displays support information.

**New and modified features/functionality in 9.0.0**

- **HTML5 support** - A HTML5 based Unisphere provides a number of advantages:
  - improved security
  - modern user interface look and feel - use of browser functionality, bookmarks for links, back and forward buttons. Facilitates enhanced collaboration as you can share links to system views with colleagues.
  - reduced application response times
  - aligns with other Dell EMC products

- **System Health Score** - The System Health dashboard provides a single place from which you can quickly determine the health of the system. The System Health panel displays values for the following high level health or performance metrics: Configuration, Capacity, System Utilization, Storage Group Response Time and Service Level Compliance. It also displays an overall health score based on the lowest health score out of the five metrics. These five categories are for storage systems running HYPERMAX OS 5977 or higher. For storage systems running Enginuity OS 5876, the health score is based on four categories: Configuration, System Utilization, Capacity and storage group (SG) Response Time. The health score is calculated every five minutes. The overall value is always calculated from all metric values. If a health score category is seen as stale or unknown then the overall health score is not updated. The previously calculated overall health score is displayed but its value is denoted as stale by setting the menu item to grey (refer to Understanding the system health score on page 35).

- **Role Based Access Control (RBAC)** - This feature provides a set of roles with more granular access that can be assigned to users in order to limit what resources can be accessed and what functions a user can perform on those resources. Additional roles are Device Management, Local Replication and Remote Replication at the entire array or an storage group subset. This feature also supports, for tracking purposes, a full audit log of users and actions performed. (refer to Adding authorization rules on page 72).

- **Service Levels (Performance QoS)** - Unisphere supports all service levels (Diamond, Platinum, Gold, Silver, Bronze and Optimized) for FBA SRPs containing internal disk groups on Storage systems running PowerMaxOS 5978 and above. There are no changes to service level restrictions for CKD SRPs or SRPs containing external disk groups (refer to Viewing service levels on page 154).
• Compliance - A Compliance Tab has been added to the Storage Group detailed view page (refer to Viewing Storage Group Compliance view on page 96).

• Noisy Neighbors - The Noisy Neighbors feature displays the following performance data for a selected storage group:
  • FE Directors details - Name, % busy, and queue depth utilization.
  • FE Port details - Name, % busy, and host I/Os per second.
  • Related SGs - Name, response time, host I/Os per second, and host MBs per second.

(refer to Viewing ESXi server performance details on page 760).

• Data Reduction - Data is reduced using data compression and de-duplication (de-duplication applies for storage systems running PowerMaxOS 5978 or higher).

• Real Time Data Collection - This feature provides the ability to troubleshoot at a more granular level for a set number of Storage Group’s for a limited set of metrics at a 30 second level. This will be limited to 1 array per time, a maximum of 5 SG’s at a time and a certain number of KPI metrics. The metrics reported on are Response Time, Host I/O's Per Sec, Host MB's Per Sec, Host Reads Per Sec, and Host Writes Per Sec.

• SRDF and Metro topology view - The SRDF and Metro topology view visually describes the layout of the SRDF connectivity of the selected storage system in Unisphere.

• Storage Templates - Using the configuration and performance characteristics of an existing storage group as a starting point, you can create templates that will pre-populate fields in the provisioning wizard and create a more realistic performance reservation in your future provisioning requests (refer to Creating storage templates on page 270).

• VMware integration - Unisphere support for VMware provides the storage admin access to all the relevant storage related objects to an ESXi server and also provides the ability to help troubleshooting storage performance related issues to the ESXi server. You can, as a read only user, discover at the vCenter level as well as discovering an individual ESXi server. If a vCenter is discovered, then all ESXi servers under that vCenter are discovered. All ESXi servers, that do not have local storage on the Unisphere performing the discovery, are filtered out. Once VMware information is added by a user, all other users of Unisphere are able to access this information. The minimum version number supported by vCenter is version 5.5. The VMware feature supports a maximum of 75 ESXi servers and 2000 VMs per Unisphere for PowerMax install (refer to Understanding Unisphere support for VMware on page 756).

• Integration of Database Storage Analyzer into Unisphere - DSA for Oracle and SQL now fully integrated with Unisphere, no separate login or page launch required. The DB mapping procedure has been streamlined to make it more user friendly (refer to Introduction on page 728).

• Silent Install - This supports installations of Unisphere by invoking an automated script which handles the various steps involved. Included is a response file containing default values that the user can edit. Where there is not enough space or memory on a host, the install will be aborted.

Using the help system

Clicking on the navigation bar results in the display of three options. Clicking the top option results in the display of a window that displays the Unisphere help home page. Clicking the middle option results in the display of a window that displays the
Unisphere help for that screen (context-sensitive help). Clicking the bottom option (About) results in the display of a window that displays the Unisphere version number.

Finding information:

- Using the Contents tab—Click the book icon to expand the table of contents and display help topics.
- Using the Search tab—Click the Search tab in the navigation pane. Type a search word or phrase and a list of topics that contain the word or phrase displays in the navigation panel. Click on the name of the topic to display it in the View panel.

Your comments—Your suggestions will help us continue to improve the accuracy, organization, and overall quality of the user publications. Send your opinions to: content feedback.

Supporting documentation

Information on the installation of Unisphere for PowerMax can be found in the Unisphere for PowerMax Installation Guide located at the Dell EMC support website or the technical documentation page.

For information specific to this Unisphere product release, refer to the Unisphere for PowerMax Release Notes located at the Dell EMC support website or the technical documentation page.

**Capacity information**

Storage capacity can be measured using two different systems—base 2 (binary) and base 10 (decimal). Organizations such as the International System of Units (SI) recommend using the base 10 measurement to describe storage capacity. In base 10 notation, one megabyte (MB) is equal to 1 million bytes, and one gigabyte (GB) is equal to 1 billion bytes.

Operating systems generally measure storage capacity using the base 2 measurement system. Unisphere and Solutions Enabler use the base 2 measurement system to display storage capacity along with the TB notation as it is more universally understood. In base 2 notation, one megabyte (MB) is equal to 1,048,576 bytes and one gigabyte (GB) is equal to 1,073,741,824 bytes.

<table>
<thead>
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<th>Name</th>
<th>Abbreviation</th>
<th>Binary Power</th>
<th>Binary Value (in Decimal)</th>
<th>Decimal Power</th>
<th>Decimal (Equivalent)</th>
</tr>
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<td>2^10</td>
<td>1,024</td>
<td>10^3</td>
<td>1,000</td>
</tr>
<tr>
<td>megabyte</td>
<td>MB</td>
<td>2^20</td>
<td>1,048,576</td>
<td>10^6</td>
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<tr>
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<td>GB</td>
<td>2^30</td>
<td>1,073,741,824</td>
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<tr>
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<td>TB</td>
<td>2^40</td>
<td>1,099,511,627,776</td>
<td>10^12</td>
<td>1,000,000,000,000</td>
</tr>
</tbody>
</table>
Introduction
CHAPTER 2

Getting Started

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Operating as the initial setup user

When Unisphere is first installed, there is a single user called the Initial Setup User (ISU). This user can perform administrative tasks only on storage systems that do not have defined roles (authorization rules). Once an Administrator or SecurityAdmin is assigned to a storage system, the ISU will no longer be able to access or even see the system from the Unisphere console. Therefore, it is recommended that users not operate in this role for too long.

When logging in to Unisphere as the Initial Setup User (ISU), the "Initial setup user warning" message is displayed and it informs you that you can only access the listed storage systems because they do not have defined authorization rules. Once rules are defined for the storage systems, you will no longer be able to access or view the storage systems as the ISU.

To continue to access/view a storage system while operating as the ISU, select the corresponding Assign Admin role to ISU option and click OK.

The main tasks of an ISU are:

- Creating local users on page 77
- Adding authorization rules on page 72

For more information on operating as the ISU, refer to the Unisphere for PowerMax Installation Guide.

Viewing Home Dashboard view - All Storage Systems

Before you begin

The user requires a minimum of Monitor permissions to perform this task.

For an overview of Unisphere functionality, see Unisphere Online Help on page 24.

The Home Dashboard view (the default mode on login) provides an overall view of the status of all of the storage systems managed by Unisphere. The following panels are displayed:

- COMPLIANCE
- CAPACITY
- HEALTH SCORE- see Understanding the system health score on page 35
- THROUGHPUT
- IOPS
- EFFICIENCY
- CLOUDIQ

You can sort the view by the following:

- COMPLIANCE
- CAPACITY
- HEALTH SCORE- see Understanding the system health score on page 35
- THROUGHPUT
- IOPS
- EFFICIENCY
- CLOUDIQ

To view the home dashboard view:

Procedure

1. From the main menu, click Unisphere for PowerMax.
   
The home dashboard view is displayed.

2. View the following parameters displayed in each storage system panel.
   
   Depending on the metric selected, some of the following items are displayed:
   
   - Storage system ID - The serial number of the storage system.
   - Storage system model - The model number of the storage system.
   - The version of microcode on the storage system.
   - Data chart - The information displayed in the chart depends on the selected metric.
   - Capacity - Percentage of currently allocated capacity for the storage system.
   - Compliance - Service level compliance data in the form of Storage group counts for each compliance state (Critical, Marginal, Stable) as well as total Storage Group count and number of Storage groups with no service level assigned.
   - Performance - Current performance health score.
   - Throughput - Current throughput for the system, in MB/second.
   - IOPS - Current IOPS for the system.
   - Efficiency - The overall efficiency ratio for the array. It represents the ratio of the sum of all TDEVs plus snapshot sizes (calculated based on the 128K track size) and the physical Used Storage (calculated based on the compressed pool track size).
   - If CLOUDIQ has been selected and the SRS gateway has not been registered, an option to register is displayed on each storage system card. Clicking REGISTER allows you to register the SRS gateway (see Registering a SRS gateway on page 88). If the SRS Gateway has already been registered, the enabled/disabled data collection status is displayed within each storage system card. Each card also shows the last time data was sent to CloudIQ for that storage system. Clicking the Enabled/Disabled link opens the Settings dialog on the CloudIQ tab to enable the user to enable or disable data collection on the storage system (see Managing CloudIQ settings on page 90).

3. (Optional) To view the alerts, click on any storage system panel and click VIEW ALERTS.

   The color reflects the highest severity alert for the associated storage system.
   
   You can also view the job list and navigate to the compliance view for the storage system by clicking the related icon on any storage system panel.
   
   Note: you can view alerts for remote storage systems and storage systems that are not registered to collect performance data.
4. (Optional) Click to view the system view in list format.
5. (Optional) Click to view the system view in card view format.
6. (Optional) From a panel view or list view, click the storage system identity of the system you want to view in more detail.
7. (Optional) To navigate to other areas, click on any of the following from the left hand panel:
   - HOME
   - PERFORMANCE
   - VMWARE
   - DATABASES
   - EVENTS
   - SUPPORT

**Viewing Home Dashboard view - Specific Storage System**

**Before you begin**

The user requires a minimum of Monitor permissions to perform this task.

For an overview of Unisphere functionality, see Unisphere Online Help on page 24.

The Home Dashboard view for a specific storage system provides a view of the status of a specific storage system managed by Unisphere. The following panels are displayed:

- PERFORMANCE
- SYSTEM HEALTH
- SG COMPLIANCE
- CAPACITY
- REPLICATION

To view the home dashboard view:

**Procedure**

1. From the main menu, click **Unisphere for PowerMax**.
   
   The home dashboard view for all storage systems is displayed.

2. Select a storage system.
   
   The system performance dashboard is displayed by default (see Viewing system performance view on page 33).

3. (Optional) To navigate to other areas, click on any of the following from the left hand panel:
   - HOME
   - DASHBOARD
   - STORAGE
   - HOSTS
Viewing system performance view

Before you begin

The user requires a minimum of Monitor permissions to perform this task.

To view the system performance view:

Procedure

1. From the main menu, click **Unisphere for PowerMax**.
2. Select a storage system.
   
   The home dashboard view for the selected storage system is displayed. The system performance dashboard is displayed by default.

3. View the capacity and performance data for the selected storage system. The following items are displayed:

   - A **Capacity** panel displaying the following:
     - A graphical representation of the system's subscribed and usable capacity (used = blue and free = grey) and the percentage used for both.
     - The percentage of subscribed usable capacity.
     - The overall efficiency ratio.

   - A **Performance** panel displaying the following graphs over a four hour, one week, or two weeks period:
     - **Host IOs per sec** in terms of read and write operations over time
     - **Latency** in terms of read and write operations over time
     - **Throughput** in terms of read and write operations over time

   - A **Capacity Trend** panel displaying usable capacity and subscribed capacity in terabytes.

   - The following control is available:
     - **VIEW PERFORMANCE DASHBOARD**—Viewing dashboards on page 523

4. (Optional) To navigate to other areas, click on any of the following from the left hand panel:

   - **HOME**
   - **DASHBOARD**
   - **STORAGE**
   - **HOSTS**
   - **DATA PROTECTION**
Viewing the System Health Dashboard

The System Health dashboard provides a single place from which you can quickly determine the health of the system. You can also access hardware information.

The System Health section displays values for the following five high level health or performance metrics: System Utilization, Configuration, Capacity, SG Response Time and Service Level Compliance. It also displays an overall health score based on these five categories. The overall system health score is based on the lowest health score out of the categories System Utilization, Configuration, Capacity, SG Response Time and service level compliance. See Understanding the system health score on page 35 for details on how these scores are calculated. These five categories are for systems running HYPERMAX OS 5977 or later. For systems running Enginuity 5876, the health score is based on the Hardware, Configuration, Capacity and SG Response time scores. The health score is calculated every five minutes.

Note

The Health score values for Hardware, SG Response and service level compliance are not real-time; they are based on values within the last hour.

The Hardware section shows the director count for Front End, Back End, and SRDF Directors as well as the available port count on the system. An alert status is indicated through a colored bell beside the title of the highest level alert in that category. If no alerts are present, then a green tick is displayed.

To view the system health dashboard:

Procedure

1. Select the storage system.
2. Optional: Hover over SYSTEM HEALTH to view the system health summary for the storage system.
3. Click SYSTEM HEALTH and view the following items:
   - Introducing your Health Score - Understanding the system health score on page 35
   - Health Score panel - The current score and the 30 day trend are displayed for the storage system health parameters - Total Issues, Configuration, Capacity, System Utilization, Service Level Compliance, and SG Response Time.

The following views are available by clicking on the associated panel item:

- VIEW ALERTS—Viewing alerts on page 52
- VIEW PERFORMANCE—Using default dashboards on page 524
- VIEW STORAGE GROUPS—Viewing storage groups on page 137
Hardware panel - The storage system hardware is displayed in terms of the number of front end (FE) directors, SRDF directors, back end (BE) directors, available ports and cache partitions. The following views are available by clicking on the associated panel item:

- **Front End** — Viewing system front-end directors on page 787
- **RDF** — Viewing RDF directors on page 791
- **Back End** — Viewing back-end directors on page 784
- **Available Ports** — Viewing available ports on page 783

The following controls are available:

- **VIEW SYMMETRIX PROPERTIES** — Viewing Storage System details on page 764
- **MANAGE EMULATION** — Using the Emulation Management wizard on page 769 (For storage systems running HYPERMAX OS 5977 or higher)
- **VIEW RESERVATIONS** — Viewing reservations on page 279
- **VIEW OTHER HARDWARE** — Viewing dynamic cache partitions on page 839
- **RUN HEALTH CHECK** — Performing system health checks on page 805
- **RUN DISK REPLACEMENT** — Replacing failed drives on page 806 (For storage systems running Enginuity OS 5876)

**Understanding the system health score**

The System Health dashboard provides a single place from which you can quickly determine the health of the system.

The System Health panel displays values for the following high level health or performance metrics: Configuration, Capacity, System Utilization, Storage Group Response Time and Service Level Compliance. It also displays an overall health score based on the lowest health score out of the five metrics. These five categories are for storage systems running HYPERMAX OS 5977 or higher. For storage systems running Enginuity OS 5876, the health score is based on four categories: Configuration, System Utilization, Capacity and storage group (SG) Response Time. The health score is calculated every five minutes. The overall value is always calculated from all metric values. If a health score category is seen as stale or unknown then the overall health score is not updated. The previously calculated overall health score is displayed but its value is denoted as stale by setting the menu item to grey.

The Configuration health score is based on storage system hardware alerts in the system like Director and Port alerts. The System Utilization, Capacity, storage group response time and service level compliance are based on performance information.

The Configuration health score is calculated every five minutes and is based on the director and port alerts in the system at the time of calculation. Unisphere does not support alert correlation or auto clearing, so you are required to manually delete alerts that have been dealt with or are no longer relevant as these will impact on the hardware health score until such time as they are removed from Unisphere.

The Configuration health score is calculated as follows:

- Director out of service - 40 points reduced
- Director Offline - 20 points reduced
- Port Offline - 10 points reduced

The Capacity health Score is based on percentage of used usable. Capacity levels are checked at the Array, SRP (only on storage systems running HYPERMAX OS 5977 or higher) and Thin Pool level (only storage systems running Enginuity OS 5876).

The capacity health scores are calculated as follows:

- Critical level: 95% - 30 points reduced
- Warning level: 80% - 10 points reduced

The System Utilization health score is calculated using the threshold limits of the following categories and metrics:

- FE_DIR: PERCENT_BUSY, QUEUE_DEPTH_UTILIZATION
- FE_PORT: PERCENT_BUSY
- BE_PORT_DA: PERCENT_BUSY
- BE_DIR_DA: PERCENT_BUSY
- RDF_PORT: PERCENT_BUSY
- RDF_DIR: PERCENT_BUSY
- BE_PORT_DX: PERCENT_BUSY
- BE_DIR_DX: PERCENT_BUSY
- IM_DIR: PERCENT_BUSY
- EDS_DIR: PERCENT_BUSY
- BOARD: UTILIZATION
- CP: WP
- DISK: PERCENT_BUSY

For each instance and metric for particular category, the threshold info is found. If not set, use defaults thresholds. The default thresholds are:

FE Port - Percent Busy - Critical 70, Warning 50
FE Director - Percent Busy - Critical 70, Warning 50; Queue Depth Utilization - Critical 75, Warning 60
BE Port DA - Percent Busy - Critical 70, Warning 55
BE Director DA - Percent Busy - Critical 70, Warning 55
RDF Port - Percent Busy - Critical 70, Warning 50
RDF Director - Percent Busy - Critical 70, Warning 50
BE Port DX - Percent Busy - Critical 70, Warning 55
BE Director DX - Percent Busy - Critical 70, Warning 55
IM Director - Percent Busy - Critical 70, Warning 55
EDS Director - Percent Busy - Critical 70, Warning 55
Board - Utilization - Critical 70, Warning 60
Cache Partition - Percent Busy - Critical 75, Warning 55
Disk - Percent Busy - Critical 70, Warning 55

The system utilization score is calculated as follows:

- Critical level: - 30 points reduced
- Warning level: - 10 points reduced
Storage systems running HYPERMAX OS 5977 or higher: The Service Level Compliance health score is based on WLP Workload state. A reduction from the health score is performed when storage groups which have an Service Level defined are not meeting the service level requirements.

It is based on WLP Workload state. A reduction from the health score is performed when storage groups, which have a service level defined, are not meeting the service level requirements.

The Service Level compliance score is calculated as follows:

- Underperforming: - 30 points reduced
- Marginal performing: - 10 points reduced

Storage systems running Enginuity OS 5876: The Storage Group Response health score is based on software category health scores. Certain key metrics are examined against threshold values and if they exceed a certain threshold, then the health score is negatively affected.

The storage group response score is calculated as follows:

- Storage Group: Read Response Time, Write Response Time, Response Time
  - Read Response Time: Critical: 30 points reduced; Warning: 20 points reduced
  - Write Response Time:
  - Response Time: 30 points reduced; Warning: 20 points reduced
- Database: Read Response Time, Write Response Time, Response Time

For each instance and metric for particular category, the threshold info is found. If not found, default thresholds are used.

## Viewing Storage Group Compliance view

### Before you begin
The user requires a minimum of Monitor permissions to perform this task.

To view the Storage Group (SG) Compliance view:

**Procedure**

1. Select a storage system.
   - The system performance dashboard is displayed by default (see Viewing system performance view on page 33).
2. Optional: Hover over **SG COMPLIANCE** to view the storage health summary for the storage system.
3. Click **SG COMPLIANCE** and view the following items:
   - **Compliance** panel—Displays how well the storage system's workload is complying with the overall service level. Storage groups compliance information displays for storage systems registered with the Performance component. The total number of storage groups is listed, along with information about the number of storage groups performing according to service level targets. Possible values are:
     - **Critical**—Number of storage groups performing well below service level targets.
- **Marginal**—Number of storage group ps performing below service level targets.
- **Stable**—Number of storage groups performing within the service level targets.
- **No Status**—Number of storage groups without a status.

- **Storage Groups** panel—The storage groups are listed in a view that can be filtered.
- The following controls are available:
  - **VIEW COMPLIANCE REPORT**—Viewing compliance reports on page 159 (For storage systems running HYPERMAX OS 5977 or higher)
  - **VIEW ALL STORAGE GROUPS**—Viewing storage groups on page 137
  - **VIEW FAST STORAGE GROUPS**—Viewing FAST storage groups on page 175 (For storage systems running Enginuity OS 5876)
  - **PROVISION STORAGE**—Using the Provision Storage wizard on page 102
  - **EXCLUDE DATA**—Managing Data Exclusion Windows on page 160 (For storage systems running HYPERMAX OS 5977 or higher)

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**Viewing Capacity dashboard view**

**Before you begin**
The user requires a minimum of Monitor permissions to perform this task.

To view the Capacity dashboard view:

**Procedure**

1. Select a storage system.
   The system performance dashboard is displayed by default (see Viewing system performance view on page 33).

2. Optional: Hover over **CAPACITY** to view the capacity summary for the storage system.

3. Click **CAPACITY**, select the system or an SRP instance (not applicable for systems running Enginuity 5876) and view the following items:
   - **System running Enginuity 5876:**
     A graphical representation of the system's physical and virtual capacity (used = blue and free = grey) and the percentage used for both.
   - **System running HYPERMAX OS 5977 or PowerMaxOS 5978 - System selected and Show Detailed selected:**
     - A graphical representation of the system's subscribed, snapshot and usable capacity (used = blue and free = grey) and the percentage used for both.
     - A textual representation of the system's subscribed usable capacity.
     - **System Usage** is displayed if you turn on the **Show Detailed** slider. The information is displayed in terms of System Meta data used, Replication Meta Data and Front End Meta Data. You can click on **Analyze Trend** to
analyze trends across metrics particular to capacity and usage. Trending shown for Metadata usage, Subscribed Capacity, Snapshot Capacity, and Usable Capacity.

- Metadata trending will capture System, Replication, Front-end and Backend.
- Subscribed capacity trending will capture all (non-shared and shared) allocated against total subscribed capacity.
- Snapshot capacity trending will capture all (shared and non-shared) modified capacity against total snapshot capacity.
- Usable capacity trending will capture all (user, system, temp) used capacity against total usable capacity.

**Note**
The data shown depends on the code level the system is running. Front-end meta data isn’t shown for systems running HYPERMAX OS 5977.

- **Efficiency** is also displayed in terms of Overall Efficiency Ratio, Data Reduction (Ratio and Enabled Percent), Virtual Provisioning savings, and Snapshot savings.

System running HYPERMAX OS 5977 or higher - SRP instance selected:

- A graphical representation of the system's subscribed, snapshot and usable capacity (used = blue and free = grey) and the percentage used for both.
- A textual representation of the system's subscribed usable capacity.
- Headroom details are also displayed. Headroom is displayed by default as an overall figure but can also be filtered to display headroom for OLTP, OLTP + Replication, DSS, DSS + Replication, and None.
  The headroom displayed depends on the system's code level — systems running HYPERMAX OS 5977 will only show Diamond service levels and a combination of workload types. Systems running PowerMaxOS 5978 will show headroom for the different SLO types (workload types aren't supported by this code level).

- **Efficiency** is also displayed in terms of Overall Efficiency Ratio, Data Reduction (Ratio and Enabled Percent), Virtual Provisioning savings, and Snapshot savings.

The following controls are available (for storage system running HYPERMAX OS 5977 or higher when a SRP instance is selected) from the **Actions** panel:

- **STORAGE GROUP DEMAND**—Viewing Storage Group Demand Reports on page 93
- **SERVICE LEVEL DEMAND**—Viewing Service Level Demand Reports on page 94
- **COMPRESSIBILITY**—Viewing compressibility reports on page 291

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**Viewing Replication dashboard**

**Before you begin**
The user requires a minimum of Monitor permissions to perform this task.

The Replication Dashboard provides Storage Group Summary Protection information, summarizing worst states of various Replication technologies and counts of...
Management objects participating in these technologies. Storage systems running Enginuity 5876 also display a Device Group Summary, with counts of various Replication Technologies using Device Groups.

To view the Replication dashboard:

Procedure

1. From the main menu, click Unisphere for PowerMax.
2. Select a storage system.
   
The system performance dashboard is displayed by default (see Viewing system performance view on page 33).
3. Click REPLICATION and view the following items:
   
   - **A Storage Group Summary** panel is displayed. For systems running HYPERMAX OS 5977 and higher, summary information for SRDF, SRDF/Metro and SnapVX is displayed. For systems running Enginuity 5876, summary information for SRDF and Device Groups is displayed. To view the Storage Groups that are in the states indicated, you can click on the row which brings you to the technologies Storage Group list view that is filtered to show only the applicable Storage Groups for the selected state.
   
   - A visual display of SRDF topology:
     The SRDF Topology View visually describe the layout of the SRDF connectivity of the selected storage system in Unisphere.

     It calculates this with a maximum of two hops, for example, Symm A has SRDF Groups to Symm B, which has SRDF Groups to Symm C, if a fourth storage system Symm D has SRDF Groups to Symm C but is not connected to Symm A or Symm B, it is not shown as it is outside the two hop count for the Array that Unisphere is currently managing. All types of SRDF Groups are used to calculate this view.

     There are two components which make up the topology view, nodes and edges. A node is the storage system and the edges are the connectivity between the storage systems.

     The edges are color coded in the familiar traffic light system. The colors are Green, Yellow and Red.

     Green edges indicate that the state of the connectivity between two nodes (Arrays) is Good.

     Yellow indicates that the connectivity between two nodes is degraded. Degraded in this case means that one or more SRDF Groups between the 2 arrays are either in a Transmit Idle state, or have some ports in an SRDF Group that are offline.

     Red indicates that the state of the connectivity between two nodes is Critical. Critical in this case means that one or more SRDF Groups between the 2 arrays are Offline, or one more SRDF Groups contains ports that are all offline.

     The edges are also drawn differently depending on the modes of the SRDF Groups between two arrays. A legend is available under the view:

     Edges that are drawn with short dashes and short gapes between the dashes indicate that all the SRDF Groups between the two Arrays are Metro or Synchronous SRDF Groups.
Edges that are drawn with longer dashes and a short gap between the dashes indicate that all the SRDF Groups between the two Arrays are Asynchronous.

Edges that are solid indicate that there is a mix of Asynchronous, Synchronous, and SRDF/Metro SRDF Groups between the two Arrays.

Edges that are drawn with short dashes and a long distance between the dashes indicate the SRDF Groups between the two Arrays are Other SRDF Groups than mentioned above, including Empty SRDF Groups, Virtual Witness, Adaptive Copy, etc.

The nodes are drawn with some basic information about the Array, including Symmetrix ID and if set, the user defined nice name of the Array. An icon specific to the model of the Array will also be drawn into the node.

- A visual display of Migration Environments:
  The Migrations Environments topology view visually describes the layout of the migration environments of the currently selected storage system.

  The edges are color coded using the familiar traffic light system Red, Yellow and Green, Red in this case meaning the Migration Environment is in an Invalid State and Green meaning it is in a valid state. The color of the edge can also be dictated by the worst state of any migrations using this Environment. The edges are all drawn in a solid full line.

  The nodes are drawn with some basic information about the storage system, including ID and if set, the user defined nice name of the storage system. An icon specific to the model of the Array is drawn into the node.

- Both topology views have the following controls:

  Re-center — this brings the topology views nodes and edges back into full view.

  — Zoom the view in to see nodes and edges.

  — zoom the view out to view more of the topology view.

  — allows the user view a fuller screen view of the topology. Clicking this opens a popup that takes up most of the visible space on the screen. All functionality of this view is the same as the view embedded on the page.

  Clicking displays a Layout Manager which provides layout change options.

- The following controls are available:
  - CREATE SNAPSHOT—Creating snapshots on page 391 (For storage systems running HYPERMAX OS 5977 or higher)
  - CREATE SRDF GROUP—Creating SRDF groups on page 461
  - CREATE MIGRATION ENVIRONMENT—Setting up a migration environment on page 514
Discovering storage systems

Discovery refers to the process by which storage system, volume-level configuration and status information is retrieved. Discovered configuration and status data for all storage systems, as well as their directors and volumes, is maintained in a configuration database file on each host. Once you have discovered your environment, you can direct information requests to retrieve system-level (high-level) data or volume-level (low-level) information from it.

To discover a storage system:

Procedure

1. On the HOME view, click Unisphere for PowerMax in the title bar.
2. Select a storage system.
3. Click the arrow next to the storage system ID in the title bar and select DISCOVER SYSTEMS.
4. Read the warning stating the operation may take some time and click OK to confirm if you wish to proceed.

Refreshing storage system information

Unisphere refreshes all of the storage system data from its database. This operation does not discover new storage systems, only refreshes data for existing systems.

To refresh a storage system:

Procedure

1. Select a storage system.
2. In the Dashboard, click in the title bar.
3. Click OK to the System Refresh Confirmation dialog.

Viewing product version information

Procedure

1. Select SUPPORT to open the Support view.

The following Latest Software properties display:

- Installed Unisphere Version
- Latest Available Unisphere Version
- Installed Solution Enabler Version
- Latest Available Solution Enabler Version

The following Solution Enabler properties display:
• **Connection Type**—Connection Type
• **Net Connection Security Level**—Net Connection Security Level
• **Net Protocol**—Net Protocol
• **Net Address**—Net Address
• **Net Port**—Net Port
• **Node Name**—Node Name
• **OS Type**—OS Type
• **OS Name**—OS Name
• **OS Version**—OS Version
• **OS Release**—OS Release
• **Machine Type**—Machine Type
• **System Time**—System Time
• **Num Symm Pdevs**—Number of Symm Pdevs
• **SYMAPI Build Version**—SYMAPI Build Version
• **SYMAPI Runtime Version**—SYMAPI Runtime Version
• **Library Type**—Library Type
• **64 bit Libraries**—64 bit Libraries
• **Multithread Libraries**—Multithread Libraries
• **Server Processor**—Server Processor
• **Storage Daemon**—Storage Daemon
• **GNS**—GNS
• **Storage Daemon GK Mgmt**—Storage Daemon GK Mgmt
• **Storage Daemon Caching**—Storage Daemon Caching
• **Storage Daemon Emulation**—Storage Daemon Emulation
• **Storage Daemon EM Caching**—Storage Daemon EM Caching
• **VMware Guest**—VMware Guest
• **Type of SYMAPI Database**—Type of SYMAPI Database
• **SYMAPI Lib Version which discovered DB**—SYMAPI Lib Version which discovered DB
• **SYMAPI Lib Version which wrote DB**—SYMAPI Lib Version which wrote DB
• **Minimum Edit Level of SYMAPI Lib Required**—Minimum Edit Level of SYMAPI Lib Required
• **Database Sync Time**—Database Sync Time
• **DG Modify Time**—DG Modify Time
• **Device in Multiple Device Groups**—Device in Multiple Device Groups

The following operations are available from the **Actions** panel:

• **PRODUCT SUPPORT PAGE**—clicking this brings you to the product support page.
• **SERVICE CENTER**—clicking this brings you to the service center.
Searching for storage objects

This procedure explains how to search for objects (storage groups, hosts, initiators) across all manage storage systems.

Procedure

1. Click in the title bar.
2. Select the type of object (Storage Group, Initiator, Host, Virtual Machine and ESXi Server).
3. Depending on the object you are looking for, type the following:
   - Storage Group—Type all or part of the storage group name.
   - Initiator—Type all or part of the initiator name.
   - Host—Type all or part of the host name.
   - Virtual Machine—Type all or part of the virtual machine name.
   - ESXi Server—Type all or part of the ESXi Server name.
   - Select All Symmetrix or a specific storage system identifier.
4. Click Find.

   Results include the object Name, the Object Type, and the associated storage system (Symmetrix ID).
5. To view object details, click the object name to open its Details view.
6. Click Clear to clear the results of the search.

Modifying server logging levels

This procedure explains how to set the severity level of the alerts to log in the debug log. Once set, will only log events with the specified severity.

Procedure

1. Select SUPPORT.
2. In the Actions panel, select MODIFY SERVER LOGGING.
3. Select a Server Logging level (WARN, INFO or DEBUG) and click OK.

Exiting the console

To exit the console, click in the title bar, select Sign Out and click OK to confirm.

Getting help

Clicking in the title bar and selecting Help opens the entire help system.
Clicking help in a dialog box, wizard page, or view opens a help topic specifically for that dialog, page, or view.
Getting Started
CHAPTER 3
Administration

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Managing settings

Before you begin

- To perform this operation, you must be a StorageAdmin or higher.

This procedure explains how to manage system settings.

Procedure

1. Select to open the Settings panel.

   The following categories of settings are displayed (and the Preferences settings are displayed by default - see Setting preferences on page 49):
   - Preferences
   - System and Licences
   - Users and Groups
   - Symmetrix Access Control
   - Management
   - Data Protection
   - Performance
   - Unisphere Databases
   - DSA Environment
   - Alerts

2. Click on one of the following categories to view or modify its settings.
   - Preferences—Setting preferences on page 49
   - System and Licences > License Usage—Viewing license usage on page 820
   - System and Licences > Solutions Enabler—Viewing host-based licenses on page 820
   - System and Licences > Symmetrix Entitlements—Viewing Symmetrix entitlements on page 819
   - Users and Groups > Authentication—Viewing authentication authorities on page 69
   - Users and Groups > Local Users—Viewing local users on page 79
   - Users and Groups > User Sessions—Viewing user sessions on page 81
   - Users and Groups > Authorized Users and Groups—Viewing the authorized users and groups list on page 76
   - Symmetrix Access Control > Access Control Entries—Viewing access control entry details on page 831
   - Symmetrix Access Control > Access Groups—Viewing access group details on page 826
   - Symmetrix Access Control > Access Pools—Viewing access pools on page 828
Setting preferences

Before you begin
Only a user with Administrator permission can set preferences.

To set system preferences:

Procedure

1. Select 🛠️ to open the Settings panel.
2. Select Preferences to open the Preferences page.
3. Modify any number of the following preferences:

   **Unisphere 360 Support**—This setting enables or disables Unisphere 360 integration from the Unisphere side. Setting the checkbox to "disabled"
prevents Unisphere 360 from being able to enroll this Unisphere and disconnects any instance of Unisphere 360 that had previously enrolled it.

**Initial Setup User Warning**—This setting enables or disables the display of the warning when permissions are not configured during initial setup.

**Introduction to Health Score Card**—This setting enables or disables the display of health score guide in the **System Health** dashboard.

**Custom Welcome Screen Message**
Type a message to display to users during login. For example, you may want to notify logging in users about a software upgrade. Messages can be up to 240 characters.

**Solutions Enabler Debug**
Specify the debug level. Set the following parameters:

- **Debug**—Set the level of debugging to write to the debug file.
- **Debug2**—Set the secondary level of debugging to write to the debug file.
- **Debug Filename**—Enter the debug file name.

**Note**
Changing the debug level from the default value of 0 might substantially increase the size of the log files and affect your system's performance.

4. Click **APPLY**.

### Backing up the system database server

**Before you begin**
To perform this operation, you must be an Administrator.

This procedure is a recommended practice and explains how to backup all the data currently on the database server, including Database Storage Analyzer, Workload Planner, performance, and infrastructure data. Database backups will enable you to recover from system crashes. Backups should be downloaded and stored in a safe location. For systems running on embedded management, backups can be downloaded using the management interface utilities accessed on the management port `https://<hostname/IP address>:5480`. It is recommended to do this periodically so that performance data and settings are backed up.

System database backups can be restored. You can only restore the database to the same version and same operating system. For example, a V8.0.1 database on Windows, can only be restored to a V8.0.1 on Windows. See the *Dell EMC Virtual Appliance Manager Installation Guide* for more details.

**Procedure**

1. Select 🔄 to open the **Settings** panel.
2. Select **Unisphere Databases** > **System Database**
3. Click **Backup** to open the **Database Backup** dialog box.
4. In **File Name**, type a description of the backup.

**Note**
Note that the final file name consists of a time stamp and your custom description.
5. Click OK.

**Viewing system database backups**

**Before you begin**
To perform this operation, you must be a Monitor.

**Procedure**
1. Select to open the Settings panel.
2. Select Unisphere Databases > System Database
   The following properties display:
   - **Name**—Name of the backup in the form `TimeStamp_CustomName`.
   - **Status**—Status of the backup.
   - **Start Time**—Time the backup started.
   - **End Time**—Time the backup ended.
   - **Description**—Message related to the backup.
   The following controls are available:
   - **Backup**—[Backing up the system database server](#) on page 50
   - —[Deleting system database backups](#) on page 51

System database backups can be restored. You can only restore the database to the same version and same operating system. For example, a V8.0.1 database on Windows, can only be restored to a V8.0.1 on Windows. See the [Dell EMC Virtual Appliance Manager Installation Guide](#) for more details.

**Deleting system database backups**

**Before you begin**
To perform this operation, you must be an Administrator.

**Procedure**
1. Select to open the Settings panel.
2. Select Unisphere Databases > System Database
3. Select one or more backups and click .
4. Click OK.

**Alert settings**

You can configure Unisphere to monitor storage systems for specific events or error conditions. When an event or error of interest occurs, Unisphere displays an alert and, if configured to do so, notifies you of the alert by way of email, SNMP, or Syslog.
In addition to alerting you of specific events or errors, Unisphere also generates a number of server alerts that also alert you. For more information, refer to Server alerts on page 66.

The procedures in this section explain how to configure and use the alert functionality.

Alerts

Viewing alerts

Before you begin

- For alert (event) descriptions, refer to the Events and Alerts Guide.
- In addition to alerting you of specific events or errors, Unisphere also generates a number of server alerts that also alert you. For more information, refer to Server alerts on page 66.
- The maximum number of alerts Unisphere displays is 10,000. Once this threshold is reached, Unisphere deletes the oldest alert for each subsequent alert it receives.

This procedure explains how to view alerts for a particular storage system or all the visible storage systems. This procedure also applies to storage container alerts which can be viewed by navigating to STORAGE > VVol dashboard and clicking on STORAGE CONTAINER ALERTS from within the Actions panel.

Procedure

1. Do the following, depending on whether you want to view the alerts for a particular storage system, or for all storage systems.

   For a particular storage system:
   a. Select the storage system.
   b. Select EVENTS > Alerts to open the system's Alerts list view.

   For all visible storage systems:
   a. Select Home, and then select to open the Alert list view.

2. (Optional) Use the alert filter to view a subset of the listed alerts. For more information on the alert filter, refer to Filtering alerts on page 53.

   In both cases, the following properties display:
   - State—State of the alert. Possible values are New or Acknowledged.
   - Severity—Severity of the alert. Possible values are:
     - Fatal
     - Critical
     - Warning—The following events map to this severity:
       - The component is in a degraded state of operation.
       - The storage array is no longer present (during certain operations).
       - The component is in an unknown state.
       - The component is (where possible) in a write-disabled state.
- Information—The component is no longer present (during certain operations).
- Normal—The component is now (back) in a normal state of operation.

- **Type**—Type of alert. Possible values are Array, Performance, Server, System, and File.
- **Symmetrix**—Storage system reporting the alert. This field only appears when viewing alerts for all Symmetrix systems. This field will appear blank for server alerts. This is because server alerts are specific to the server or runtime environment and are not associated with a specific object or storage system.
- **Object**—Component to which the alert is related. This is because server alerts are specific to the server or runtime environment and are not associated with a specific object or storage system.
- **Description**—Description of the alert.
- **Created**—Date/time the alert was created.
- **Acknowledged**—Date/time the alert was acknowledged.

The following controls are available:

- Viewing alert details on page 54.
- Acknowledging alerts on page 54.
- Deleting alerts on page 55.

## Filtering alerts

### Procedure

1. Select EVENTS > Alerts, or select Home and then select to open the Alerts list view.

2. Use the filter tool to narrow the listed alerts to only those that meet the specified criteria:
   - **State**—Filters the list for alerts with the specified state.
   - **Severity**—Filters the list for alerts with the specified severity.
   - **Type**—Filters the list for alerts with the specified type.
   - **Symmetrix**—Filters the list based on the storage system identity.
   - **Object**—Filters the list for alerts for the specified object.
   - **Description**—Filters the list for alerts with the specified description.
   - **Created**—Filters the list based on when the alert was created.
   - **Acknowledged**—Filters the list for alerts that have been acknowledged.
Acknowledging alerts

**Procedure**

1. Select EVENTS > Alerts, or select Home and then select ![icon] to open the Alerts list view.
2. Select one or more alerts and click **Acknowledge**.

Viewing alert details

**Procedure**

1. Select EVENTS > Alerts, or select Home and then select ![icon] to open the Alerts list view.
2. Select an alert and click ![icon] to open the Alerts Details view.

The following properties display:

- **Alert ID**
  Unique number assigned by Unisphere.
- **State**
  State of the alert. Possible values are new or acknowledged.
- **Severity**
  Alert's severity. Possible values are:
  - Fatal
  - Critical
  - Warning
  - Information
  - Normal
- **Type**
  Type of alert. Possible values are Array, Performance, and System.
- **Symmetrix**
  ID of the storage system generating the alert.
- **Object**
  Object to which the alert is related. For more information, click the object to open its details view.
- **Created**
  Date/time the alert was created.
- **Description**
  Description of the alert.
- **Acknowledged**
  Shows the date on which the alert was acknowledged (if it has been).
Deleting alerts

Procedure

1. Select EVENTS > Alerts, or select Home and then select to open the Alerts list view.

2. Select one or more alerts and click .

Configuring alert notifications

Before you begin

- To perform this operation, you must be an Administrator or StorageAdmin.
- Unisphere employs the following throttling algorithms to prevent alert flurries from straining the system:

  **Storage system Event Throttling**
  
  When a storage system raises an alert flurry, the alert infrastructure packages all the alerts into a single notification.

  **Generic Throttling**
  
  When the number of alerts generated by a non-storage system event exceeds a set threshold, the alert infrastructure ignores subsequent alerts from the source.

This procedure explains how to configure Unisphere to notify you when a storage system generates an alert.

Procedure

1. Do one of the following:
   - To enable alert notifications:
     - Select to open the Settings panel.
     - Select Alerts > Notifications to open the Notifications page.
     - In the panel, click Configure for method you want to use to deliver the notifications (see Configuring email notifications on page 60 or Configuring SNMP notifications on page 606. (Not applicable for Syslog. For syslog, refer to Setting up the event daemon for monitoring in the Solutions Enabler Installation and Configuration Guide for instructions.)
     - In the panel, move the slider bar to the right to enable the configured method you want to use to deliver the notifications. Possible methods are:
       - **Syslog**
         - Forwards alert notifications to a remote syslog server.
       - **Email**
         - Forwards alert notifications to an email address.
       - **SNMP**
         - Forwards alert notifications to a remote SNMP listener.
In the **Alerts** panel, do the following for each storage system from which you want to receive notifications:

- Select the **System Level** and **Performance Level** severities in which you are interested.
- To clear your selection, click a previously clicked item.
- Once satisfied, click **APPLY**.

**Alert policies**

**Configuring alert policies**

**Before you begin**

- To perform this operation, you must be an Administrator or StorageAdmin.
- To receive alert notifications, you must first configure alert notifications.
- For alert (event) descriptions and the list of recommended alerts for you to monitor or consider monitoring (depending on your environment), refer to the **Events and Alerts Guide**.

**Procedure**

1. Select **Settings** to open the **Settings** panel.
2. Select **Alerts > Alert Policies**.
3. Select all or a specific storage system from the **Select Array** drop-down list.
   
   The following properties display:

   **Name**
   
   Policy name. For alert (event) descriptions, refer to the **Events and Alerts Guide**.

   **Type**
   
   Type of alert policy. Possible values are:
   - **Array** for array-based alerts.
   - **SMAS** for application-based alerts.
   - **File** for eNAS-based alerts.

   **Enabled**
   
   Whether the policy is Enabled or Disabled.

   **Notifications**
   
   Icon indicating the method to use when delivering the alert notification (email, SNMP, or Sys Log). None indicates that Unisphere is not configured to deliver an alert notification for the corresponding policy.

4. To enable alert reporting for a particular event, configure alert notifications, select the **Enabled** checkbox for that event and click **APPLY**.
5. To disable alert reporting for a particular event, clear the **Enabled** checkbox for that event and click **APPLY**.
Threshold alerts

Managing threshold alerts

Before you begin

- For alert (event) descriptions, refer to the Events and Alerts Guide.
- Pool utilization thresholds are enabled by default on every storage system.
- To receive utilization threshold alerts, you must enable alerts on the storage system.
- To receive alert notifications, you must first configure the alert notifications feature.

Certain alerts are associated with a numerical value. This value is compared with a set of threshold values, which determine whether the alert is delivered and, if so, with what severity. This procedure explains how to manage the alert threshold feature.

Procedure

1. Select \( \text{Settings} \) to open the Settings panel.
2. Select Alerts > Symmetrix Threshold and Alerts.
3. Do the following, depending on whether you are creating, editing, or deleting thresholds:
   - Creating:
     - Click \( \text{Create} \).
     - Select the storage system on which to create the threshold.
     - Select the Category of threshold to assign.
     - Possible values are:
       - **DSE Pool Utilization**
         Threshold event that reflects the allocated capacity (as percentage) within a DSE pool. This category only applies to Enginuity 5876.
       - **DSE Spill Duration**
         Threshold event that reflects how long (in minutes) an SRDF spillover has been occurring. This category only applies to Enginuity 5876.
       - **Snap Pool Utilization**
         Threshold event that reflects the allocated capacity (as percentage) within a snap pool. This category only applies to Enginuity 5876.
       - **Thin Pool Utilization**
         Threshold event that reflects the allocated capacity (as percentage) within a virtual pool.
       - **FAST VP Policy Utilization**
         Threshold event that reflects the allocated capacity (as percentage) of all the pools in all the tiers in a FAST VP policy. This category only applies to Enginuity 5876.
Storage Resource Pool Utilization
Threshold event that reflects the allocated capacity (as percentage) within an SRP. This category only applies to storage systems running HYPERMAX OS 5977 or higher.

Local Replication Utilization
Threshold event that indicates that the local replication resource usage has exceeded the threshold. This category only applies to storage systems running HYPERMAX OS 5977 Q1 2016 SR or higher.

System Meta Data Utilization
Threshold event that indicates that the system meta data Utilization usage has exceeded the threshold. This category only applies to storage systems running HYPERMAX OS 5977 Q1 2017 SR or higher.

Storage Container Utilization
Threshold event that indicates that the storage container utilization usage has exceeded the threshold. This category only applies to storage systems running HYPERMAX OS 5977 or higher.

Frontend Meta Data Usage
Threshold event that indicates that the front end meta data usage has exceeded the threshold. This category only applies to storage systems running PowerMaxOS 5978 or higher.

Backend Meta Data Usage
Threshold event that indicates that the back end meta data usage has exceeded the threshold. This category only applies to storage systems running PowerMaxOS 5978 or higher.

- Select the pools (Instances to enable) on which to create the threshold.
- Enable (select) or disable (clear) alerts for the threshold.
- Specify a threshold value (percentage of utilization) for each severity level: Warning, Critical, and Fatal.

  - Click OK.

Editing:
- Hover over a threshold and click .
- Select a threshold and specify a new threshold value (percentage of utilization) for any number of the severity levels: Warning, Critical, and Fatal.
- Enable (select) or disable (clear) alerts for the threshold.
- Click OK.

Deleting:
- Hover over a threshold and click .

Viewing threshold alerts

Before you begin
- For alert (event) descriptions, refer to the Events and Alerts Guide.
Procedure

1. Select 🛠️ to open the Settings panel.
2. Select Alerts > Symmetrix Threshold and Alerts
3. Select All or a specific storage system.

The following properties display:

- **Name**—Category on which the threshold is defined. Possible values are:
  - DSE Pool Utilization—Threshold event that reflects the allocated capacity (as percentage) within a DSE pool.
  - DSE Spill Duration—Threshold event that reflects how long (in minutes) an SRDF spillover has been occurring.
  - Snap Pool Utilization—Threshold event that reflects the allocated capacity (as percentage) within a snap pool.
  - Thin Pool Utilization—Threshold event that reflects the allocated capacity (as percentage) within a virtual pool.
  - FAST VP Policy Utilization—Threshold event that reflects the allocated capacity (as percentage) of all the pools in all the tiers in a FAST VP policy.
  - Local Replication Utilization—Threshold event that indicates that the local replication resource usage has exceeded the threshold. This category only applies to storage systems running HYPERMAX OS 5977 Q1 2016 SR or higher.
  - System Meta Data Utilization—Threshold event that indicates that the system meta data Utilization usage has exceeded the threshold. This category only applies to storage systems running HYPERMAX OS 5977 Q1 2017 SR or higher.
  - Storage Container Utilization—Threshold event that indicates that the storage container utilization usage has exceeded the threshold. This category only applies to storage systems running HYPERMAX OS 5977 or higher.
  - Storage Resource Pool Utilization—Threshold event that reflects the allocated capacity (as percentage) within an SRP. This category only applies to storage systems running HYPERMAX OS 5977 or higher.
- **Warning**—Percentage of utilization at which point a warning alert is issued.
- **Critical**—Percentage of utilization at which point a critical alert is issued.
- **Fatal**—Percentage of utilization at which point a fatal alert is issued.
- **Custom**—Whether the policy has been customized.
- **Enabled**—Whether the policy is Enabled or Disabled.
- **Notifications**—Whether the alert notification option is enabled (Email, SYSLOG, or SNMP) or disabled (NONE) for the alert.

The following controls are available:

- **Create**—Managing threshold alerts on page 57
- ⚙️—Managing threshold alerts on page 57
Configuring email notifications

You can configure email addresses to which notifications, alerts, and reports are sent. You can configure a single email address for all notification instances, or you can use different email addresses for different notifications on different storage systems.

To set up email notifications:

Procedure

1. To set up email notification:
   a. Select to open the Settings panel.
   b. Click Alerts > Notifications.
   c. In the Email section, click Configure.
   d. In the Outgoing Mail Server (SMTP) section specify the following details:
      - IP Address/Host
      - Server Port
   e. In the User Information section, specify the Sender E-mail Address.
   f. In the Recipients section, click Create and specify the address you want to add.
   g. Select one or more system or performance level indicators or reports to enable email notifications for the relevant level of system or performance notifications.
   h. Click APPLY.

Editing subscriptions

To edit a subscription:

Procedure

1. Select to open the Settings panel.
2. Click Alerts > Notifications.
3. Select a storage system and click to open the Edit Subscriptions dialog.
4. Tick one or more of the checkboxes (System Notifications, Performance Notifications, and Reports) and click OK.

Performance thresholds and alerts

Creating a performance threshold alert

You can use the default system values for thresholds and alerts, or create your own. When you set threshold values, you can optionally view them when you create charts for performance metrics in the Diagnostic view.

To create performance threshold alerts:
Procedure

1. Select to open the Settings panel.
2. Select Alerts > Performance Thresholds and Alerts.
3. Select a storage system.
4. Select the category for which you want to create a threshold or alert.
5. Click Create.
   The Create Threshold and Alert wizard displays.
6. Select the Array, Category, and Metrics.
7. Select Instances from the Available Instances list and click to move them to the Instances to Enable list.
8. Add a value for Warning Threshold or Warning Threshold and Critical Threshold.
9. Click NEXT.
10. To add an alert for each configured threshold, complete the following steps:
    a. Select Enable Alert.
    b. For each threshold you are configuring, specify values for the following fields:
       **Severity**
       The following values are available:
       - Information
       - Warning
       - Critical
       **Occurrence**
       The number of occurrences in the data samples which must happen before the alert is triggered. For example, if the threshold is breached 3 times out of 5 samples, an alert is initiated.
       **Samples**
       The number of occurrences in the data samples which must happen before the alert is triggered. For example, if the threshold is breached 3 times out of 5 samples, an alert is initiated.
    c. (Optional) If required, select any additional configuration options.
       For some group categories, you can choose to enable the alert for the individual components of the group, for example, when the Disk Group category is selected, you have the option to enable the alert for the disk.
11. Click OK.

Editing a performance threshold alert

When you edit a threshold and alert setting, a symbol displays in the Custom column of the alerts list to indicate that the value has changed from the default.
To edit performance threshold alerts:

**Procedure**

1. Select 🔧 to open the **Settings** panel.

2. Select **Alerts > Performance Thresholds and Alerts**.

3. Navigate to the threshold alert to be edited by selecting the appropriate storage system and category.

4. Hover over an item from the table and click ✂️.

5. Edit the settings.

6. Click **OK**.

Deleting performance thresholds and alerts

**Before you begin**

You can delete only custom values. You cannot delete default thresholds.

To delete a performance threshold and alert:

**Procedure**

1. Select 🔧 to open the **Settings** panel.

2. Select **Alerts > Performance Thresholds and Alerts**.

3. Navigate to the threshold or alert to be edited by selecting the appropriate category in the **Category** section.

4. Select one or more rows and click ✂️.

5. Click **OK**.

Viewing Performance thresholds and alerts

You can configure a warning threshold and a critical threshold value for each metric.

**Procedure**

1. Select 🔧 to open the **Settings** panel.

2. Select **Alerts > Performance Thresholds and Alerts**.

3. Select All or a storage system.

4. Select the category for which you want to view the configured thresholds and alerts.

   The thresholds and alerts configured for that category are displayed, according to metric.

   Any metrics that include a custom threshold or alert are highlighted with a tick mark in the **Custom** column.

   The following properties display:

   - **Name**—The metric name.
   - **Warning**—The warning threshold.
   - **Alert**—Indicates if a warning alert has been generated. The icon displayed corresponds to the alert type.
• **Critical**—The critical threshold.

• **Alert**—Indicates if a critical alert has been generated. The icon displayed corresponds to the alert type.

• **KPI**—Indicates if the metric is a KPI.

• **Custom**—Indicates if a custom threshold or alert has been generated.

5. Click **APPLY**.

The following controls are available:

• **Create** - Creating a performance threshold alert on page 60

• **Delete** - Deleting performance thresholds and alerts on page 62.

---

**Service level alert policies**

**Creating service level compliance alerts policies**

This procedure explains how to configure Unisphere to alert you when the performance of a storage group, relative to its service level target, changes. Once configured, Unisphere will assess the performance of the storage every 30 minutes, and deliver the appropriate alert level.

When assessing the performance for a storage group, Workload Planner calculates its weighted response time for the past 4 hours and for the past 2 weeks, and then compares the two values to the maximum response time associated with its given service level. If both calculated values fall within (under) the service level defined response time band, the compliance state is STABLE. If one of them is in compliance and the other is out of compliance, then the compliance state is MARGINAL. If both are out of compliance, then the compliance state is CRITICAL.

The following table details the state changes that will generate an alert and the alert level.

**Table 1 Service level compliance rules**

<table>
<thead>
<tr>
<th>State change</th>
<th>Alert generated</th>
<th>Alert level</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANY STATE &gt; NONE</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>NONE &gt; STABLE</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>NONE &gt; MARGINAL</td>
<td>Yes</td>
<td>Warning</td>
</tr>
<tr>
<td>NONE &gt; CRITICAL</td>
<td>Yes</td>
<td>Critical</td>
</tr>
<tr>
<td>STABLE &gt; MARGINAL</td>
<td>Yes</td>
<td>Warning</td>
</tr>
<tr>
<td>STABLE &gt; CRITICAL</td>
<td>Yes</td>
<td>Critical</td>
</tr>
<tr>
<td>STABLE &gt; STABLE</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>MARGINAL &gt; STABLE</td>
<td>Yes</td>
<td>Info</td>
</tr>
<tr>
<td>MARGINAL &gt; CRITICAL</td>
<td>Yes</td>
<td>Critical</td>
</tr>
<tr>
<td>MARGINAL &gt; MARGINAL</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>CRITICAL &gt; STABLE</td>
<td>Yes</td>
<td>Info</td>
</tr>
</tbody>
</table>
### Table 1 Service level compliance rules (continued)

<table>
<thead>
<tr>
<th>State change</th>
<th>Alert generated</th>
<th>Alert level</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRITICAL &gt; MARGINAL</td>
<td>Yes</td>
<td>Warning</td>
</tr>
<tr>
<td>CRITICAL &gt; CRITICAL</td>
<td>Yes</td>
<td>Critical</td>
</tr>
</tbody>
</table>

**Note**

When a storage group configured for compliance alerts is deleted or renamed, the compliance alerts will need to be deleted manually. For instructions, refer to Deleting compliance alerts policies on page 65.

### Before you begin

- The storage system must be running HYPERMAX OS 5977 or higher and registered for performance stats collection.
- The storage group must:
  - Be either a child or standalone. Parent storage groups are not supported.
  - Be associated with a service level other than optimized.
  - Contain volumes other than gatekeepers.
  - Be in a masking view.
  - Not have a policy currently associated with it.

To create service level compliance alert policies:

**Procedure**

1. Select ![Settings icon] to open the Settings panel.
2. Select Alerts > Compliance Alert Policies
3. Click Create.
4. Select the storage system on which the storage groups are located.
5. Select one or more storage groups and click >.
6. (Optional) By default, service level compliance policies are configured to generate alerts for all service level compliance states. To change this default behavior, clear any of the states for which you do not want generate alerts:
   - Critical—Storage group performing well below service level targets.
   - Marginal—Storage group performing below service level target.
   - Stable—Storage group performing within the service level target.
7. Click OK.

**Editing compliance alerts policies**

**Before you begin**

The storage system must be running HYPERMAX OS 5977 or higher.
Procedure

1. Select to open the Settings panel.
2. Select Alerts > Compliance Alert Policies
3. Select the policy, and then select (enable) or clear (disable) any of the compliance states.
   Unisphere generates alerts only for enabled compliance states.
4. Click APPLY.

Deleting compliance alerts policies

Before you begin
The storage system must be running HYPERMAX OS 5977 or higher.

Procedure

1. Select to open the Settings panel.
2. Select Alerts > Compliance Alert Policies
3. Select one or more policies and click .
4. Click OK.

Viewing compliance alerts policies

This procedure explain how to view compliance alert polices set on storage systems running HYPERMAX OS 5977 or higher.

Procedure

1. Select to open the Settings panel.
2. Select Alerts > Compliance Alert Policies
3. Select All or a specific storage system.
   The following properties display:
   • Name — Policy name.
   • Compliance State — Enabled compliance states:
     ■ Critical — Storage group performing well below service level targets
     ■ Marginal — Storage group performing below service level target.
     ■ Stable — Storage group performing within the service level target.
   • Notifications — Method to use when delivering the alert notification (e-mail, SNMP, or Sys Log). None indicates that Unisphere is not configured to deliver an alert notification for the corresponding policy. To enable alert reporting for a particular event, see Configuring compliance alert notifications on page 66.
The following controls are available:

- **Create** — Creating service level compliance alerts policies on page 63
-  

### Configuring compliance alert notifications

**Before you begin**

- The storage system must be running HYPERMAX OS 5977 or higher.
- The storage system must be configured to deliver alert notifications, as described in Configuring alert notifications on page 55.

This procedure explains how to configure Unisphere to notify you when a storage group generates a compliance alert.

**Procedure**

1. Select ✗ to open the Settings panel.
2. Select **Alerts > Compliance Alert Policies**
3. Select one or more policies and click **Notify**.
4. Select (enable) the method you want to use to deliver the notifications. Possible methods are:
   - **Enable Email** — Forwards alert notifications to an email address.
   - **Enable SNMP** — Forwards alert notifications to a remote SNMP listener.
   - **Enable Syslog** — Forwards alert notifications to a remote syslog server.

   **Note**

   The storage system must already be configured to deliver alerts in the desired method, as described in Configuring alert notifications on page 55.

5. Click **APPLY**.

**Server alerts**

Unisphere generates server alerts under the conditions listed in the table below.

Checks are run on 10 minute intervals and alerts are raised on 24 hour intervals from the time the server was last started. Note that these time intervals also apply to discover operations. That is, performing a discover operation will not force the delivery of these alerts.

**Note**

Runtime alerts are not storage system-specific. They can be deleted as long as the user has admin or storage admin rights on at least one storage system. A user with a monitor role is not allowed to delete the server alerts.
### Server alert

<table>
<thead>
<tr>
<th>Server alert</th>
<th>Number of volumes</th>
<th>Threshold</th>
<th>Alert Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total memory on the Unisphere server</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 - 64,000</td>
<td></td>
<td>12 GB</td>
<td>System memory &lt;# GB&gt; is below the minimum requirement of &lt;# GB&gt;</td>
</tr>
<tr>
<td>64,000 - 128,000</td>
<td></td>
<td>16 GB</td>
<td></td>
</tr>
<tr>
<td>128,000 - 256,000</td>
<td></td>
<td>20 GB</td>
<td></td>
</tr>
<tr>
<td>Free disk space on the Unisphere installed directory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 - 64,000</td>
<td></td>
<td>100 GB</td>
<td>Free disk space &lt;# GB&gt; is below the minimum requirement of &lt;# GB&gt;</td>
</tr>
<tr>
<td>64,000 - 128,000</td>
<td></td>
<td>140 GB</td>
<td></td>
</tr>
<tr>
<td>128,000 - 256,000</td>
<td></td>
<td>180 GB</td>
<td></td>
</tr>
<tr>
<td>Number of managed storage systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Threshold is 20.</td>
<td></td>
<td></td>
<td>Number of managed arrays &lt;#&gt; is over the maximum supported number of #</td>
</tr>
<tr>
<td>Number of managed volumes</td>
<td>256,000</td>
<td></td>
<td>Number of managed volumes &lt;#&gt; is over the maximum supported number of &lt;#&gt;.</td>
</tr>
<tr>
<td>Note that Solutions Enabler may indicate a slightly different number of volumes than indicated in this alert.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of gatekeepers</td>
<td>6</td>
<td></td>
<td>Number of gatekeepers &lt;#&gt; on Symmetrix (SymmID) is below the minimum requirement of 6.</td>
</tr>
</tbody>
</table>

### Security

#### Authentication

Login authentication

When you log in, Unisphere checks the following locations for validation:

- **Windows** — The user has a Windows account on the server. (Log in to Unisphere with your Windows Domain\Username and Password.)

- **LDAP-SSL** — The user account is stored on an LDAP-SSL server. (Log in to with your Unisphere LDAP-SSL Username and Password.) The Unisphere Administrator or SecurityAdmin must set the LDAP-SSL server location in the LDAP-SSL Configuration dialog box.

- **Local** — The user has a local Unisphere account. Local user accounts are stored locally on the Unisphere server host. (Log in to Unisphere with your Username and Password.)

User names are case-sensitive and allow alphanumeric characters of either case, an underscore, a dash, or a period:

- a-z
- A-Z
- 0-9
- _
Passwords cannot exceed 16 characters. There are no restrictions on special characters when using passwords.

The Initial Setup User, Administrator, or SecurityAdmin must create a local Unisphere user account for each user.

**Logging in**

The Login dialog box contains the following elements:

- **Username**—user name (refer to Login authentication on page 67).
- **Password**—password.

This dialog box may also include a login message. The login message feature enables Administrators and StorageAdmins to display a message to users during login. For example, an administrator may want to notify users about a software upgrade.

**Login**—Opens the console.

### Configuring authentication authorities

**Before you begin**

- If configuring authentication to use LDAP, obtain the LDAP-SSL server bind distinguished name (DN) and password from your LDAP Administrator.

This procedure explains how to configure Unisphere to authenticate users.

To configure authentication:

**Procedure**

1. Select  to open the Settings panel.
2. Select **Users and Groups > Authentication**.
3. Select the **Authentication Authority** to use during login. Possible values are:
   - **Local Directory** — You can disable this if enabled and enable this if disabled. When enabled, users can log in as a user from the CST local directory.
   - **LDAP-SSL** — You can disable this if enabled and enable this if disabled. When enabled, users can log in as a user from the configured LDAP directory.
   - **Windows OS/AD** — You can disable this if enabled and enable this if disabled. When enabled, users can log in as a user from the Windows local host and/or from the Active Directory domain. This option only applies to Windows installations.
4. If you select the Windows OS/AD authority and click **Modify**, as an option you can specify to limit authentication to members of a specific Windows OS/AD group. To do this, select the **Limit authentication to members of a specific Windows OS/AD group(s)** checkbox option, and type the **Group Name(s)**, separated by commas.
5. Click **Next**.
6. If you are configuring LDAP-SSL, click **Enable** and do the following:
   a. Specify values for the following parameters and click **Next**.
• **Server (IP or Hostname)**—IP address or hostname of the LDAP server to use for authentication. Only alphanumeric characters are allowed. Values longer than 40 characters will wrap.

• **Port**—Port number of the LDAP service. Typically, this value is 389 for LDAP and 636 for LDAPS. Valid values range from 1 through 65,535.

• **Bind DN**—Distinguished name of the privileged account used to perform operations, such as searching users and groups, on the LDAP directory. Only alphanumeric characters are allowed. Values longer than 60 characters will wrap.

• **Bind Password**—Password of the privileged account. Only alphanumeric characters are allowed. Values longer than 15 characters will wrap.

• **User Search Path**—Distinguished name of the node at which to begin user searches. Only alphanumeric characters are allowed. Values longer than 40 characters will wrap.

• **User Object Class**—Object class identifying users in the LDAP hierarchy. Only alphanumeric characters are allowed. Values longer than 15 characters will wrap.

• **User ID Attribute**—Attribute identifying the user login ID within the user object. Only alphanumeric characters are allowed. Values longer than 15 characters will wrap.

• **Group Search Path**—Distinguished name of the node at which to begin group searches. Only alphanumeric characters are allowed. Values longer than 40 characters will wrap.

• **Group Object Class**—Object class identifying groups in the LDAP hierarchy. Only alphanumeric characters are allowed. Values longer than 15 characters will wrap.

• **Group Name Attribute**—Attribute identifying the group name. Only alphanumeric characters are allowed. Values longer than 15 characters will wrap.

• **Group Member Attribute**—Attribute indicating group membership for a user within the group object. Only alphanumeric characters are allowed. Values longer than 15 characters will wrap.

b. Optional: To upload an SSL certificate, click **Choose File**, locate the certificate, and click **Open**. To view the contents of the certificate, click **VIEW CERTIFICATE**. To clear the file selection, click **CLEAR**.

c. Optional: To limit authentication to only members of specific LDAP groups, click **Limit Authentication to members of LDAP group(s)**, select the option, and then type the **Group Name(s)**, separated by commas.

d. Click **Next**.

7. Click **OK**.

**Viewing authentication authorities**

**Procedure**

1. Select open the **Settings** panel.

2. Select **Settings > Users and Groups > Authentication**

   Use the **Authentication** page to view and manage authentication settings.

   The following properties display:
**Authentication**

The following authentication types are displayed:

- **Local Directory**—When enabled, users can log in as a user from the CST local directory.

- **Windows OS/AD**—When enabled, users can log in as a user from the Windows local host and/or from the Active Directory domain. This property only displays for Windows installations.

- **LDAP-SSL**—When enabled, users can log in as a user from the configured LDAP directory.

The following controls are available:

- ![Info](icon-info.png) — Hover over an authentication type and click to view the authentication authority information (see Viewing authentication authority information on page 87).

- **Enable**—This control changes the status of Local Directory or Windows OS/AD from disabled to enabled. This control also changes the status of LDAP-SSL (see Configuring authentication authorities on page 68).

- **Disable**—This control changes the status of Local Directory, Windows OS/AD, or LDAP-SSL from enabled to disabled.

- **Modify**—Configuring authentication authorities on page 68

**Understanding user authorization**

User authorization is a tool for restricting the management operations users can perform on a storage system or with the Database Storage Analyzer application. By default, user authorization is enabled for Unisphere users, regardless of whether it is enabled on the Symmetrix system.

When configuring user authorization, an Administrator or SecurityAdmin maps individual users or groups of users to specific roles on storage systems or Database Storage Analyzer, which determine the operations the users can perform. These user-to-role-to-storage system/Database Storage Analyzer mappings (known as authorization rules) are maintained in the symauth users list file, which is located on either a host or storage system, depending on the storage operating environment.

---

**Note**

If there is one or more users listed in the symauth file, users not listed in the file are unable to access or even see storage systems from the Unisphere console.

**Roles**

The following lists the available roles. Note that you can assign up to four of these roles per authorization rule. For a more detailed look at the permissions that go along with each role, see Roles and associated permissions on page 81.

- **None**—Provides no permissions.

- **Monitor**—Performs read-only (passive) operations on a storage system excluding the ability to read the audit log or Access Control definitions.

- **StorageAdmin**—Performs all management (active or control) operations on a Symmetrix system and modifies GNS group definitions in addition to all Monitor operations.
- **Administrator**—Performs all operations on a storage system, including security operations, in addition to all StorageAdmin and Monitor operations.
- **SecurityAdmin**—Performs security operations on a Symmetrix system, in addition to all Monitor operations.
- **Auditor**—Grants the ability to view, but not modify, security settings for a Symmetrix system, (including reading the audit log, symacly list and symauth) in addition to all Monitor operations. This is the minimum role required to view the Symmetrix audit log.
- **DSA Admin**—Collects and analyzes database activity with Database Storage Analyzer.
  A user cannot change their own role so as to remove Administrator or SecurityAdmin privileges from themselves.
- **Local Replication**—Performs local replication operations (SnapVX or legacy Snapshot, Clone, BCV). To create Secure SnapVX snapshots a user needs to have Storage Admin rights at the array level. This role also automatically includes Monitor rights.
- **Remote Replication**—Performs remote replication (SRDF) operations involving devices and pairs. Users can create, operate upon or delete SRDF device pairs but can't create, modify or delete SRDF groups. This role also automatically includes Monitor rights.
- **Device Management**—Grants user rights to perform control and configuration operations on devices. Note that Storage Admin rights are required to create, expand or delete devices. This role also automatically includes Monitor rights.

In addition to these user roles, Unisphere includes an administrative role, the Initial Setup User. This user, defined during installation, is a temporary role that provides administrator-like permissions for the purpose of adding local users and roles to Unisphere. For more information, see [Operating as the initial setup user](#) on page 30.

**Individual and group roles**

Users gain access to a storage system or component either directly through a role assignment and/or indirectly through membership in a user group that has a role assignment. If a user has two different role assignments (one as an individual and one as a member of a group), the permissions assigned to the user will be combined. For example, if a user is assigned a Monitor role and a StorageAdmin role through a group, the user is granted Monitor and StorageAdmin rights.

**User IDs**

Users and user groups are mapped to their respective roles by IDs. These IDs consist of a three-part string in the form:

*Type:Domain\Name*

**Where:**

- **Type**—Specifies the type of security authority used to authenticate the user or group. Possible types are:
  - **L** — Indicates a user or group authenticated by LDAP. In this case, Domain specifies the domain controller on the LDAP server. For example:
    *L:danube.com\Finance*
    Indicates that user group Finance logged in through the domain controller danube.com.
  - **C** — Indicates a user or group authenticated by the Unisphere server. For example:
C:Boston\Legal
Indicates that user group Legal logged in through Unisphere sever Boston.

- H — Indicates a user or group authenticated by logging in to a local account on a Windows host. In this case, Domain specifies the hostname. For example:
  H:jupiter\mason
Indicates that user mason logged in on host jupiter.

- D — Indicates a user or group authenticated by a Windows domain. In this case, Domain specifies the domain or realm name. For example:
  D:sales\putman
Indicates user putman logged in through a Windows domain sales.

- Name—specifies the username relative to that authority. It cannot be longer than 32 characters and spaces are allowed if delimited with quotes. Usernames can be for individual users or user groups.

Within role definitions, IDs can be either fully qualified (as shown above), partially qualified, or unqualified. When the Domain portion of the ID string is an asterisk (*), the asterisk is treated as a wildcard, meaning any host or domain.

When configuring group access, the Domain portion of the ID must be fully qualified. For example:

- D:ENG\jones—Fully qualified path with a domain and username (for individual domain users).
- D:ENG.xyz.com\ExampleGroup—Fully qualified domain name and group name (for domain groups).
- D:*\jones—Partially qualified that matches username jones with any domain.
- H:HOST\jones—Fully qualified path with a hostname and username.
- H:*\jones—Partially qualified that matches username jones within any host.
- jones—Unqualified username that matches any jones in any domain on any host.

In the event that a user is matched by more than one mapping, the user authorization mechanism uses the more specific mapping. If an exact match (for example, D:sales\putman) is found, that is used; if a partial match (for example, D:*\putman) is found, that is used; if an unqualified match (for example, putman) is found, that is used; otherwise, the user is assigned a role of None.

**Authorization**

**Adding authorization rules**

**Before you begin**

- To perform this operation, you must be the Initial Setup User (set during installation), or a SecurityAdmin.

To add authorization rules:

**Procedure**

1. Select ![Settings icon] to open the Settings panel.
2. Select Users and Groups > Authorized Users and Groups
3. Click Create.
4. Optional: Select an authentication Authority. Possible values are:
   - **Local Directory**—Specifies to authenticate the user against the Local Authority repository.
   - **Windows AD**—Specifies to authenticate the user against the Active Directory domain.
   - **LDAP-SSL**—Specifies to authenticate the user against an LDAP directory.

5. Do the following depending on the authority:
   - **Local Directory**:
     Select the user **Name**.
   - **Windows AD** or **LDAP-SSL**
     a. Specify whether the rule is for an individual **User** or for a user **Group**.
     b. Optional: Type the name of the **Domain** used to authenticate the user/group. Possible values are based on the authentication authority:

     | Authority      | Domain Name                  |
     |----------------|------------------------------|
     | Local directory| Unisphere server hostname    |
     | Windows OS     | Unisphere server domain      |
     | Windows AD     | Unisphere server domain      |
     | LDAP-SSL       | LDAP server domain           |

   c. Type the **Name** of the user or group.

   User names are case-sensitive and allow alphanumeric characters of either case, an underscore, a dash, or a period:
   - a-z
   - A-Z
   - 0-9
   - _
   - .
   - *

6. For **Database Storage Analyzer**, select **None**, **Read Only**, or **Admin**. By default, **Database Storage Analyzer** permissions are set to **None**.

7. On the **Roles** tab, select the object and up to four **roles**.

8. Click the **DSA Fast Hinting** role. This role is only enabled for DSA administrators.

9. If you choose a **Local Replication**, **Remote Replication** or **Device Management** role, click **Select Storage Group(s)** and in the edit dialog that opens choose between:

   a. **Wildcard**—A wildcard syntax used with the storage group component name to allow a single rule to apply to multiple storage groups.

      A simple wildcard syntax can be used with the component name to allow a single rule to apply to multiple SGs as follows:
      - abc - Exactly these characters
      - ? Any 1 character
      - * Any zero or more characters
+ Zero or more additional occurrences of the previous match
[a-z0-9] Any of these characters
[!a-z] Anything but one of these characters

All SG name comparisons are case-insensitive. The following examples show how they will be interpreted:

<table>
<thead>
<tr>
<th>This pattern</th>
<th>Matches these Storage Groups</th>
<th>Does not match these Storage Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>tg_*</td>
<td>tg_DB.SqlClient or tg_newSG or TG_sg_db</td>
<td>tgNewSG</td>
</tr>
<tr>
<td>prod_sg?</td>
<td>prod_sg1 or prod_sga por Prod_sg2</td>
<td>prod_sg12 or prod_sgab</td>
</tr>
<tr>
<td>prod_sg[0-9]+</td>
<td>prod_sg1 or prod_sg12</td>
<td>prod_sga or prod_sgab</td>
</tr>
</tbody>
</table>

The only allowed characters are: a-zA-Z0-9_- along with the above *+?[]! wildcard characters.

The only roles that can be assigned against storage groups are: Local Replication, Remote Replication and Device Management.

Storage groups do not have to exist at the time that a matching Role Based Authentication Controls (RBAC) rule for them is defined.

These storage groups-level RBAC rules are only applicable to parent and stand-alone SGs and not child SGs. Child SGs are protected by the RBAC rules, if any, on their parent SG.

---

**Note**

Unisphere for PowerMax does not support RBAC Device Group management.

---

b. **Storage Group**

c. Once your input or selection is complete, click **Save**.

10. Click **OK**.

**Editing authorization rules**

**Before you begin**
- To perform this operation, you must be the Initial Setup User (set during installation), or a SecurityAdmin on all authorized storage systems.

To modify authorization rules:

**Procedure**

1. Select **Settings** to open the Settings panel.

2. Select **Users and Groups > Authorized Users and Groups**

3. Select a storage system ID from the drop-down list.

4. Select a rule and click **Modify**.

5. On the **Roles** tab, add or remove from any of the available objects, being sure to not exceed the four roles/object limit.
6. Click OK.

Removing authorization rules

Before you begin

To perform this operation, you must be the Initial Setup User (set during installation), or a SecurityAdmin on all authorized storage systems.

To remove an authorization rule on a single object, select Modify.

Procedure

1. Select to open the Settings panel.
2. Select Users and Groups > Authorized Users and Groups
3. Select a storage system ID from the drop-down list.
4. Select a rule and click .
5. Click OK.

Viewing authorization rules

Procedure

1. Select to open the Settings panel.
2. Select Users and Groups > Authorized Users & Groups.

After you finish

Use the Authorized Users & Groups list view to view and manage authorization rules.

The following properties display:

- **Name**—User or group name.
- **Authority**—Authentication authority. Possible values are:
  - **Local Directory**—Directory of users and encrypted passwords stored in a CST .xml file (users only, no groups).
  - **Windows OS**—Local Windows users and groups.
  - **Windows AD**—Windows Active Directory users and groups that are accessed through the SMAS server’s domain.
  - **LDAP-SSL**—Users and groups on LDAP server that have been configured the Configure Authorization wizard.
  - **Unsupported**—Not supported.
- **Authentication Domain**—Domain name. Possible values are based on the authentication authority:

<table>
<thead>
<tr>
<th>Authority</th>
<th>Domain name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local directory</td>
<td>Unisphere server hostname</td>
</tr>
<tr>
<td>Windows OS</td>
<td></td>
</tr>
</tbody>
</table>
The following controls are available:

- **Create**—Adding authorization rules on page 72
- **Remove**—Removing authorization rules on page 75
- **Modify**—Editing authorization rules on page 74

### Viewing the authorized users and groups list

To view local user details, refer to Viewing local users details on page 79.

To view the authorized users and groups list:

**Procedure**

1. Select ☰ to open the Settings panel.
2. Select Users and Groups > Authorized Users & Groups.
3. Select your required storage system ID from the drop-down list.
4. To see more information on a user, select the user and on the right-hand side of the row, click the icon.

The following controls are available:

- **Create**—Adding authorization rules on page 72
- **Modify**—Editing authorization rules on page 74
- **Remove**—Removing authorization rules on page 75

### Viewing the authorized users and groups details

To view the authorized users and groups list:

**Procedure**

1. Select ☰ to open the Settings panel.
2. Select Users and Groups > Authorized Users & Groups.
3. Select your required storage system ID from the drop-down list.
4. To see more information on a user, select the user and on the right-hand side of the row, click the icon.
5. View the following information in the information dialog: name, authority, domain, storage system identity, roles, and component name.
View Certificate dialog box

Use this dialog box to view contents of an SSL certificate.

Local Users

Creating local users

Before you begin

To perform this operation, you must be the Initial Setup User (set during installation), or SecurityAdmin on at least one storage system.

This procedure explains how to create local users. Local users have accounts stored locally in the user database in the Unisphere server host.

Procedure

1. Select ☰ to open the Settings panel.
2. Select Users and Groups > Local Users
3. Click Create to open the Create Local User dialog box.
4. Type a User Name.
   User names are case-sensitive and allow alphanumeric characters of either case, an underscore, a dash or a period:
   - a-z
   - A-Z
   - 0-9
   - _
   - .
   - -

5. Optional: Type a Description.
6. Type and confirm a user Password.
   Passwords cannot exceed 16 characters. There are no restrictions on special characters when using passwords.
7. Select the storage system and click the Roles tab and select one or more roles - up to four can be selected.
8. For Database Storage Analyzer select None, Read Only, or Admin.
   By default, Database Storage Analyzer permissions are set to Read Only.
9. Click the DSA Fast Hinting role.
   This role is only enabled for DSA administrators. It allows a user to create and modify FAST hints.
10. Click OK.
Editing local users

Before you begin
- To perform this operation, you must be the Initial Setup User (set during installation), or SecurityAdmin on all authorized storage systems.
- Users cannot remove the SecurityAdmin role from themselves.

This procedure explains how to edit the roles associated with a user or group.

To create local users:

Procedure
1. Select to open the Settings panel.
2. Select Users and Groups > Local Users
3. Select a user and click Modify.
4. Optional: Type a new Description.
5. On the Roles tab, add or remove from any of the available objects, being sure to not exceed the four roles/object limit.
6. Click OK.

Deleting local users

Before you begin
- To perform this operation, you must be the Initial Setup User (set during installation), or SecurityAdmin on all authorized storage systems.
- Users cannot remove the SecurityAdmin role from themselves.

This procedure explains how to delete local users and all fully-qualified authorization rules (rules in the format \L:HostName\UserName).

Procedure
1. Select to open the Settings panel.
2. Select Users and Groups > Local Users
3. Select a user and click .
4. Click OK.

Changing local user passwords

Before you begin
- To perform this operation, you must be the Initial Setup User (set during installation), or SecurityAdmin on at least one storage system.

This procedure explains how to change a local user passwords.

To change local directory user passwords:

Procedure
1. Select to open the Settings panel.
2. Select Users and Groups > Local Users
3. Select a user and click Change Password.
4. Type the user's Old Password.
5. Type a New Password and Confirm Password.
6. Click OK.

Viewing local users

Before you begin

- To perform this operation, you must be the Initial Setup User (set during installation), or Monitor on at least one storage system.

To view users with a local Unisphere account:

Procedure

1. Select to open the Settings panel.
2. Select Users and Groups > Local Users.
3. The Local Users list view allows you to view and manage local users.
   The following properties display:
   - User Name—User or group name.
   - Description—Optional description.
   The following controls are available:
   - Viewing local users details on page 79.
   - Create—Creating local users on page 77.
   - Modify—Editing local users on page 78.
   - Change Password—Changing local user passwords on page 78.
   - Deleting local users on page 78.

Viewing local users details

This procedure explains how to view the details of a local user.

Procedure

1. Select to open the Settings panel.
2. Select Users and Groups > Local Users.
3. Select a user, hover over the row and click to see the details view.
   The following properties display:
   - Name—User or group name.
   - Authority
   - Domain
Symmetrix ID
Roles
Component Name

Viewing authorization rules

This procedure explains how to view the authorization rules associated with users and groups.

Procedure

1. Select 
   to open the Settings panel.
2. Select Users and Groups > Authorized Users & Groups.
3. Select the user and click 
   to open the user's details view.
4. The following properties display:
   - Name—User or group name.
   - Authority—Authentication authority. Possible values are:
     - Local Directory—Directory of users and encrypted passwords stored in a CST .xml file (users only, no groups).
     - Windows OS—Local Windows users and groups.
     - Windows AD—Windows Active Directory users and groups that are accessed through the SMAS server's domain.
     - LDAP-SSL—Users and groups on LDAP server that have been configured the Configure Authorization wizard.
   - Authentication Domain — Domain name. Possible values are based on the authentication authority:

<table>
<thead>
<tr>
<th>Authority</th>
<th>Domain name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local directory</td>
<td>Unisphere server hostname</td>
</tr>
<tr>
<td>Windows OS</td>
<td>Unisphere server domain</td>
</tr>
<tr>
<td>Windows AD</td>
<td>LDAP server domain</td>
</tr>
<tr>
<td>LDAP-SSL</td>
<td>Virtualization domain</td>
</tr>
<tr>
<td>Virtualization domain</td>
<td>Any</td>
</tr>
</tbody>
</table>

The following controls are available:

- Create—Adding authorization rules on page 72
- Modify—Editing authorization rules on page 74
- Delete—Removing authorization rules on page 75
Viewing user sessions

This procedure explains how to view active user sessions for a storage system.

Procedure

1. Select 🌐 to open the Settings panel.
2. Select Users and Groups > User Sessions

The following properties display:

- **User Name**—Name of the individual or group. An asterisk indicates the current user.
- **Start Time**—Date and time that the user logged in to the console.
- **IP Address**—Address of the console.

Roles and associated permissions

The following tables detail the permissions that go along with each role in Unisphere.

**Note**

The Unisphere Initial Setup User has all permissions on a storage system until an Administrator or SecurityAdmin is added to the storage system.

The roles and the acronyms used for them in these tables are:

- Administrator (AD)
- StorageAdmin (SA)
- Monitor (MO)
- SecurityAdmin (SecA)
- Auditor (AUD)
- None
- PerfMonitor (PM)
- Database Storage Analyzer Admin (DSA)
- Local Replication
- Remote Replication
- Device Management

**Table 2 User roles and associated permissions**

<table>
<thead>
<tr>
<th>Permissions</th>
<th>AD</th>
<th>SA</th>
<th>MO</th>
<th>SecA</th>
<th>AUD</th>
<th>None</th>
<th>PM</th>
<th>DSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create/delete user accounts</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Reset user password</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Permissions</td>
<td>AD</td>
<td>SA</td>
<td>MO</td>
<td>SecA</td>
<td>AUD</td>
<td>None</td>
<td>PM</td>
<td>DSA</td>
</tr>
<tr>
<td>----------------------------------------------------------</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>------------------------------</td>
<td>-----</td>
<td>------</td>
<td>----</td>
<td>-----</td>
</tr>
<tr>
<td>Create roles</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes (self-excluded)</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Change own password</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Manage storage systems</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Discover storage systems</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Add/show license keys</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Set alerts and Optimizer monitoring options</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Release storage system locks</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Set Access Controls</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Set replication and reservation preferences</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>View the storage system audit log</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Access performance data</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Start data traces</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Set performance thresholds/alerts</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Create and manage performance dashboards</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Collect and analyze database activity with DSA</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Permissions</td>
<td>Local Replication</td>
<td>Remote Replication</td>
<td>Device Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>------------------------------------------------</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create/delete user accounts</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reset user password</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create roles</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change own password</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manage storage systems</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discover storage systems</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Add/show license keys</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set alerts and Optimizer monitoring options</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Release storage system locks</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set Access Controls</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set replication and reservation preferences</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>View the storage system audit log</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access performance data</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start data traces</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set performance thresholds/alerts</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create and manage performance dashboards</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collect and analyze database activity with</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Database Storage Analyzer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perform control and configuration operations on devices</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create, expand or delete devices</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perform local replication operations (SnapVX,</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3 Permissions for Local Replication, Remote Replication and Device Management roles (continued)

<table>
<thead>
<tr>
<th>Permissions</th>
<th>Local Replication</th>
<th>Remote Replication</th>
<th>Device Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>legacy Snapshot, Clone, BCV)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create Secure SnapVX snapshots</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Create, operate upon or delete SRDF device pairs</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Create, modify or delete SRDF groups</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Link and Launch operations

- Creating link-and-launch client registrations (see Creating link-and-launch client registrations on page 84).
- Editing link-and-launch client registrations (see Editing link-and-launch client registrations on page 85).

Creating link-and-launch client registrations

Before you begin

To perform this operation, you must be an Administrator or SecurityAdmin.

Link-and-launch is not supported with X.509 certificate-based user authentication.

This procedure explains how to register other applications with the SMAS server. Once registered, users of the registered applications can launch Unisphere without logging in.

Procedure

1. Select to open the Settings panel.
2. Select Management > Link and Launch
3. Click Create.
4. Type a unique Client ID.
   Client IDs can be up to 75 alphanumeric characters.
5. Type the Password associated with the client ID.
   Passwords can be up to 75 alphanumeric characters.
6. Retype the password to confirm it.
7. Click OK.
Editing link-and-launch client registrations

Before you begin
To perform this operation, you must be an Administrator or SecurityAdmin.
This procedure explains how to change the password associated with a registered application.

Procedure
1. Select to open the Settings panel.
2. Select Management > Link and Launch
3. Select a registration, and click Edit.
4. Type the Current Password.
5. Type the New Password.
   Passwords can be up to 75 alphanumeric characters.
6. Retype the new password to confirm it.
7. Click OK.

Deleting link-and-launch client registrations

Before you begin
To perform this operation, you must be an Administrator or SecurityAdmin.

Procedure
1. Select to open the Settings panel.
2. Select Management > Link and Launch
3. Select a registration, and click .
4. Click OK.

Viewing link and launch client registrations

Procedure
1. Select to open the Settings panel.
2. Select Management > Link and Launch

After you finish
The Link and Launch list view allows you to view and manage link and launch client registrations.

The following property displays:
• Client ID—Unique client ID.

The following controls are available:
• Create—Creating link-and-launch client registrations on page 84
Managing Database Storage Analyzer (DSA) environment preferences

**Before you begin**
Only a user with Administrator permission can specify DSA environment preferences.

To specify DSA environment preferences:

**Procedure**

1. Select 
   to open the **Settings** panel.
2. Select **DSA Environment** to open the **DSA Environments** page.
3. Select an environment from the Environments drop-down list.
4. Modify any number of the following:
   - **Data retention for 5 min data** — Number of days (between 15 and 30) to retain 5 minute data.
   - **Data retention for hourly data** — Number of months (between 12 and 36) to retain hourly data.
   - **Data retention for daily data** — Number of months (between 12 and 36) to retain daily data.
   - **First threshold for DB read response time (ms)** — First threshold for DB read response time.
   - **Second threshold for DB read response time (ms)** — Second threshold for DB read response time.
5. Click **APPLY**.

Managing data protection preferences

**Before you begin**
Only a user with Administrator permission can specify data protection preferences.

To specify data protection preferences:

**Procedure**

1. Select 
   to open the **Settings** panel.
2. Select **Data Protection** to open the **Data Protection** page.
3. Modify any number of the following:
   - **Clone Copy Mode** — Select the default behavior for creating clone sessions. Possible values are:
     - **No Copy No Diff** — Creates a nondifferential (full) copy session without a full background copy.
- **Copy No Diff**—Creates a nondifferential (full) copy session in the background.
- **PreCopy No Diff**—Creates a nondifferential (full) copy session in the background before the activate starts.
- **Copy Diff**—Creates a differential copy session in the background. In differential copy sessions, only those volume tracks that have changed since the full clone was performed are copied (that is, only new writes to the source volume are copied).
- **PreCopy Diff**—Creates a differential copy session in the background before the activate starts. In differential copy sessions, only those volume tracks that have changed since the full clone was performed are copied (that is, only new writes to the source volume are copied).
- **VSE No Diff**—Creates a VP Snap Copy session.

- **Clone Target**—Select the default target volume.
- **Protection Setup Wizard SRDF Communication Protocol**—Select the default SRDF communication protocol, Fibre Channel or GigE.
- **Protection Setup Wizard SRDF Number of Ports**—Select the default number of ports to use with SRDF.

4. Click **APPLY**.

## Viewing authentication authority information

### Procedure

1. Select ![gear icon] to open the **Settings** panel.
2. Select **Settings > Users and Groups > Authentication**.
3. Hover over an authentication type and click ![info icon].

   The authentication authority information is displayed. For LDAP-SSL, the following is displayed when LDAP is enabled.

   - **Port**—Port number of the LDAP service. Typically, this value is 389 for LDAP and 636 for LDAPS.
   - **Server**—Hostname of IP address of the LDAP server used for authentication.
   - **Port**—Port number of the LDAP service. Typically, this value is 389 for LDAP and 636 for LDAPS.
   - **Bind DN**—Distinguished name (DN) of the privileged account used to perform operations, such as searching users and groups, on the LDAP directory.
   - **User Search Path**—Distinguished name of the node at which to begin user searches.
   - **User Object Class**—Object class identifying users in the LDAP hierarchy.
   - **User ID Attribute**—Attribute identifying the user login ID within the object.
   - **Group Search Path**—Distinguished name of the node at which to begin group searches.
   - **Group Object Class**—Object class identifying groups in the LDAP hierarchy.
**Local User and Authorization operations**

- Modify Local User (see Editing local users on page 78).
- Viewing local users details (see Viewing local users details on page 79).
- Modify Authorization rules (see Removing authorization rules on page 75).
- Viewing the authorized users and groups details (see Viewing the authorized users and groups details on page 76).

**Entering PIN number**

To enter the PIN number:

**Procedure**

1. Select to open the Settings panel.
2. Select one of the following:
   - Symmetrix Access Control > Access Control Entries
   - Symmetrix Access Control > Access Groups
   - Symmetrix Access Control > Access Pools
   A warning is displayed if you have read-only access.
3. Click Enter PIN.
4. Enter the PIN number.
5. Click OK.

**Report operations**

The following report operations are available:

- Create Compliance reports (see Creating Compliance Reports on page 159).
- Create performance reports (see Creating performance reports on page 583).
- Modify performance reports (see Modifying performance reports on page 587).
- Copy performance reports (see Copying performance reports on page 584).

**Registering a SRS gateway**

**Before you begin**

This functionality only applies to a Unisphere running release 9.0.1 or higher.
You have been assigned the Administrator or StorageAdmin role.

Secure Remote Services (SRS) provides an automated health and system monitoring capability for your storage systems. It sends notifications to Dell EMC customer support, sends data to Dell EMC CloudIQ, and enables remote support where necessary.

To register a SRS gateway:

**Procedure**

1. Select **Settings** to open the **Settings** panel.
2. Select **Management > Secure Remote Services** to open the EMC Secure Remote Services page.
3. Click **Configure**.
4. Enter values for ESRS Gateway IP address, user ID and password.
5. Click **OK**.

**Unregistering a SRS gateway**

**Before you begin**

This functionality only applies to a Unisphere running release 9.0.1 or higher.

You have been assigned the Administrator or StorageAdmin role.

The SRS gateway has already been registered in Unisphere.

Secure Remote Services (SRS) enables Dell EMC to address potential problems before there is an impact to your business, and to provide you with actionable intelligence and advice based on product-generated alerts and configuration files.

SRS provides an automated health and system monitoring capability for your storage systems. It sends notifications to Dell EMC customer support, sends data to Dell EMC CloudIQ, and enables remote support where necessary.

To unregister a SRS gateway:

**Procedure**

1. Select **Settings** to open the **Settings** panel.
2. Select **Management > Secure Remote Services** to open the EMC Secure Remote Services page.
3. Click **Configure**.
4. Click **OK**.

**Managing Secure Remote Services settings**

**Before you begin**

This functionality only applies to a Unisphere running release 9.0.1 or higher.

You have been assigned the Administrator or StorageAdmin role.

To manage Secure Remote Services preferences:
Procedure
1. Select to open the Settings panel.
2. Select Management > Secure Remote Services to open the EMC Secure Remote Services page.
3. Click Configure to register a new SRS gateway (see Registering a SRS gateway on page 88) or unconfigure an existing SRS gateway (see Unregistering a SRS gateway on page 89).

Managing CloudIQ settings

Before you begin
This functionality only applies to a Unisphere running release 9.0.1 or higher.
You have been assigned the Administrator or StorageAdmin role.
The SRS gateway has already been registered in Unisphere.
To manage CloudIQ preferences:
Procedure
1. Select to open the Settings panel.
2. Select Management > CloudIQ to open the CLOUDIQ page.
3. Select the Send data to CloudIQ checkbox to enable the transmission of data to CloudIQ.
4. Do one of the following:
   • Select the Data Collection Enabled checkbox for one, more than one, or all arrays.
   • Deselect the Data Collection Enabled checkbox for one, more than one, or all arrays.
5. Click APPLY.
# CHAPTER 4

## Storage Management

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Understanding Storage Management

Storage Management covers the following areas:

- **Storage Groups** - Management of Storage groups. Storage groups are a collection of devices stored on the array that are used by an application, a server, or a collection of servers. Storage groups are used to present storage to hosts in masking/mapping, Virtual LUN Technology, FAST, and various base operations.

- **Service Levels** - Management of service levels. A service level is the response time target for a storage group. The Service Level sets the storage array with the desired response time target for a storage group. It automatically monitors and adapts to the workload in order to maintain the response time target. The Service Level includes an optional workload type so it can be fine tuned to meet performance levels.

- **Templates** - Management of templates. Using the configuration and performance characteristics of an existing storage group as a starting point, you can create templates that will pre-populate fields in the provisioning wizard and create a more realistic performance reservation in your future provisioning requests.

- **Storage Resource Pools** - Management of Storage Resource Pools. Fully Automated Storage Tiering (FAST) provides automated management of storage array disk resources to achieve expected service levels. FAST automatically configures disk groups to form a Storage Resource Pool (SRP) by creating thin pools according to each individual disk technology, capacity and RAID type.

- **Volumes** - Management of volumes. A storage volume is an identifiable unit of data storage. Storage groups are sets of volumes.

- **External Storage** - Management of external storage. FAST.X attaches external storage to storage systems directs workload movement to these external arrays while having access to the array features such as local replication, remote replication, storage tiering, data management, and data migration. In addition, it simplifies multi-vendor or Dell EMC storage array management.

- **Vvol** - Management of Vvols. VMware VVols allow data replication, snapshots, encryption and so on to be controlled at the VMDK level instead of the LUN level, where these data services are performed on a per VM (application level) basis from the storage array.

- **FAST Policies** - Management of FAST policies. A FAST policy is a set of one to three DP tiers or one to four VP tiers, but not a combination of both DP and VP tiers. Policies define a limit for each tier in the policy. This limit determines how much data from a storage group associated with the policy is allowed to reside on the tier.

- **Tiers** - Management of storage tiers. FAST automatically moves active data to high-performance storage tiers and inactive data to low-cost, high-capacity storage tiers.

- **Thin Pools** - Management of Thin pools. Storage systems are pre-configured at the factory with virtually provisioned devices. Thin Provisioning helps reduce cost, improve capacity utilization, and simplify storage management. Thin Provisioning presents a large amount of capacity to a host and then consumes space only as needed from a shared pool. Thin Provisioning ensures that thin pools can expand in small increments while protecting performance, as well as non-disruptive shrinking of thin pools to help reuse space and improve capacity utilization.
• Disk Groups - Management of disk groups. A disk group is a collection of physical drives within the storage array that share the same performance characteristics.

• VLUN Migration - Management of VLUN migration. Virtual LUN Migration (VLUN Migration) enables transparent, nondisruptive data mobility for both disk group provisioned and virtually provisioned storage system volumes between storage tiers and between RAID protection schemes. Virtual LUN can be used to populate newly added drives or move volumes between high performance and high capacity drives, thereby delivering tiered storage capabilities within a single storage system. Migrations are performed while providing constant data availability and protection.

Tag and Untag operations

The following tag and untag operations are available:

• Storage Group level - RecoverPoint tag and untag (see Tagging and untagging volumes for RecoverPoint (storage group level) on page 476).

• Volume level - RecoverPoint tag and untag (see Tagging and untagging volumes for RecoverPoint (volume level) on page 476).

• Data Protection> Open Replicator> RecoverPoint volumes untag (see Untagging RecoverPoint tagged volumes on page 477).

Viewing Storage Group Demand Reports

This procedure explains how to view storage groups on an SRP and their associated workloads.

Before you begin:

This feature requires HYPERMAX OS 5977 or higher.

To view storage group demand reports:

Procedure

1. Select the storage system.

2. Select CAPACITY to open the CAPACITY dashboard.

3. Select a SRP instance from the drop down menu and in the Actions panel, click STORAGE GROUP DEMAND.

Some or all of the following properties display:

• Storage Group—Name of the storage group.

• Subscription (GB)—Amount of SRP capacity to which the storage group subscribed.

• Allocated (GB)—The amount of allocated pool capacity (in GB).

• Allocated (%)—The percentage of allocated pool capacity.

• Used (GB)—The amount of allocated pool capacity (in GB).

• Snapshot Allocated (GB)—The amount allocated to snapshots.

• Compression Ratio—The compression ratio.

• SNAP Used (GB)—The amount used by snapshots.

• Snapshot Compression Ratio—The snapshot compression ratio.
Emulation—Emulation type. This displays only if the storage system is capable of containing CKD devices.

The following control is available:

- **Export Report**—Exports the report to a PDF file.

**Viewing Service Level Demand Reports**

This procedure explains how to view demand that each service level is placing on the SRP.

Before you begin:

This feature requires HYPERMAX OS 5977 or higher.

To view service level demand reports:

**Procedure**

1. Select the storage system.
2. Select **CAPACITY** to open the **CAPACITY** dashboard.
3. Select a SRP instance from the drop down menu and in the **Actions** panel, click **SERVICE LEVEL DEMAND**.

**Results**

Some or all of the following properties display:

- **Service Level**
  - Name of the service level.

- **Allocated (GB)**
  - Total space that the service level has allocated on the SRP in GB.

- **Allocated (%)**
  - Percentage of space that the service level has allocated on the SRP.

- **Subscription (GB)**
  - Total space that the service level has subscribed on the SRP in GB.

- **Subscription (%)**
  - Percentage of space that the service level has subscribed on the SRP.

**Viewing CKD volumes**

See below for procedure to view CKD volumes from the **Hosts > Mainframe** dashboard. To see the CKD volumes in a CU image, see Viewing CKD volumes in CU image on page 95.

**Procedure**

1. Select the storage system.
2. Select **HOSTS > Mainframe** and click on **CKD Volumes** in the **Summary** panel.
   
   The **CKD Volumes** list view is displayed. Use the this list view to view and manage the volumes.
   
   The following properties display; however, not all properties may be available for every volume type:
- **Name**—Assigned volume name.
- **Type**—Type of volume.
- **Allocated %**—% of the volume that is allocated.
- **Capacity (GB)**—Volume capacity in Gigabytes.
- **Status**—Volume status.
- **Emulation**—Emulation type for the volume.
- **Host Paths**—Number of masking records for the volume.
- **Reserved**—Indicates whether the volume is reserved.
- **Split**—The name of the associated split.
- **CU Image**—The number of the associated CU image.
- **Base Address**—Base Address.

The following controls are available, however, not all controls may be available for every volume type:

- ![info icon]—Viewing CKD volume details on page 206
- **Create**—Creating volumes on page 180
- **Expand**—Expanding existing volumes on page 193
- ![trash icon]—Deleting volumes on page 190
- **Create SG**—Creating storage groups on page 114
- **Set Volumes > Emulation**—Setting volume emulation on page 98
- **Set Volumes > Attribute**—Setting volume attributes on page 197
- **Set Volumes > Identifier**—Setting volume identifiers on page 198
- **Set Volumes > Status**—Setting volume status on page 196
- **Set Volumes > Replication QoS**—QoS for replication on page 200
- **Set Volumes > Set SRDF GCM**—Setting the SRDF GCM flag on page 438
- **Set Volumes > Reset SRDF/Metro Identity**—Resetting original device identity on page 436
- **Allocate/Free/Reclaim > Start**—Managing thin pool allocations on page 247
- **Allocate/Free/Reclaim > Stop**—Managing thin pool allocations on page 247
- **Configuration > Change Volume Configuration**—Changing volume configuration on page 192
- **Configuration > Duplicate Volume**—Duplicating volumes on page 190
- **Configuration > z/OS Map**—z/OS map from the volume list view on page 337
- **Configuration > z/OS Unmap**—z/OS unmap from the volume list view on page 338

**Viewing CKD volumes in CU image**
Procedure

1. Select the storage system.
2. Select **Hosts > CU Images**
3. Select the CU image and click .
4. In the details panel, click on the number in the **Number of Volumes** field to open the **CKD Volumes** list view.
5. Use the **CKD Volumes** list view to display and manage CKD volumes in a CU image.

Results

**Name** — Symmetrix volume name.

**Type** — Volume configuration.

**Status** — Volume status.

**Capacity (GB)** — Volume capacity in GBs.

**Emulation** — Emulation type.

**UCB Address** — Unit control block (address used by z/OS to access this volume.

**Volser** — Volume serial number (disk label (VOL1) used when the volume was initialized).

The following controls are available:

- Viewing CU image details on page 333
- z/OS Map — z/OS map from the volume list view on page 337
- z/OS Unmap — z/OS unmap from the volume list view on page 338

### Viewing Storage Group Compliance view

**Before you begin**

The user requires a minimum of Monitor permissions to perform this task.

**Definitions:**

- **Workload Skew** - Skew is represented by capacity and load pairs. There are two sources of skew for a storage group. One is using device stats. The other is using **SG_PER_POOL** chunks. There is an algorithm in WLP to merge these two lists to give us a usable skew profile. A skew profile is only useful if you have multiple chunks. If an SG has a single device, there is not enough data to calculate skew, the corresponding storage group per pool metrics can be used. Similarly, if an array has only one pool, the device stats are more meaningful for skew.

- **Workload Mixture** - The mixture is the distribution of various I/O types as percentages of the total IOPS. These are useful for determining, for example, whether a workload is heavy read or heavy write, whether I/Os are mostly random or mostly sequential.

To view the Storage Group (SG) Compliance view:

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Storage Groups** to open the **Storage Groups View**.
3. Select a storage group and click to view its details.

4. Select VIEW ALL DETAILS.

5. Select the Compliance tab.

Charts are displayed for the following:

- **Response Time chart** - this chart displays wait time weighted response time and (if applicable) the target service level response time band. The following section explains the data in the chart.
  - **Actual**: running I/O to Storage Group - Wait time weighted response time is calculated in buckets and displayed. If a bucket has no data, 0 is displayed.
  - **Actual**: no I/O to Storage Group - 0s are displayed.
  - **Planned**: SLO Response Time Max and SLO Response Time Min are displayed as a data band across the timeline. This is labeled "Planned". If the service level is Optimized, no plan is displayed, because there is no Response Time band for Optimized.
  - **Excluded Data**: If a recurring exclusion has been set via the Exclusion Windows dialog, the windows are represented by vertical gray plot bands.
  - **Last Processed**: A 2px dotted plot line marks the most recent SPA HOURLY timestamp processed by SPA for a given metric. It is not represented in the legend, but if you hover, you can see the timestamp associated. In normal successful/processing, this acts as a "Where am I" indicator. If WLP stops processing for some reason, it's a subtle debugging helper.

- **IOPS chart** - This chart toggles between IO/sec and MB/sec, displaying IO rate weighted metric values, "planned" values, and (if set) Host IO Limits. The following section explains the data in the chart.
  - **Actual**: running I/O to Storage Group - IO Rate weighted total IOPS (or total MBPS) are calculated in buckets and displayed. If a bucket has no data, 0 is displayed.
  - **Actual**: no I/O to Storage Group - 0s are displayed.
  - **Planned**: Host I/O Limits for Standalone SG - Host IO Limit is displayed as a static value across the timeline. Host IO Limit is only shown on the chart it impacts. For example, if MBPS host IO limit is set, and the user has IOPS selected, they won't see anything unless they toggle to MBPS.
  - **Planned**: Host I/O Limits for Child SG, no limit for the parent SG - Host IO Limit is displayed as a static value across the timeline. Host IO Limit is only shown on the chart it impacts. For example, if MBPS host IO limit is set, and the user has IOPS selected, they won't see anything unless they toggle to MBPS.
  - **Planned**: No Host I/O Limits for Child SG and parent SG - If a cascaded SG has a host IO limit set at the parent, but no direct limit of its own, the host IO limit of any given child would be the parent limit minus whatever the siblings are using.
  - **Planned**: Host I/O Limits for Child SG and parent SG - If a cascaded SG has a host IO limit set at the parent, and a direct limit of its own, the host IO limit of any given child would be the more limiting of the parent limit minus whatever the siblings are using, or the child SGs own limit.
  - **Excluded Data**: If a recurring exclusion has been set via the Exclusion Windows dialog, the windows are represented by vertical gray plot bands.
- Last Processed: A 2px dotted plot line marks the most recent SPA HOURLY timestamp processed by SPA for a given metric. It is not represented in the legend, but if you hover, you can see the timestamp associated. In normal successful/processing, this acts as a "Where am I" indicator. If WLP stops processing for some reason, it's a subtle debugging helper.

- Workload Skew chart - This chart compares actual workload skew - represented by cumulative capacity and load percentages (ordered by access density) - to planned skew. If there is no IO data, Actual is displayed as 50% skew - a straight line from (0,0) to (100,100). If there is one Device in SG AND Only One Thin Pool, then themerged device ans sg per pool skew profile doesn't give us enough data points. Actual is displayed as 50% skew - a straight line from (0,0) to (100,100). If IO is running to the SG, the skew is a logarithmic curve (or stepped line graph in some cases).

- I/O Mixture chart - This chart compares actual workload mixture to planned workload mixture. The inner pie represents the actual IO distribution. The outer donut represents the planned mixture. If there is no I/O to the storage group, the mixture distribution will be equal percentages for each IO type (20% read hit, 20% sequential write, etc.) and the tooltip will show the corresponding IO sizes as 0kB.

Select the Show Plan slider to turn on or turn off the display of the plan. The plan is reference point used for comparison, and is a two week expiring performance reservation for subsequent provisioning suitability calculations.

The following controls are available:

- Exclude Data - Managing Data Exclusion Windows on page 160
- Save As a Template - Creating storage templates on page 270
- Reset Workload Plan - Resetting Workload Plan on page 179
- Set Host I/O Limits - Setting host I/O limits on page 134

Dialog displayed when there is less than one week's data collected

This dialog is displayed when at least one week of data has not been collected for the selected storage group. It is recommended that you wait until you have at least one week or data. Alternatively, if you wish to proceed, click the Autofill the template workload with averages from the stats collected so far checkbox. Click OK.

Setting volume emulation

Before you begin

You cannot set attributes for DATA volumes.

Setting emulation for CKD volumes is not supported. If attempting to set attributes for multiple volumes of type FBA and CKD, a warning is displayed stating that the action will be applied only to FBA volumes.

Setting emulation is not supported on masked/mapped volumes.

To set volume emulation:
Procedure
1. Select the storage system.
2. Select STORAGE > Volumes.
3. Select one of the volume type tabs.
4. Select a volume, click , and click Set Volumes > Emulation.
5. Select the Emulation type.
6. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

FAST association operations
The follow FAST association operations are available:
- Associating storage groups with FAST policies (see Associating storage groups with FAST policies on page 171).
- Associating FAST policies with storage groups (see Associating FAST policies with storage groups on page 170).
- Re associating FAST polices and storage groups (see Reassociating FAST polices and storage groups on page 172).

Removing DATA volumes
This procedure explains how to remove DATA volumes on storage systems running Enginuity version 5876.
Procedure
1. Select the storage system.
2. Select STORAGE > Thin Pools to open the Thin Pools list view.
3. Select the thin pool and click to open its Details view.
4. Click the number next to Number of Data Volumes.
5. Select a data volume and click Remove.
6. Click OK.

Mapping volume operations
The follow mapping volume operations are available:
- Mapping volumes (see Mapping volumes on page 194).
- Unmapping volumes (see Unmapping volumes on page 195).
- Mapping CKD volumes (see Mapping CKD volumes on page 344).
Unmapping CKD volumes (see Unmapping CKD volumes on page 345).

z/OS map from the volume list view (see z/OS map from the volume list view on page 337).

z/OS unmap from the volume list view (see z/OS unmap from the volume list view on page 338).

z/OS map from the Volumes (Storage Groups) list view (see z/OS map from the Volumes (Storage Groups) list view on page 339).

z/OS unmap from the Volumes (Storage Groups) list view (see z/OS unmap from the Volumes (Storage Groups) list view on page 339).

z/OS map FBA volumes from the Volumes (Storage Groups) list view (see z/OS map FBA volumes from the Volumes (Storage Groups) list view (HYPERMAX OS 5977 or higher) on page 342).

z/OS map from the CU image list view (see z/OS map from the CU image list view on page 336).

z/OS unmap from the CU image list view (see z/OS unmap from the CU image list view on page 337).

Rename operations

The follow rename operations are available:

- Rename disk groups (see Renaming disk groups on page 239).
- Rename storage tiers (see Renaming tiers on page 165).

Provisioning storage

With the release of HYPERMAX OS 5977 and the next generation storage systems, Unisphere introduces support for service level provisioning. Service level provisioning simplifies storage management by automating many of the tasks associated with provisioning storage.

Service level provisioning eliminates the need for storage administrators to manually assign physical resources to their applications. Instead, storage administrators specify the storage performance and capacity required for the application and let the system provision the workload appropriately.

By default, storage systems running HYPERMAX OS 5977 or higher are pre-configured with a single Storage Resource Pool (SRP) containing all the physical disks on the system organized into disk groups by technology, capacity, rotational speed, and RAID protection type. allows storage administrators to view all the SRPs configured on the system and the demand that storage groups are placing on them.

In addition, storage systems are also pre-configured with a number of Service Level and workloads, which storage administrators use to specify the performance objectives for the application they are provisioning.

When provisioning storage for an application, storage administrators assign the appropriate SRP, service level, and workload to the storage group containing the application's LUNs.
Unisphere provides the following methods for provisioning storage:

Recommended: This method relies on wizards to step you through the provisioning process, and is best suited for novice and advanced users who do not require a high level of customization (that is, the ability to create their own volumes, storage groups, and so on).

Advanced: This method, as its name implies, is for advanced users who want the ability to control every aspect of the provisioning process.

This section provides the high-level steps for each method, with links to the relevant help topics for more detail.

Regardless of the method you choose, once you have completed the process you will have a masking view, in which the volumes in the storage group are masked to the host initiators and mapped to the ports in the port group.

Before you begin:

The storage system must already be configured.

For instructions on provisioning storage systems running Enginuity 5876 or higher, refer to Provisioning storage on page 109.

To provision storage:

1. Creating hosts on page 296
   Use the Create Host dialog box to group host initiators (HBAs).

2. Using the Provision Storage wizard on page 102
   Use the Provision Storage wizard, which will step you through the process of creating the storage group, port group, and masking view.

3. Creating volumes on page 180
   Create one or more volumes on the storage system.

4. Using the Create Storage Group dialog box to add the volumes you just created to a storage group, and associate the storage group with a storage resource pool, a service level, and a workload.

5. Creating port groups on page 321
   Group Fibre Channel and/or iSCSI front-end directors.

6. Creating masking views on page 311
Using the Provision Storage wizard

Before you begin

- The storage system is running HYPERMAX OS 5977 or higher.
- The user must have Administrator or StorageAdmin permission.
- There are multiple ways to open the Provision Storage wizard. Depending on the method you use, some of steps listed below may not apply. For example, if you open the wizard from the Hosts view, the step on selecting a host does not apply. Or, if you open the wizard from the Provisioning Templates view, the steps on selecting the Service Level and Workload Type does not apply. When opening the wizard from the Provisioning Templates view, please also note the following:
  - Based on the selected template, the appropriate fields (service level, workload type, size and number of volumes) will be filled in with values from the template. If the service level is not available on the default SRP on the selected storage system, it will default to the default service level (Diamond for AFA, Optimized for hybrid arrays)
  - When creating a storage group from the first page without adding it to a masking view, the storage group will be associated with the template but will be marked invalid (will not be included in the usage count for that template) until it is added to a masking view.
  - If the selected template has host IO limits defined based on the provisioning request the limits will be set
    - Standalone SG: The limits will be set and can be modified.
    - Cascaded SG: The limits will be set on each of the children but the parent will have no limit set.

There are multiple ways to open the Provisioning Storage wizard. Depending on the method you use, some of the following steps may not apply. For example, selecting a storage group in the Storage Groups list view and clicking Provision Storage will open the wizard on the Select Host/Host Group page because you are starting out with a storage group.

This procedure explains how to use the Provision Storage wizard to provision storage systems running HYPERMAX OS 5977. In addition, you can also use a subset of the steps to simply create a storage group, without actually provisioning it.

The maximum number of storage groups allowed on a storage system running HYPERMAX OS 5977 is 16,384.

For HYPERMAX OS 5977 or higher, the maximum number of child storage groups allowed in a cascaded configuration is 64.

For instructions on provisioning storage systems running Enginuity 5876, refer to Using the Provision Storage wizard on page 110.

To use the Provisioning Storage wizard:

Procedure

1. Select the storage system.
2. Select STORAGE > Storage Groups.
3. Do one of the following:
   - Select the storage group and click **Create** to open the **Provision Storage** wizard.
   - Select the storage group and click **Provision Storage to Host** to open the **Provision Storage** wizard (go to step 8).

4. Type a **Storage Group Name** name.
   Storage group names must be unique from other storage groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores (-), and dashes (-) are allowed. Storage group names are case-insensitive.

5. If required, select an Emulation type.

6. Select a **Storage Resource Pool**. To create the storage group outside of FAST control, select **None**. External storage resource pools are listed below the **External heading**.

7. Optional: Add one or more storage groups by hovering over the area to the right of the volume capacity and selecting 📀.

8. Optional: Create a storage group with multiple volume sizes or edit the storage group by hovering over the area to the right of the volume capacity and selecting 📀 (see Editing storage group volume details on page 151).

9. Select the **Service Level** to set on the storage group. Service levels specify the characteristics of the provisioned storage, including average response time, workload type, and priority. This field defaults to None if you set the **Storage Resource Pool** to None. Possible values are:

<table>
<thead>
<tr>
<th>Service level</th>
<th>Performance type</th>
<th>Use case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamond</td>
<td>Ultra high</td>
<td>HPC, latency sensitive</td>
</tr>
<tr>
<td>Platinum</td>
<td>Very high</td>
<td>Mission critical, high rate OLTP</td>
</tr>
<tr>
<td>Gold</td>
<td>High</td>
<td>Very heavy I/O, database logs, datasets</td>
</tr>
<tr>
<td>Silver</td>
<td>Price/Performance</td>
<td>Database datasets, virtual applications</td>
</tr>
<tr>
<td>Bronze</td>
<td>Cost optimized</td>
<td>Backup, archive, file</td>
</tr>
<tr>
<td>Optimized (Default)</td>
<td>Optimized</td>
<td>Places the most active data on the highest performing storage and the least active on the most cost-effective storage.</td>
</tr>
</tbody>
</table>

For all-flash storage systems running HYPERMAX OS 5977, the only service level available is Diamond and it is selected by default.

10. Select the **Workload Type** to assign it.

---

**Note**

Workload type is not supported for CKD storage groups.
Note
Starting with Unisphere 9.0, workloads are not supported on PowerMaxOS 5978 and higher.

Workload types are used to refine the service level (that is, narrow the latency range). Possible values are OLTP or DSS, where OLTP workload is focused on optimizing performance for small block I/O and DSS workload is focused on optimizing performance for large block I/O. The **Workload Type** can also specify whether to account for any overhead associated with replication (OLTP_Rep and DSS_Rep).

11. Type the number of **Volumes** and select the **Capacity** of each.

Note
The maximum volume size supported on a storage system running HYPERMAX OS 5977 is 64 TB. It is possible to create an empty Storage Group with no volumes.

12. Optional: To set host I/O limits for the storage groups, click **Set Host I/O Limits** to open the Host I/O Limits dialog box. For instructions setting the limits, refer to the help page for the dialog box. When done, close the dialog box to return to the wizard.

13. Compression is enabled by default on All Flash systems running the HYPERMAX OS 5977 Q3 2016 Service Release or higher when you are creating a storage group or storage container. To disable it, uncheck the **Compression** check box. For more information, refer to Understanding compression.

14. To create a storage group, without actually provisioning it, click one of the following; otherwise, click **Next** and continue with the remaining steps in this procedure:
   - **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

15. Specify the host/host group to use by selecting an existing host/host group, or doing the following to create a new host/host group. When done, click **Next**.
   - To create a new host, click **Create Host** to open the **Create Host** dialog box. For instructions on creating a host, refer to the dialog's help page.
   - To create a new host group, click **Create Host Group** to open the **Create Host Group** dialog box. For instructions on creating a host, refer to the dialog's help page.

16. Select whether to use a New or an Existing port group, and then do the following depending on your selection:
   - **New**:
     - Optional: Edit the suggested **Port Group Name** by highlighting it and typing a new name over it. Port group names must be unique from other port groups on the storage system and cannot exceed 64 characters. Only
alphanumeric characters, underscores (_), and (-) are allowed. Port group names are case-insensitive.

b. Select the ports to use. To view host-invisible ports (unmasked and unmapped), select **include ports not visible to the host**. If a Fibre or iSCSI host was not selected, select the appropriate filter to filter the port list by iSCSI virtual ports or FC ports based on the selected host. If an empty host was selected, the radio button Fibre is selected by default. The Dir-Port table is filtered to only show either FC or iSCSI depending on the radio button selection.

The following properties display:

- **Dir-Port** — Storage system director and port in the port group.
- **Identifier** — Port identifier.
- **Initiators Logged In** — Number of initiators logged into the fabric.
- **PGs** — Number of port groups where the port is a member.
- **Mappings** — Number of mappings.
- **% Busy** — Percentage of time that the port is busy.

17. Optional: Click **Next**.

Existing: Select the port group and click **Next**.

18. Optional: To receive alerts when the performance of the storage group changes, relative to its service level target, select **Enable Compliance Alerts**. For more information on Compliance Alerts, refer to Creating service level compliance alerts policies on page 63.

19. Optional: Click **Set Host I/O Limits**.

This option is not displayed when you select an existing storage group and click ** Provision**. The option is displayed when you click **Create**.

20. Optional: Determine if the storage system can handle the updated service level:

   - **Click Run Suitability Check**. The **Suitability Check** dialog box opens, indicating the suitability of the change. For information on interpreting the results, refer to the dialog's help page. This option is only available under certain circumstances. For more information, refer to **Suitability Check** on page 113.
   - **Click OK** to close the message.
   - If your updates are found to be unsuitable, modify the settings and run the check again until the suitability check passes.

21. Do one of the following:

   - **Click Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - **Expand Add to Job List**, and click **Run Now** to perform the operation now.
Provisioning storage for mainframe

With the release of HYPERMAX OS 5977 Q1 2016, Unisphere introduces support for service level provisioning for mainframe. Service level provisioning simplifies storage system management by automating many of the tasks associated with provisioning storage.

Service level provisioning eliminates the need for storage administrators to manually assign physical resources to their applications. Instead, storage administrators specify the service level and capacity required for the application and the system provisions the storage group appropriately.

You can provision CKD storage to a mainframe host using the Provision Storage wizard. For specific instructions about how to provision storage for mainframe, refer to Using the Provision Storage wizard for mainframe on page 106.

The storage system must be running HYPERMAX OS 5977 Q1 2016, or higher, and have at least one FICON director configured.

To provision storage for Open Systems, refer to Using the Provision Storage wizard on page 102.

Mapping CKD devices to CU images

You can map CKD devices to front-end EA/EF directors. Addressing on EA and EF directors is divided into Logical Control Unit images, referred to as CU images. Each CU image has its own unique SSID and contains a maximum of 256 devices (numbered 0x00 through 0xFF). When mapped to an EA or EF port, a group of devices becomes part of a CU image.

For more information about how to map CKD devices to CU images, see the following tasks:

- z/OS map from the CU image list view on page 336
- z/OS map from the volume list view on page 337

Using the Provision Storage wizard for mainframe

Before you begin

- The storage system must be running HYPERMAX OS 5977 Q1 2016, or higher, and have at least one FICON director configured.
- Depending on the type of configuration selected, not all of the steps listed below might be required.

To provision storage to mainframe:

Procedure

1. Select the storage system.
2. Select Hosts > Mainframe to open the Mainframe Dashboard.
3. In the Actions panel, click Provision Storage. The Provision Storage wizard for mainframe is displayed.
4. In the Create Storage Group page, type a Storage Group Name.
   Storage group names must be unique from other storage groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and dashes (-) are allowed. Storage group names are case-insensitive.
   If you want to create an empty storage group, proceed to the final step after typing the storage group name.
5. Select a **Storage Resource Pool**.
   To create the storage group outside of FAST control, select **None**. External storage resource pools are listed below the **External** heading.

6. Select an **Emulation** type. Available values are **CKD-3390** and **CKD-3380**.

7. Select the **Service Level** to set on the storage group.
   Service levels specify the characteristics of the provisioned storage, including average response time, workload type, and priority. This field defaults to None if you set the **Storage Resource Pool** to None.
   Available values are:

<table>
<thead>
<tr>
<th>Service level</th>
<th>Performance level</th>
<th>Use case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamond</td>
<td>Ultra high</td>
<td>HPC, latency sensitive</td>
</tr>
<tr>
<td>Bronze</td>
<td>Cost optimized</td>
<td>Backup, archive, file</td>
</tr>
<tr>
<td>Optimized</td>
<td></td>
<td>Places the most active data on the highest performing storage and the least active on the most cost-effective storage.</td>
</tr>
<tr>
<td>(Default)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For all-flash storage systems, the only service level available is Diamond and it is selected by default.

8. Type the number of **Volumes** and select either a **Model** or **Volume Capacity**.
   Selecting a **Model** type automatically updates the **Volume Capacity** value. Alternatively, you can type the **Volume Capacity**.

   **Note**
   The maximum CKD volume size supported is 1182006 cylinders or 935.66 GB. It is possible to create an empty Storage Group with no volumes.

9. (Optional) Configure volume options:

   **Note**
   When using this option, Unisphere uses only new volumes when creating the storage group; it will not use any existing volumes in the group.

   - a. Hover the cursor on the service level and click 

   - b. Edit the **Volume Identifier**.

   The following options are available:

   **None**
   Do not set a volume identifier.

   **Name Only**
   All volumes will have the same name. Type the name in the **Name** field.
**Name and VolumeID**

All volumes will have the same name with a unique volume ID appended to them. When using this option, the maximum number of characters allowed is 50. Type the name in the Name field.

**Name and Append Number**

All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the Append Number and increment by 1 for each additional volume. Valid Append Numbers must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50. Type the name in the Name field.

c. To **Allocate capacity for each volume** you are adding to the storage group, select this option. You can use the this option only for newly created volumes, not existing volumes.

d. If you selected to allocate capacity in the previous step, you can mark the allocation as persistent by selecting **Persist preallocated capacity through reclaim or copy**. Persistent allocations are unaffected by standard reclaim operations and any TimeFinder/Clone, TimeFinder/Snap, or SRDF copy operations.

e. Click OK.

10. (Optional) To add a child storage group, do one of the following:

- On all-flash storage systems, click **Add Storage Group**.
- On all other storage systems click **Add Service Level**.

Specify a **Name**, **Service Level**, **Volumes**, and **Model/Volume Capacity**. Repeat this step for each additional child storage group. The maximum number of child storage groups allowed is 64.

11. To create a storage group, without actually provisioning it, click one of the following; otherwise, click **Next** and continue with the remaining steps in this procedure:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812
- Expand **Add to Job List**, and click **Run Now** to perform the operation now.

12. On the **CU Image** page, select whether to use a **New** or an **Existing** CU image, and then do the following depending on your selection:

- New:
  a. Specify the following information for the new CU image:
     - **CU Image Number**
     - **SSID**
     - **Base Address**
  b. Select a **Split** with which to associate the CU image.

- Existing:
  a. Select a CU image.
b. To specify a new value for the base address, click **Set Base Address**. For more information about setting the base address, refer to **Setting the base address** on page 341.

13. Click **Next**.

14. On the **Review** page, review the summary information displayed.

   If the storage system is registered for performance, you can subscribe for compliance alerts for the storage group and run a suitability check to ensure that the load being created is appropriate for the storage system.

   To enable compliance alerts, select **Enable Compliance Alerts**.

   To run a suitability check, click **Run Suitability Check**.

15. Do one of the following:
   
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
   
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

---

**Provisioning storage**

Provisioning storage refers to the process by which you make storage available to hosts.

Unisphere provides the following methods for provisioning storage on storage systems running Enginuity 5876:

**Recommended:** This method relies on wizards to step you through the provisioning process, and is best suited for novice and advanced users who do not require a high level of customization (that is, the ability to create their own volumes, storage groups, and so on).

**Advanced:** This method, as its name implies, is for advanced users who want the ability to control every aspect of the provisioning process.

This section provides the high-level steps for each method, with links to the relevant help topics for more detail.

Regardless of the method you choose, once you have completed the process you will have a masking view, in which the volumes in the storage group are masked to the host initiators and mapped to the ports in the port group.

---

**Before you begin:**

---
The storage system must already be configured.

To provision storage:

1. Use the Create Host dialog box to group host initiators (HBAs).
2. Use the Provision Storage wizard, which will step you through the process of creating the storage group, port group, and masking view, and to optionally associate the storage group with a FAST policy.

Using the Provision Storage wizard

Before you begin

The storage system is running Enginuity OS version 5876 and must already be configured and you must already have a host. For instructions on creating a host, refer to Creating hosts on page 296.

Note the following recommendations:

Port groups should contain four or more ports.

Each port in a port group should be on a different director.

There are multiple ways to open the Provisioning Storage wizard. Depending on the method you use, some of the following steps may not apply. For example, selecting a storage group in the Storage Groups list view and clicking Provision Storage to Host will open the wizard on the Select Host/Host Group page because you are starting out with a storage group.

This procedure explains how use the Provision Storage wizard to provision storage systems running Enginuity OS 5876. The wizard steps you through the provisioning process, and is best suited for novice and advanced users who do not require a high level of customization, that is, the ability to create their own volumes, storage groups, and so on. In addition, you can also use a subset of the steps to simply create a storage group, without actually provisioning it.
The maximum number of storage groups allowed on a storage system running Enginuity 5876 is 8,192.

For Enginuity 5876 or higher, the maximum number of child storage groups allowed in a cascaded configuration is 32.

For users who want the ability to control every aspect of the provisioning process, refer to the Advanced procedure in Using the Provision Storage wizard on page 110.

For instructions on provisioning storage systems running HYPERMAX OS 5977, refer to Using the Provision Storage wizard on page 102.

To use the Provisioning Storage wizard:

Procedure

1. Select the storage system.
2. Select STORAGE > Storage Groups.
3. Do one of the following:
   - Select the storage group and click **Create** to open the Provision Storage wizard.
   - Select the storage group and click **Provision Storage to Host** to open the Provision Storage wizard (go to step 8).
4. Type a **Storage Group Name**.
   Storage group names must be unique from other storage groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores ( _ ), and dashes ( - ) are allowed. Storage group names are case-insensitive.
5. Select the **Storage Group Type**.
6. Do the following, depending on the storage group type:
   - **Standard Storage Group**:
     - Select the **Volume Type** to add to the storage group and click **NEXT**.
     - Do the following, depending on the volume type:
       - **Virtual Volumes**:
         a. Select the **Emulation** type for the volumes to add to the storage group.
         b. Optional: Select the **Thin Pools** containing the volumes to add to the storage group.
         c. Type the number of volumes and enter volume capacity information.
         d. Optional: To add more volumes, hover the cursor over the volume and click **+**.
         e. Optional: To remove a previously added volume, hover the cursor over it and click **-**.
         f. Optional: To edit a volume, hover the cursor over the volume and click edit ( ✎ ) (see **Editing storage group details** on page 152)
       - **Regular Volumes**:
         a. Select the **Disk Technology** on which the storage group will reside.
b. Select the **Emulation** type for the volumes to add to the storage group.

c. Select the **Protection** level for the volumes to add to the storage group.

d. Type the number of volumes and enter volume capacity information.

e. Optional: To add more volumes, hover the cursor over the volume and click 

f. Optional: To remove a previously added volume, hover the cursor over it and click 

g. Optional: To edit a volume, hover the cursor over the volume and click edit ( ) (see Editing storage group details on page 152)

- **Empty Storage Group:**
  
  Note: It is possible to create an empty Storage Group with no volumes.

  Do one of the following:

  - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
  
  - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

7. If you want to create a storage group, without actually provisioning it, click one of the following; otherwise, click **NEXT** and continue with the remaining steps in this procedure:

   Do one of the following:

   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

8. Specify the host/host group to use by selecting an existing host/host group, or doing the following to create a new host or host group.

   - To create a new host, click **Create Host** (see Creating hosts on page 296).
   
   - To create a new host group, click **Create Host Group** (see Creating host groups on page 306).

9. Click **NEXT**.

10. Select whether to use a new or an existing port group, and then do the following depending on your selection. When done, click **NEXT**.

    New:
    
    a. Optional: Edit the suggested port group name by highlighting it and typing a new name over it. Port group names must be unique from other port groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores ( _ ), and (-) are allowed. Port group names are case-insensitive.
b. Select the ports to use. To view host-invisible ports (unmasked and unmapped), click **Include ports not visible to the host** slider. The following properties display:

- **Dir-Port**—Storage system director and port in the port group.
- **Identifier**—Identifier.
- **Initiators**—Number of initiators logged into the fabric.
- **PGs**—Number of port groups where the port is a member.
- **Mappings**—Number of volumes mapped to the port.

c. Click **NEXT**.

Existing: Select the port group and click **NEXT**.

11. Optional: Edit the suggested name for the Masking View by highlighting it and typing a new name over it.

12. Optional: To set host I/O limits for the storage groups, click **Set Host I/O Limits**. For information about setting the limits, refer to Setting host I/O limits on page 134.

Verify the rest of your selections. To change any of them, click **BACK**. Note that some changes may require you to make additional changes to your configuration.

13. Do one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.

- Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Suitability Check restrictions

The Suitability Check option is only available when:

- The storage system is running HYPERMAX OS 5977 or higher.
- The storage system is registered with the performance data processing option for statistics.
- The workloads have been processed.
- All the SGs involved have a service level and SRP set.
- The target SRP does not contain only external disk groups (like XstreamIO).
- The storage system is local.
- The SG is not in a masking view (only for the local provisioning wizard).
- If there is an issue with one of the selected ports (for example, a virtual port is selected, an offline port is selected, a selected port has no negotiated speed) when provisioning storage, a valid Front End Suitability score cannot be derived. When this issue arises, 200.0% (not a real suitability score) is displayed. Excluding data has no impact on this.

### Suitability Check

The Suitability Check option is only available when the storage system is running HYPERMAX OS 5977 or higher.

This message indicates whether the storage system can handle the updated service level. Results are indicated with either of the following:
Indicates suitable.

Indicates non-suitable.

In both cases, results are displayed in a bar chart by component (Front End, Back End, Cache) along with a score from 0 to 100 (viewed by hovering the cursor over the bar) indicating the components expected availability on the target storage system after the change.

The current score for the component is shown in gray, with the additional load for the component shown in green or red indicating suitability. The additional score is red if the current and additional loads total more than 100.

Creating storage groups

This procedure explains how to create storage groups on storage systems running HYPERMAX OS 5977 or later. In addition to method described below, you can also create a storage group using the Provision Storage wizard, as described in Using the Provision Storage wizard on page 102.

For instructions on creating storage groups on storage systems running Enginuity 5876, refer to Using the Provision Storage wizard on page 110.

Before you begin:

- The storage systems is running HYPERMAX OS 5977 or higher.
- The user must have Administrator or StorageAdmin permission.
- The maximum number of storage groups allowed on a storage system running HYPERMAX OS 5977 is 16,384.
- For HYPERMAX OS 5977 or higher, the maximum number of child storage groups allowed in a cascaded configuration is 64.
- A storage group can contain up to 4,096 volumes.
- A volume can belong to multiple storage groups if only one of the groups is under FAST control.
- You cannot create a storage group containing CKD volumes and FBA volumes.

To create a storage group:

Procedure

1. Select the storage system.
2. Select Storage > Volumes.
3. Select one or more volumes, click and select Create SG.
4. Type a Storage Group Name.

   Storage group names must be unique from other storage groups on the system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and (-) are allowed. Storage group names are case-insensitive.

5. To create the storage group outside of FAST control, set Storage Resource Pool to None; otherwise, leave this field set to the default.
6. Select the Service Level to set on the SG.

   Service level policies specify the characteristics of the provisioned storage, including maximum response time, workload type, and priority. This field
defaults to None if you set the **Storage Resource Pool** to None. Possible values are:

<table>
<thead>
<tr>
<th>Service level</th>
<th>Performance type</th>
<th>Use case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamond</td>
<td>Ultra high</td>
<td>HPC, latency sensitive</td>
</tr>
<tr>
<td>Platinum</td>
<td>Very high</td>
<td>Mission critical, high rate OLTP</td>
</tr>
<tr>
<td>Gold</td>
<td>High</td>
<td>Very heavy I/O, database logs, datasets</td>
</tr>
<tr>
<td>Silver</td>
<td>Price/Performance</td>
<td>Database datasets, virtual applications</td>
</tr>
<tr>
<td>Bronze</td>
<td>Cost optimized</td>
<td>Backup, archive, file</td>
</tr>
<tr>
<td>Optimized (Default)</td>
<td></td>
<td>Places the most active data on the highest performing storage and the least active on the most cost-effective storage.</td>
</tr>
<tr>
<td>None</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For all-flash storage systems running HYPERMAX OS 5977, the only service level available is Diamond and it is selected by default.

7. Refine the service level by selecting the **Workload Type** to assign it.

   **Note**
   Workload type is not supported for CKD storage groups.

   **Note**
   Starting with Unisphere 9.0, workloads are not supported on PowerMaxOS 5978 and higher.

   Possible values for the **Workload Type** are:
   - OLTP
   - OLTP+REP
   - DSS
   - DSS+REP

   The workload type does not apply when the service level is Optimized or None.

8. Click **OK** to create the storage group now, or click **Advanced Options** to continue setting the advanced options, as described in the remaining steps.

9. Compression is enabled by default on All Flash systems running the HYPERMAX OS 5977 Q3 2016 Service Release or higher when you are creating a storage group or storage container. To disable the feature, uncheck the **Compression** check box. For more information, refer to **Understanding compression**

10. Optional: Click the **Enable Mobility ID** checkbox to assign Mobility IDs to the volumes in the storage group. If you leave the checkbox unchecked, Compatibility IDs will be assigned to the volumes instead.
11. Optional: Select **Allocate Full Volume capacity**.

12. Optional: Click **Persist preallocated capacity through reclaim or copy** checkbox.

13. If you selected to allocate capacity in the previous step, you can mark the allocation as persistent by selecting **Persist preallocated capacity through reclaim or copy**.

   Persistent allocations are unaffected by standard reclaim operations and any TimeFinder/Clone, TimeFinder/Snap, or SRDF copy operations.

14. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**Adding volumes to storage groups**

This procedure explains how to add volumes to existing storage groups.

Before you begin:

A storage group can contain up to 4,096 volumes.

A volume can belong to more than one storage group.

To add volumes to storage groups:

**Procedure**

1. Select the storage system.
2. Under **STORAGE**, select **Storage Groups**.
3. Select the storage group and click 1.
4. Click the number next to **Volumes**.
5. Click **Add Volumes to SG** to open the **Add Volumes to Storage Group** wizard.
6. Locate the volumes by selecting or typing values for any number of the following criteria:
   - **Capacity equal to**—Filters the list for volumes with a specific capacity and capacity type.
   - **Volume ID**—Filters the list for a volume with specific ID.
   - **Volume Identifier Name**—Filters the list for the specified volume name.
   - **Volume configuration**—Filters the list for the specified volume configuration.
   - **Emulation**—Filters the list for the specified volume emulation.
   - **Exclude Volumes in use**—Tick the checkbox to filter the list to exclude volumes in use.
7. Click **NEXT** to run the query.
   Results are displayed on the next page in the wizard.
8. Select the volumes and click **OK**.
Copying volumes between storage groups

This procedure explains how to copy volumes between storage groups.

Before you begin:

- Storage groups require Enginuity 5876 or HYPERMAX OS 5977 or later.
- The user must have StorageAdmin permission.

To copy volumes between storage groups:

Procedure

1. Select the storage system.
2. Under STORAGE, select Storage Groups.
3. Select the storage group and click .
4. Click Volumes.
5. Select one or more volumes click , and click Copy Volumes To SG to open the Copy Volumes to Storage Group dialog box.
6. Select the Target Storage Group Name.
7. Click OK.

Moving volumes between storage groups

This procedure explains how to move volumes between storage groups.

Before you begin:

- Storage groups require Enginuity 5876 or HYPERMAX OS 5977 or later.
- The user must have StorageAdmin permission.
- To perform this operation without disrupting the host's ability to view the volumes, at least one of the following conditions must be met:
  - Each storage group must be a child of the same parent storage group, and the parent storage group must be associated with a masking view.
  - Each storage group must be associated with a masking view, and both masking views must contain a common initiator group and a common port group. In this scenario, the port groups can be different, but they must both contain the same set of ports, or the target port group can contain a superset of the ports in the source port group.
  - The source storage group is not in a masking view.

To move volumes between storage groups:

Procedure

1. Select the storage system.
2. Under STORAGE, select Storage Groups.
3. Select the storage group and click .
4. Click Volumes.
5. Select one or more volumes, click , and click **Move Volumes to SG** to open the **Move Volumes to Storage Group** dialog box.

6. Select the **Target Storage Group Name**.

7. Optional: By default, the operation will fail if at least one of the conditions above is not met. To override this default behavior, select **Use force flag**.

8. Click **OK**.

**Removing volumes from storage groups**

This procedure explains how to remove volumes from storage groups.

Before you begin:

Storage groups require Enginuity 5876 or HYPERMAX OS 5977 or higher.

To remove volumes from storage groups:

**Procedure**

1. Select the storage system.
2. Under **STORAGE**, select **Storage Groups**.
3. Select the storage group and click .
4. Click **Volumes**.
5. Select one or more volumes and click **Remove Volumes** to open the **Remove Volume** dialog box.
6. To unbind the volumes, select **Unbind** or **Unmap**, depending on the storage operating environment.
7. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**Storage Group operations**

The following storage group operations are available:

- Expanding Storage Group (see **Expanding storage groups** on page 118).
- Modifying Storage Group (see **Modifying storage groups** on page 121 (5977 or greater)).

**Expanding storage groups**

This procedure explains how to increase the amount of storage in a group accessible to the masking view or in the FAST Policy.

Before you begin:

- This procedure requires Enginuity OS 5876.
- In this procedure you can optionally name the volumes you are adding the storage group. For more information, refer to **Setting volume names** on page 198.
Empty SGs are not displayed while creating a cascaded SG.

To expand a storage group:

**Procedure**

1. Select the storage system.
2. Select **STORAGE** > **Storage Groups**.
3. Select the storage group and click **Expand** to open the **Expand Storage Group** wizard.
4. Select a method for expanding the storage group. Possible values are:
   - **Virtual Volumes**—Expands the group using virtual volumes.
   - **Regular Volumes**—Expands the group using regular volumes.
   - **Copy Volume**—Expands the group by copying the configuration of volumes already in the group.
5. Click **NEXT**.
6. Do the following, depending on the method you are using:
   - **Virtual Volumes**:
     a. Select the **Emulation** type for the volumes to add to the storage group.
     b. Optional: Select the **Thin Pools** containing the volumes to add to the storage group.
     c. Type the number of volumes and enter volume capacity information.
     d. Optional: To add more volume sizes, hover the cursor over the volume and click 
        ![add](image).
     e. Optional: To remove a previously added volume, hover the cursor over it and click 
        ![remove](image).
     f. Optional: To edit a volume, hover the cursor over the volume and click edit ( ![edit](image)) (see Editing storage group details on page 152)
   - **Regular Volumes**:
     a. Select the **Disk Technology** on which the storage group will reside.
     b. Select the **Emulation** type for the volumes to add to the storage group.
     c. Select the **Protection** level for the volumes to add to the storage group.
     d. Type the number of volumes and enter volume capacity information.
     e. Optional: To add more volume sizes, hover the cursor over the volume and click 
        ![add](image).
     f. Optional: To remove a previously added volume, hover the cursor over it and click 
        ![remove](image).
     g. Optional: To edit a volume, hover the cursor over the volume and click edit ( ![edit](image)) (see Editing storage group details on page 152)
   - **Copy Volume**:
     a. Select the **Disk Technology** on which the storage group will reside.
     b. Select the **Emulation** type for the volumes to add to the storage group.
c. Select the **Protection** level for the volumes to add to the storage group.

d. Specify the capacity by typing the number of volumes, and entering volume capacity information.

e. Optional: Hover the cursor over the volume and click edit (✏) (see Editing storage group details on page 152)

7. Do one of the following:

- Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
- Expand Add to Job List, and click Run Now to perform the operation now.

**Expanding ProtectPoint storage groups**

**Before you begin**

- This feature requires HYPERMAX OS 5977 or higher.
- You must have StorageAdmin permission.
- The Data Domain appliance must be connected and zoned to the storage system.
- Provide the Data Domain Admin the number and size of volumes that you added to the production storage group and request that they provide you with double the number of similar volumes (masked/visible to the storage system). For example, if the production storage group contains 10 volumes, the Data Domain Admin should provide you with the LUN numbers of 20 similar volumes.
- CKD devices are not supported by ProtectPoint.

This procedure explains how to increase the amount of storage in a storage group protected by ProtectPoint.

To expand protected storage groups:

**Procedure**

1. Select the storage system.
2. Under STORAGE, select Storage Groups.
3. Select the storage group, click , and click **Expand ProtectPoint**.

   Opens the **Expand ProtectPoint** wizard.
4. Select the Point In Time Copy to expand and click Next.
5. Select the external LUNs to add to the backup storage group and click **Add to Group**. Select the same number of external LUNs as the number of volumes added to the production storage group.
6. Click Next and select the Restore Storage Group.
7. Select the external LUNs to add to the restore storage group and click **Add to Group**. Select the same number of external LUNs as the number of volumes added to the production storage group.
8. Click Next and verify your selections. To change any of them, click Back. Some changes may require additional configuration changes.
9. Do one of the following:
• Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to [Scheduling jobs](#) on page 812 and [Previewing jobs](#) on page 812.

• Expand **Add to Job List**, and click **Run Now**.

Once the job has completed, provide the following information to the Data Domain Admin:

- The LUN numbers added to the backup storage group.
- The LUN numbers added to the restore storage group.
- The name of the point in time copy.

## Modifying storage groups

This procedure explains how to modify storage groups on storage systems running HYPERMAX OS 5977 or later.

### Before you begin:

- You must be an Administrator or StorageAdmin.
- The maximum number of storage groups allowed on a storage system is 16,384.
- A storage group can contain up to 4,096 storage volumes.
- A volume can belong to more than one storage group.
- A volume can belong to multiple storage groups if only one of the groups is under FAST control.

### To modify a storage group:

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Storage Groups**
3. Select the storage group and click **Modify** to open the **Modify Storage Group** dialog box.
4. Do any number of the following:
   - **Change the Storage Group Name** by highlighting it and typing a new name over it. Storage group names must be unique from other storage groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores ( _ ), and dashes (-) are allowed. Storage group names are case-insensitive.
     - **Note the following about renaming storage groups:**
       - If renaming a storage group with workload on it, you will have to wait some time before the workload is visible in the storage group's Details view.
       - When renaming a storage group configured compliance alerts, the compliance alerts will need to be deleted manually. For instructions, refer to [Deleting compliance alerts policies](#) on page 65.
   - **Change the Storage Resource Pool** by selecting the new pool from the drop-down menu. Setting this property to **None** creates the storage group outside of FAST control. External storage resource pools are listed below the **External** heading.
   - **Change the Service Level** for the storage group. Service levels specify the characteristics of the provisioned storage, including maximum response
time, workload type, and priority. This field defaults to None if you set the Storage Resource Pool to None. Possible values are:

<table>
<thead>
<tr>
<th>Service level</th>
<th>Performance type</th>
<th>Use case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamond</td>
<td>Ultra high</td>
<td>HPC, latency sensitive</td>
</tr>
<tr>
<td>Platinum</td>
<td>Very high</td>
<td>Mission critical, high rate OLTP</td>
</tr>
<tr>
<td>Gold</td>
<td>High</td>
<td>Very heavy I/O, database logs, datasets</td>
</tr>
<tr>
<td>Silver</td>
<td>Price/Performance</td>
<td>Database datasets, virtual applications</td>
</tr>
<tr>
<td>Bronze</td>
<td>Cost optimized</td>
<td>Backup, archive, file</td>
</tr>
<tr>
<td>Optimized (Default)</td>
<td></td>
<td>Places the most active data on the highest performing storage and the least active on the most cost-effective storage.</td>
</tr>
</tbody>
</table>

For all-flash storage systems running HYPERMAX OS 5977, the only service level available is Diamond and it is selected by default.

d. Change the Workload Type assigned to the service level.

Note
Starting with Unisphere 9.0, workloads are not supported on PowerMaxOS 5978 and higher.

e. Add or remove Volumes.
f. Do the following to change the capacity of the storage group, depending on whether the group contains volumes of the same capacity or mixed capacities:

- If the group contains volumes of the same capacity, do one of the following:
  - Type or select an increased number of volumes in the Volumes drop-down menu.
  - Type or select an increased unit capacity of the volumes and/or change the unit in the Volume Capacity drop-down menus.

Note
In mixed FBA/CKD All Flash systems, volume capacity defaults to GB for FBA Storage Groups and Cyl for CKD Storage Groups.

- If the group contains volumes of mixed capacities, click Edit custom capacity to open the Modify Custom Capacity dialog box. Change the number of Volumes by capacity, and click OK. You can only use the Allocate capacity for each volume option for newly created volumes, not existing volumes.

The Total Capacity and Additional Capacity figures are updated to reflect any changes.
Note

The maximum volume size supported on a storage system running HYPERMAX OS 5977 is 64 TB. All Flash systems running the HYPERMAX OS 5977 Q2 2017 Service Release or higher supports a maximum CKD device size of up to 1,182,006 cylinders.

g. SRDF storage group volume capacity can be expanded using the controls. In the case of SRDF Storage Groups, you need to specify a SRDF group number so that the dialog allowing you to remote volumes can also be displayed (see Expanding remote volumes on page 515).

h. Optional: Add one or more storage groups by hovering over the area to the right of the volume capacity and selecting +.

i. Optional: Create a storage group with multiple volume sizes or edit the storage group by hovering over the area to the right of the volume capacity and selecting (see Editing storage group volume details on page 151).

j. Optional: to add a child storage group, do one of the following:

- On all-flash storage systems, click Add Storage Group.
- On all other storage systems, click Add Service Level.
- Modify any of the service level parameters, as described earlier in this procedure.

5. Compression is enabled by default on All Flash systems running the HYPERMAX OS 5977 Q3 2016 Service Release or higher when you are creating a storage group or storage container. To disable the feature, uncheck the Enable Compression check box. In a cascaded setup, changes will be passed to each of the child storage groups. For more information on compression, refer to Understanding compression

6. Optional: To determine if the storage system can handle the updated service level:

- Click Run Suitability Check. The Suitability Check dialog box opens, indicating the suitability of the change. For information on interpreting the results, refer to the dialog's help page. This option is only available under certain circumstances. For more information, refer to Suitability Check restrictions on page 113.

- Click OK to close the message.

- If your updates are found to be unsuitable, modify the settings and run the check again until the suitability check passes.

7. Do one of the following:

- Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.

- Expand Add to Job List, and click Run Now to perform the operation now.

Renaming storage groups

This procedure explains how to rename storage groups.

Before you begin:
Storage group names must be unique from other storage groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and (-) are allowed. Storage group names are case-insensitive.

Storage groups require Enginuity 5876, or HYPERMAX OS 5977 or later.

To rename a storage group:

**Procedure**
1. Select the storage system.
2. Under STORAGE, select Storage Groups.
3. Select the storage group, click ..., and click Rename.
4. Type the new name.
5. Click OK.

**Protecting storage groups**

The Protect Storage Group wizard guides you through the process of protecting your storage group. Depending on the capabilities of the storage system, the following options may be available:

- **Snap/VX**—For instructions, refer to Creating snapshots on page 391. This is the default method for storage systems running HYPERMAX OS 5977 or higher.
- **TimeFinder/Clone**—For instructions, refer to Protecting storage groups using TimerFinder/Clone on page 124. This is the default method for storage systems running Enginuity 5876.
- **ProtectPoint**—For instructions, refer to Protecting storage groups using ProtectPoint on page 126. This method is only available on storage systems running HYPERMAX OS 5977 or later.
- **RecoverPoint**—For instructions, refer to Protecting storage groups using RecoverPoint on page 127. This method is only available for storage systems running Enginuity 5876.
- **SRDF**—For instructions, refer to Protecting storage groups using SRDF on page 128. This method is available for storage systems, subject to connectivity rules.
- **SRDF/Metro**—For instructions, refer to Protecting storage groups using SRDF/Metro on page 129. This method is only available for storage systems running HYPERMAX 5977 or higher.

**Protecting storage groups using TimerFinder/Clone**

Before you begin:

- This feature requires the Enginuity 5876.163.105 or later. This feature does not apply to storage systems running HYPERMAX OS 5977 or later.
- The storage group must contain only thin volumes (except gatekeepers under 10 MB) and they must all be of the same type (either BCV or standard thin volumes (TDEVs)). This restriction also applies to cascaded storage groups, that is, all volumes in the parent and child storage groups must be thin and of the same type.
- The SYMAP_ALLOW_DEV_INT_MULTI_GRPS option must be enabled. For instructions on enabling the option, refer to "Editing the Options file" in the Solutions Enabler Installation Guide.
Meta volumes are not supported.

To protect storage groups using TimeFinder/Clone:

Procedure

1. Select the storage system.
2. Select STORAGE > Storage Groups.
3. Select the storage group and click Protect.
4. If not already selected, select Point In Time Using Clone.
5. Click NEXT.
6. Type the name of the device group that will hold the target volumes (Device Group Name).
7. Select the thin pool to which the target volumes will be bound (Bind to Pool). If the source storage group contains thin volumes bound to different thin pools, or if it's a cascaded storage group with child storage groups containing volumes bound to different thin pools, selecting a single thin pool will result in all target volumes being bound to that single pool.
8. Clear the Create Replica Storage Group option in which case a storage group for the target volumes will not be created. Leaving the option selected allows you to optionally change the name of replica storage group (Storage Group Name). Changing the name will also change the target volume storage group name.
9. z/OS Only: If the storage group contains CKD volumes, type a New SSID for the target, or click Select ... to open a dialog from which you can select an SSID.
10. Select the mode in which to create the clone session Clone Copy Mode.
    The mode you specify here will override the default mode specified in the preferences. Possible values are:
    - No Copy No Diff — Create a nondifferential (full) copy session without a full background copy.
    - Copy No Diff — Creates a nondifferential (full) copy session in the background.
    - PreCopy No Diff — Creates a nondifferential (full) copy session in the background before the activate starts.
    - Copy Diff — Creates a differential copy session in the background. In differential copy sessions, only those volume tracks that have changed since the full clone was performed are copied (that is, only new writes to the source volume will be copied).
    - PreCopy Diff — Creates a differential copy session in the background before the activate starts. In differential copy sessions, only those volume tracks that have changed since the full clone was performed are copied (that is, only new writes to the source volume will be copied).
    - VSE No Diff — Creates a VP Snap Copy session.
11. Select the type of volumes to use as the targets (Clone Targets).
12. Click NEXT.
13. Verify your selections, and then do one of the following:
    - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
Protecting storage groups using ProtectPoint

Before you begin
- The storage system must be running HYPERMAX OS 5977.
- You must have StorageAdmin permission.
- The Data Domain appliance must be connected and zoned to the storage system.
- Provide the Data Domain Admin the number and size of volumes in the production storage group and request that they provide you with double the number of similar volumes (masked/visible to the storage system). For example, if the production storage group contains 10 volumes, the Data Domain Admin should provide you with the LUN numbers of 20 similar volumes.
- CKD devices are not supported by ProtectPoint.

To protect storage groups using ProtectPoint:

Procedure
1. Select the storage system.
2. Under STORAGE, select Storage Groups.
3. Select the storage group and click Protect.
4. Select Backup Using ProtectPoint.
5. Click NEXT.
6. Click OK.
7. Type the name of the Point In Time Copy Name and click Next.
8. Type a name for the Backup Storage Group, or leave the system-generated suggestion.
9. Select the external LUNs to add to the backup storage group and click Add to Storage Group.
   Note that the external LUNs you select must match in number and capacity the volumes in the production storage group.
10. Click NEXT.
11. Type a name for the New Restore Storage Group, or leave the system-generated suggestion.
12. Select the external LUNs to add to the restore storage group and click Add to Storage Group.
   Note that the external LUNs you select must match in number and capacity the volumes in the production storage group.
13. Click NEXT.
14. Verify your selections. To change any of them, click BACK.
   Note that some changes may require you to make additional changes to your configuration.
15. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
• Expand Add to Job List, and click Run Now to perform the operation now.

16. Once the job completes successfully, provide the following information to the Data Domain Admin:
   • The LUN numbers used in the backup storage group
   • The LUN numbers used in the restore storage group
   • The name of the point in time copy

Protecting storage groups using RecoverPoint

Before you begin
• RecoverPoint operations on Unisphere require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
• To perform this operation you must be a StorageAdmin.
• The storage group being replicated must be masked to the host.
• The storage group being replicated must not contain any volumes that are already tagged for RecoverPoint.
• Connectivity to the RecoverPoint system/cluster is available.
• RecoverPoint 4.1 is setup and operational. For each cluster in the setup, gatekeepers and repository volumes must be configured in their relevant masking view. uses a default journal masking view naming convention.
• Depending on the options selected as part of the Protect Storage Group wizard and the existing configuration, some values for some options might populate automatically.

Procedure
1. Select the storage system.
2. Select STORAGE > Storage Groups.
3. Select the storage group and click Protect.
5. Click NEXT.
6. On the Configure RecoverPoint page, specify the following information:
   • RecoverPoint System—RecoverPoint system.
   • RecoverPoint Group Name—Name of the RecoverPoint group.
   • RecoverPoint Cluster—RecoverPoint cluster.
   • Production Name—Name of the production.
   • Data Initiator Group—Data initiator group.
   • Journal Thin Pool—Journal thin pool.
   • Journal Port Group—Journal port group.
   • Data Initiator Group—Journal initiator group.
7. Click NEXT.
8. On the Add Copies page, specify the following information:
- **RecoverPoint Cluster**—RecoverPoint cluster.
- **Copy Name**—Name of the RecoverPoint copy.
- **Mode**—Specify whether the mode is Synchronous or Asynchronous.
- **Array**—Storage system.
- **Target Storage Group**—Specify whether the RecoverPoint copy targets a new storage group or an existing group.
- **Copy Storage Group**—Name of storage group to be copied.
- **Data Thin Pool**—Name of data thin pool.
- **Data Port Group**—Name of data port group.
- **Journal Thin Pool**—Name of journal thin pool.
- **Journal Port Group**—Name of journal port group.

9. Click **Add Copy**.

Lists the copy in the **Copy Summary** table.

10. Click **NEXT**.

11. On the **FINISH** page, verify your selections. To change any of them, click **BACK**. Some changes may require you to make additional changes to your configuration.

12. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
   - Expand **Add to Job List**, then click **Run Now** to perform the operation now.

**Protecting storage groups using SRDF**

This procedure explains how to protect storage groups using SRDF.

Before you begin:

- You must have StorageAdmin permission.
- Connectivity to remote storage system must be available.
- All storage systems involved must be discoverable and manageable from the console.
- The SRDF wizard in Unisphere 8.1 and higher releases supports the mandatory creation of a storage group and the optional creation of a device group. The storage group may contain non-concurrent SRDF devices of any one SRDF type, or may contain non-SRDF devices.
- The following validation check is performed by the wizard to determine if selected storage group be SRDF protected: Volumes in the storage group need to be all TDEV's, or all volumes in the storage group need to be R1s and in the same SRDF Group, or all volumes need to be R2s and in the same SRDF Group.
- The SRDF wizard in Unisphere 8.2 and higher releases supports the creation of SRDF protection for CKD Storage Groups.
- Set the default number of ports to use with SRDF. To set this number, refer to **Managing data protection preferences** on page 86.

To protect storage groups using SRDF:
Procedure

1. Select the storage system.
2. Under STORAGE, select Storage Groups.
3. Select the storage group and click Protect.
4. Select Remote Replication Using SRDF.
5. Click NEXT.
6. Select the Remote Array ID. To update the list of remote systems, click Scan.
7. Select the Replication Mode. For more information, refer to SRDF session modes on page 446.
8. Select Automatic to automatically select a SRDF group or Manual to select a SRDF group from a list.
9. Optional: To not start pair mirroring, clear the Establish Pairs option.
10. Do the following, depending on the storage operating environment (target system):
    For HYPERMAX OS 5977 or later:
        Optional: Change the Remote Storage Group Name, and optionally select a Remote Service Level. Changing the name will also change the target volume storage group name.
    For Enginuity 5876:
        a. Optional: Change the Remote Storage Group Name.
        b. Select the Remote Thin Pool to which the target volumes will be bound. If the source storage group contains thin volumes bound to different thin pools, or if it is a cascaded storage group with child storage groups containing volumes bound to different thin pools, selecting a single thin pool will result in all target volumes being bound to that single pool.
        c. Optional: Select the Remote FAST Policy. This is the FAST policy associated with the remote storage group.
        d. z/OS Only: If the storage group contains CKD volumes, type a New SSID for the target, or click Select ... to open a dialog from which you can select an SSID.
    11. For HYPERMAX OS 5977 or later, click Create Device Group check box and select the Device Group Name that will hold the target volumes.
    12. Click NEXT.
    13. Verify your selections. To change any of them, click BACK.
        Note that some changes may require you to make additional changes to your configuration.
    14. Do one of the following:
        • Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
        • Expand Add to Job List, and click Run Now to perform the operation now.

Protecting storage groups using SRDF/Metro

This procedure explains how to protect storage groups using SRDF/Metro, in order to improve support for host applications in high availability environments.
Before you begin:

- SRDF requires HYPERMAX OS 5977 or later.
- You must have StorageAdmin permission.
- Connectivity to remote storage system must be available.
- All storage systems involved must be discoverable and manageable from the console.
- CKD devices are not supported by SRDF/Metro.

You are not allowed to set RDF devices in the non-Metro RDF mirror to operate in Synchronous mode.

For systems running PowerMaxOS 5978 or higher, the create pair operation is blocked if the device ID types of each individual SRDF device pair are not the same (both Compatibility ID or both Mobility ID) on both sides. Device type ID conversion from a Compatibility ID to a Mobility ID is not allowed on a device once it is part of an SRDF/Metro session. Candidate IDs are restricted to those running PowerMaxOS 5978 or higher if the source storage group has devices with Mobility ID in them.

Protecting a storage group using SRDF/Metro from the protection wizard is allowed when one or more of the devices in the storage group have the GCM flag set.

To protect storage groups using SRDF Metro:

**Procedure**

1. Select the storage system.
2. Under STORAGE, select Storage Groups.
3. Select the storage group and click Protect.
   
   The Select Protection Type page displays.
4. Select High Availability using SRDF/Metro.
5. Click NEXT.
6. Select the Remote Array ID. To update the list of remote arrays, click Scan.
7. Optional: To stop the initiation of pair mirroring, clear the Establish Pairs option.
8. If Establish Pairs is checked, choose Protected by Witness or Bias.
   
   If Witness is unavailable on the local or remote array, the option is disabled and Bias is selected by default. If available, Witness is selected by default.

   For storage systems running HYPERMAX OS 5977 Q3 2016 or higher, when the Witness radio button is selected, the Witness Candidate (Remote Array) field displays a list of physical and Virtual witnesses instances which are enabled. Disabled virtual witness instances are not displayed.
   
   Changing the name will also change the target volume storage group name.
10. Optional: To disable compression, clear the Compression option.
11. Click NEXT.
12. Verify your selections. To change any of them, click BACK.

   Note that some changes may require you to make additional changes to your configuration.
13. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Converting storage groups to cascaded

This procedure explains how to non-disruptively convert a standalone storage group to cascaded storage group. Once complete, the original storage group will serve as the parent to a new child storage group.

Before you begin:
   - You must have Administrator or StorageAdmin permission.
   - The storage system must be running HYPERMAX OS 5977 or later.

To convert storage groups:

Procedure

1. Select the storage system.
2. Select STORAGE > Storage Groups
3. Select the storage group, click , and click SG Maintenance > Convert to Cascaded.
4. Type a new name over the system-suggested child storage group name.
   Storage group names must be unique from other storage groups on the system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and (-) are allowed. Storage group names are case-insensitive.
5. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Changing Storage Resource Pools for storage groups

This procedure explains how to change the Storage Resource Pool of a parent storage group, with child service levels using different Storage Resource Pools.
In eNAS environments, you can also perform this operation from the File Storage Groups page (System > System Dashboard > File Dashboard > File Storage Groups).

Before you begin:
   - The storage system must be running HYPERMAX OS 5977 or later.
   - You must have Administrator or StorageAdmin permission.

To change the Storage Resource Pool for storage groups:

Procedure

1. Select the storage system.
2. Under STORAGE, select Storage Groups.
3. Select the storage group, click 
, and select **Change SRP** to open the **Change SRP** dialog box.

4. Select the new SRP.

5. (Optional) Change the Service Level for the SG. Service levels specify the characteristics of the provisioned storage, including maximum response time, workload type, and priority. This field defaults to None if you set the **Storage Resource Pool** to None. Possible values are:

<table>
<thead>
<tr>
<th>Service level</th>
<th>Performance type</th>
<th>Use case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamond</td>
<td>Ultra high</td>
<td>HPC, latency sensitive</td>
</tr>
<tr>
<td>Platinum</td>
<td>Very high</td>
<td>Mission critical, high rate OLTP</td>
</tr>
<tr>
<td>Gold</td>
<td>High</td>
<td>Very heavy I/O, database logs, datasets</td>
</tr>
<tr>
<td>Silver</td>
<td>Price/Performance</td>
<td>Database datasets, virtual applications</td>
</tr>
<tr>
<td>Bronze</td>
<td>Cost optimized</td>
<td>Backup, archive, file</td>
</tr>
<tr>
<td>Optimized (Default)</td>
<td></td>
<td>Places the most active data on the highest performing storage and the least active on the most cost-effective storage.</td>
</tr>
</tbody>
</table>

For all-flash storage systems, the only service level available is Diamond and it is selected by default.

6. (Optional) Refine the service level by selecting the **Workload Type** to assign it. (This step is not applicable for storage systems running PowerMaxOS 5978.)

7. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Adding or removing cascaded storage groups

This procedure explains how to add or remove child storage groups from parent storage groups.

**Before you begin:**

To add or remove cascaded storage groups:

**Procedure**

1. Select the storage system.
2. Select **Storage > Storage Groups** to open the **Storage Group** list view.
3. Select the parent storage group and click 
 to open its **Details** view.
4. Click the number next to **Storage Groups** to open the child **Storage Groups** list view.
5. Do the following, depending on whether you are adding or removing storage groups:

- Adding storage groups:
  a. Click Add.
  b. Select one or more storage groups.
  c. Do one of the following:
     a. Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
     b. Expand Add to Job List, and click Run Now to perform the operation now.

- Removing storage groups:
  a. Select one or more storage groups and click Remove.
  b. Click OK.

### Renaming storage groups

This procedure explains how to rename storage groups.

**Before you begin:**

- Storage group names must be unique from other storage groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and (-) are allowed. Storage group names are case-insensitive.
- Storage groups require Enginuity 5876 or HYPERMAX OS 5977 or later.

**To rename a storage group:**

**Procedure**

1. Select the storage system.
2. Under STORAGE, select Storage Groups.
3. Select the storage group, click ..., and click Rename.
4. Type the new name.
5. Click OK.

### Deleting storage groups

This procedure explains how to delete storage groups.

**Before you begin:**

- Storage groups require Enginuity 5876 or HYPERMAX OS 5977 or later.
- You cannot delete a storage group that is part of a masking view or associated with a FAST Policy.
- Before you can delete a child storage group, you must first remove it from its parent.
- When a storage group configured compliance alerts (requires HYPERMAX OS 5977 or higher) is deleted or renamed, the compliance alerts will...
need to be deleted manually. For instructions, refer to Deleting compliance alerts policies on page 65.

To delete a storage group:

Procedure

1. Select the storage system.
2. Under STORAGE, select Storage Groups.
3. Select the storage group, click , and select Delete.
4. Click OK.

Setting host I/O limits

Host I/O limits (quotas) is a feature that can be used to limit the amount of Front End (FE) Bandwidth and I/Os per second (IOPs) that can be consumed by a set of storage volumes over a set of director ports. The bandwidth and I/Os against the set of volumes over the set of director ports will be monitored by the Symmetrix system to ensure that it will not exceed the user specified maximum bandwidth or maximum IOPs placed on these. This feature allows you to place limits on the FE Bandwidth and IOPs consumed by applications on the storage system.

Host I/O limits are defined as storage group attributes – the maximum bandwidth (in MB per second) and the maximum IOPs (in I/Os per second). For a cascaded storage group, a host I/O limit can be added for the parent and/or the child storage group. If set for both, the child limits cannot exceed that of the parent.

The Host I/O limit for a storage group can be either active or inactive, only the active Host I/O limit can limit the FE bandwidth and IOPs of the volumes in a storage group. The Host I/O limit will become active when a provisioning view is created using the storage group and will become inactive when the view is deleted. When a view is created on a parent storage group with a Host I/O limit, the limit will be shared among all the volumes in all child storage groups.

The Host I/O limit of the storage group will apply to all the director ports of the port group in the provisioning view. The Host I/O limit is divided equally among all the directors in the port group independent of the number of ports on each director. For this reason it is recommended that you configure only one of the ports of a director in the port group.

Before you begin:

- The storage system must be running Enginuity 5876.159.102 or later, or HYPERMAX OS 5977 or later.
- For Enginuity 5876.159.102 up to HYPERMAX OS 5977, the maximum number of quotas per array is 2,000. For HYPERMAX OS 5977 and later, the maximum number is 16,000.
- For more information on setting host I/O limits, refer to the Solutions Enabler Array Management CLI Product Guide. This guide is part of the Solutions Enabler Complete Documentation Set.

To set host I/O limits:

Procedure

1. Select a storage system.
2. Under STORAGE, select Storage Groups.
3. Select the storage group and select **Set Host I/O Limits** to open the **Set Host I/O Limits** dialog box.

4. Select and type values for one or both of the following:
   - **MB/Sec**—Maximum bandwidth (in MB per second). Valid values range from 1 MB/sec to 100,000 MB/sec.
   - **IO/Sec**—Maximum IOPs (in I/Os per second). Valid values range from 100 IO/Sec to 2,000,000 IO/sec, in 100 increments.

5. To configure a dynamic distribution of host I/O limits, set **Dynamic Distribution** to one of the following; otherwise, leave this field set to **Never** (default). This feature requires Enginuity 5876.163.105 or later.
   - **Always**—Enables full dynamic distribution mode. When enabled, the configured host I/O limits will be dynamically distributed across the configured ports, thereby allowing the limits on each individual port to adjust to fluctuating demand.
   - **OnFailure**—Enables port failure capability. When enabled, the fraction of configured host I/O limits available to a configured port will adjust based on the number of ports currently online.

6. Click **OK**

### Splitting storage groups

This procedure explains how to split cascaded storage groups on storage systems. Unisphere supports the splitting of storage groups in two different ways:

- During the split operation, a specified child storage group is removed from the parent storage group. A new masking view is created on this child storage group with the same initiator groups and port groups of the parent storage group masking view.
- During the split operation, a new storage group with the user specified name will be created. The user specified devices from the source standalone storage group are moved to the newly created storage group and a new masking view is created on the new storage group using the same initiator groups and port groups of the source standalone storage group masking view.

To split a storage group:

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Storage Groups**
3. Select the storage group, click , and click **SG Maintenance > Split From**.
4. Do one of the following:
   - When splitting a child storage group from its parent masking view and moving it to a standalone masking view, select a child storage group and specify a new masking view name.
   - When splitting a standalone storage group into two storage groups each with a masking view, specify a new storage group name, specify a new masking view name, and select the volumes to be added to the new storage group.
5. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Merging storage groups

This procedure explains how to merge storage groups in order to create a cascaded storage group.

Unisphere support merging the masking views of a source standalone storage group and a target storage group which has a common initiator group and orf group. The target storage group may be a parent storage group or a standalone storage group. In the case of the target being a parent storage group, during the merge operation, the source standalone SG is added to the target parent storage group and uses the parent storage group masking view. In the case of the target storage group being a standalone storage group, all devices in the source standalone storage group are moved to the target storage group. The source standalone storage group and its masking view are deleted.

To split a storage group:

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Storage Groups**
3. Select the storage group, click , and click **SG Maintenance > Merge Into**.
4. Select the target storage group.
5. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Managing VP compression on thin volumes in storage groups

The following explains how to manage VP compression on the thin volumes in a storage group.

**Before you begin:**

This feature requires Enginuity 5876.159.102 or higher. This feature is not supported on storage systems running HYPERMAX OS 5977 or later.

To manage VP compression on storage groups:

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Volumes** and click the **Virtual** panel.
3. Select a volume, click , and click **VP Compression**.
4. Select one of the following compression operations:
   - **CompressStart**—Starts compressing the thin volumes in the storage group.
   - **CompressStop**—Stops compressing the thin volumes in the storage group.
   - **UncompressStart**—Starts uncompressing the thin volumes in the storage group.
   - **UncompressStop**—Stops uncompressing the thin volumes in the storage group.

5. Click **OK**.

**Viewing storage groups**

This procedure explains how to view storage groups on a storage system running HYPERMAX OS 5977 or higher. There are multiple ways to view the same information. Depending on the method you use, some of the properties and controls may not apply.

For information on viewing cascaded storage groups, see Viewing cascaded storage groups on page 143.

**Procedure**

1. Select the storage system.

2. Select **STORAGE > Storage Groups** to open the **Storage Groups** list view.

   The following properties display:
   - **Name** — Name of the storage group.
   - **Compliance** — How well the storage group is complying with its service level, if applicable. Possible values are:
     - ![Critical](image) **Critical**—Storage group is performing well below service level targets.
     - ![Marginal](image) **Marginal**—Storage group is performing below service level target.
     - ![Stable](image) **Stable**—Storage group is performing within the service level target.
     - ![No Service Level](image) **Storage group has no assigned service level.**
     - ![Compliance Information](image) **Compliance information is being collected.**
   - **SRP** — Name of SRP that the storage group belongs to, if any.
   - **Service Level**—Name of the service level associated with the storage group. If there is no service level associated with the group, then file displays N/A.
   - **Capacity (GB)**—Total capacity of the storage group in GB.
   - **Emulation**—Emulation associated with the storage group.

   The following controls are available:
   - ![Viewing Storage Group Details](image) — **Viewing storage group details** on page 142.
Create — Using the Provision Storage wizard on page 102.
Modify — Modifying storage groups on page 121.
Provision — Using the Provision Storage wizard on page 102.
Protect — Protecting storage groups on page 124.
Set Host I/O Limits — Setting host I/O limits on page 134.
Set Volumes > Set Volume Status — Setting volume status on page 196.
Set Volumes > Replication QoS — Setting copy pace (QoS) for storage groups on page 200.
Migrate — Creating a non-disruptive migration (NDM) session on page 507
Allocate/Free/Reclaim > Start — Managing thin pool allocations on page 247
Allocate/Free/Reclaim > Stop — Managing thin pool allocations on page 247
SG Maintenance > Convert to Cascaded — Converting storage groups to cascaded on page 131.
SG Maintenance > Split From — Splitting storage groups on page 135.
SG Maintenance > Merge Into — Merging storage groups on page 136.
SG Maintenance > Remove — Adding or removing cascaded storage groups on page 132.
Delete — Deleting storage groups on page 133.
Expand ProtectPoint — Managing thin pool allocations on page 247.

Viewing storage groups

This procedure explains how to view storage groups on a storage system running Enginuity 5876. There are multiple ways to view the same information. Depending on the method you use, some of the properties and controls may not apply.

To view storage groups associated with a FAST policy, see Viewing storage group for FAST policies on page 173.

For information on viewing cascaded storage groups, see Viewing cascaded storage groups on page 143.

Procedure

1. Select the storage system.
2. Select STORAGE > Storage Groups to open the Storage Groups list view.
   The Storage Groups list view allows you to view and manage storage groups on a storage system.
   The following properties display:
   • Name — Name of the storage group.
   • FAST Policy — Policy associated with the storage group.
   • Capacity (GB) — Total capacity of the storage group in GB.
   • Emulation — Emulation type.
   • Masking Views — Number of masking views associated with the storage group.
The following controls are available:

- Viewing storage group details on page 142.
- Create—Using the Provision Storage wizard on page 110.
- Expand—Expanding storage groups on page 118.
- Provision Storage to Host—Using the Provision Storage wizard on page 110.
- Protect—Protecting storage groups on page 124.
- Set Host I/O Limits—Setting host I/O limits on page 134.
- FAST > Associate—Associating FAST policies with storage groups on page 170.
- FAST > Disassociate—Disassociating FAST policies and storage groups on page 172.
- FAST > Reassociate—Reassociating FAST policies and storage groups on page 172.
- FAST > Pin—Pinning and unpinning volumes on page 175.
- FAST > Unpin—Pinning and unpinning volumes on page 175.
- FAST > Bind—Binding/Unbinding/Rebinding thin volumes on page 260.
- FAST > Unbind—Binding/Unbinding/Rebinding thin volumes on page 260.
- FAST > Rebind—Binding/Unbinding/Rebinding thin volumes on page 260.
- Migrate—Creating a non-disruptive migration (NDM) session on page 507
- Allocate/Free/Reclaim > Start—Managing thin pool allocations on page 247
- Allocate/Free/Reclaim > Stop—Managing thin pool allocations on page 247
- SG Maintenance > Split From—Splitting storage groups on page 135.
- SG Maintenance > Merge Into—Merging storage groups on page 136.
- RecoverPoint > Tag—Tagging and untagging volumes for RecoverPoint (storage group level) on page 476.
- RecoverPoint > Untag—Tagging and untagging volumes for RecoverPoint (storage group level) on page 476.
- Delete—Deleting storage groups on page 133.
- Rename—Renaming storage groups on page 123.
- VP Compression—Managing VP compression on thin volumes in storage groups on page 136.
- Replication QOS—QOS for replication on page 200.
- Assign Symmetrix Priority—Assigning array priority to individual volumes on page 191
- VLUN Migration—Migrating regular storage group volumes on page 263.
- Set Optimized Read Miss—Setting optimized read miss on page 195.
Storage Group details

- Viewing storage group details on storage systems running HYPERMAX OS 5977 or later (see Viewing storage group details on page 140).
- Viewing storage group details on storage systems running Enginuity OS 5876 (see Viewing storage group details on page 142).

Viewing storage group details

This procedure explains how to view configuration details for storage groups on storage systems running HYPERMAX OS 5977 or later. To view storage groups on a storage system running Enginuity OS 5876, refer to Viewing storage group details on page 142. In eNAS operating environments, there are multiple ways to view the same information. Depending on the method you use, some of the properties and controls may not apply.

Procedure

1. Select the storage system.
2. Select STORAGE > Storage Groups to open the Storage Groups list view.
3. Select the storage group and click .

The following properties display:

- SRP—Name of SRP that the storage group belongs to, if any.
- Compliance—How well the storage group is complying with its service level, if applicable.
- Service Level—Service level associated with the storage group. If there is no service level associated with the group, then this field displays N/A.
- Volumes—Number of volumes in the storage group.
- Child Storage Groups—Number of child storage groups.
- Masking Views—Number of masking views associated with the storage group.
- SnapVX Snapshots—Number of SnapVX snapshots associated with the storage group.
- SRDF—SRDF.
- Symmetrix ID—Name of the storage group.
- Capacity (GB)—Total capacity of the storage group in GB.
- VP Saved—The percentage of space saved on the storage group.
- Compression—If compression is enabled on this storage group a tick will appear. If it’s disabled a horizontal dash will appear.
- Compression Ratio—Current compression ratio for the storage group.
- Last Updated—Timestamp of the most recent changes to the storage group.
- Host I/O Limit —Whether the host I/O limit feature is enabled. For more information, see Setting host I/O limits on page 134.
- Host I/O Limit (MB/Sec) — Maximum bandwidth (in MB per second). Valid values range from 1 MB/sec to 100,000 MB/sec.
• **Host I/O Limit (IO/Sec)**—Maximum IOPs (in I/Os per second). Valid values range from 100 IO/Sec to 100,000 IO/sec.

• **Emulation**—Emulation type.

• **Workload Type**—Workload type.

• **Dynamic Distribution**—When enabled, the configured host I/O limits will be dynamically distributed across the configured ports, thereby allowing the limits on each individual port to adjust to fluctuating demand.

• **Is Child**—Indicates whether the storage group is or is not a child storage group.

• **Parent Storage Group(s)**—Number of storage groups of which this storage group is a child. This field only displays for child storage groups.

• **RecoverPoint**—Indicates RecoverPoint usage.

Links are also provided to views for objects contained in and associated with the storage group. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking the number next to **Volumes** will open a view listing the volumes contained in the storage group.

4. Click **VIEW ALL DETAILS**.

A view with two tabs, **Details** and **Volumes** is displayed. Clicking the **Volumes** tab displays a view of the volumes in the storage group (see Viewing volumes in storage groups on page 144). Clicking the **Details** displays a view with two panels, a **Properties** panel and a **Capacity** panel.

The **Properties** panel displays the following:

• **Symmetrix ID**—Name of the storage group.

• **Compliance**—How well the storage group is complying with its service level, if applicable.

• **Service Level**—Service level associated with the storage group. If there is no service level associated with the group, then this field displays N/A.

• **Workload Type**—Type of the workload associated with the storage group.

• **SRP**—Storage resource pool (SRP) containing the storage group.

• **Masking Views**—Number of masking views associated with the storage group.

• **Emulation**—Emulation type.

• **Last Updated**—Timestamp of the most recent changes to the storage group.

• **Host I/O Limit**—Whether the host I/O limit feature is enabled. For more information, see Setting host I/O limits on page 134.

• **SnapVX Snapshots**—Number of of SnapVX snapshots associated with the storage group.

• **SRDF**—SRDF.

• **Is Child**—Indicates that the storage group is or is not a child storage group.

• **Child Storage Groups**—Number of child storage groups.

• **RecoverPoint**—Indicates RecoverPoint usage.

The **Capacity** panel displays the following:

• **Capacity (GB)**—Total capacity of the storage group in GB.
Volumes—Number of volumes in the storage group.
Allocated Capacity—Number of volumes in the storage group.
VP Saved—The percentage of space saved on the storage group.
Compression—If compression is enabled on this storage group a tick will appear. If it’s disabled a horizontal dash will appear.
Compression Ratio—Current compression ratio for the storage group.
The following controls are available:

- Storage Group operations on page 118.
- Set Host I/O Limits—Setting host I/O limits on page 134.

Results

Viewing storage group details

This procedure explains how to view storage groups on a storage system running Enginuity OS 5876. There are multiple ways to view the same information. Depending on the method you use, some of the properties and controls may not apply.

Procedure

1. Select the storage system.
2. Select STORAGE > Storage Groups to open the Storage Groups list view.
3. Select the storage group and click .

The following properties display:

- Symmetrix ID—Identity of the storage system.
- FAST Policy—Policy associated with the storage group.
- Capacity (GB)—Capacity of the storage group in GB.
- Volumes—Number of volumes in the storage group.
- Child Storage Groups—Number of child storage groups.
- Masking Views—Number of masking views associated with the storage group.
- SRDF—Number of SRDFs associated with the storage group.
- Emulation—Emulation type.
- VP Saved—The percentage of space saved on the storage group.
- Last Updated—Timestamp of the most recent changes to the storage group.
- Host I/O Limit—Whether the host I/O limit feature is enabled. For more information, see Setting host I/O limits on page 134.
- Host I/O Limit (MB/Sec)—Maximum bandwidth (in MB per second). Valid values range from 1 MB/sec to 100,000 MB/sec.
- Host I/O Limit (IO/Sec)—Maximum IOPs (in I/Os per second). Valid values range from 100 IO/Sec to 100,000 IO/sec.
- Dynamic Distribution—When enabled, the configured host I/O limits will be dynamically distributed across the configured ports, thereby allowing the limits on each individual port to adjust to fluctuating demand.
• **Is Child**—Indicates whether the storage group is or is not a child storage group.

• **Parent Storage Group(s)**—Number of storage groups of which this storage group is a child. This field only displays for child storage groups.

Links are also provided to views for objects contained in and associated with the storage group. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking the number next to **Volumes** will open a view listing the volumes contained in the storage group.

4. Click **VIEW ALL DETAILS**.

A view with two tabs, **Details** and **Volumes** is displayed. Clicking the **Volumes** tab displays a view of the volumes in the storage group (see Viewing volumes in storage groups on page 144). Clicking the **Details** displays a view with two panels, a **Properties** panel and a **Capacity** panel.

The **Properties** panel displays the following:

• **Symmetrix ID**—Name of the storage group.

• **Masking Views**—Number of masking views associated with the storage group.

• **Emulation**—Emulation type.

• **Last Updated**—Timestamp of the most recent changes to the storage group.

• **Host I/O Limit**—Whether the host I/O limit feature is enabled. For more information, see Setting host I/O limits on page 134.

• **SRDF**—SRDF.

• **Is Child**—Indicates that the storage group is or is not a child storage group.

• **Child Storage Groups**—Number of child storage groups.

• **RecoverPoint**—Indicates RecoverPoint usage.

The **Capacity** panel displays the following:

• **Capacity (GB)**—Total capacity of the storage group in GB.

• **Volumes**—Number of volumes in the storage group.

• **Allocated Capacity**—Number of volumes in the storage group.

• **VP Saved**—The percentage of space saved on the storage group.

The following controls are available:

• ![storage group operations](storage group operations on page 118).

• **Set Host I/O Limits**—Setting host I/O limits on page 134.

**Results**

**Viewing cascaded storage groups**

**Procedure**

1. Select the storage system.

2. Select **STORAGE > Storage Groups** to open the **Storage Groups** list view.
3. Select the storage group and click 🔄 to open its Details view.

4. Click the number next to Storage Groups to open the Child Storage Groups list view.

5. Optional: Use the Child Storage Groups list view to view and manage cascaded storage groups.

6. The following properties (depending on the storage operating environment) display:
   - Name—Name of the storage group.
   - Compliance—Indicates Compliance status.
   - SRP—SRP associated with the storage group.
   - Service Level—Service level associated with the storage group.
   - Capacity (GB)—Total capacity of the storage group in GB.
   - Emulation—Emulation type.
   - Masking Views—Number of masking views associated with the storage group.

7. The following controls are available:
   - 🔄—Viewing storage group details on page 142
   - Add—Adding or removing cascaded storage groups on page 132
   - Remove—Adding or removing cascaded storage groups on page 132

Viewing volumes in storage groups

Procedure

1. Select the storage system.

2. Select STORAGE > Storage Groups to open the Storage Group list view.

3. Select the storage group and click 🔄 to open its Details view.

4. Click the number next to Volumes to open the Volumes list view.

   Use the Volumes list view to view and manage the volumes in a storage group.

5. The following properties display:
   - Volume—Assigned volume name.
   - Type—Type of volume.
   - Allocated %—Percentage allocated.
   - Capacity (GB)—Volume capacity in Gigabytes.
   - Emulation—Emulation type for the volume.
   - Status—Volume status.
   - Pinned—Whether the volume is pinned. Pinning volumes prevents any automated process such as FAST or Optimizer from moving them.

   The following controls are available, depending on the storage operating environment:
• **Create** — *Creating volumes* on page 180.
• **Add Volumes to SG** — *Adding volumes to storage groups* on page 116.
• **Remove Volumes** — *Removing volumes from storage groups* on page 118.
• **Expand** — *Expanding existing volumes* on page 193
• **Copy Volumes to SG** — *Copying volumes between storage groups* on page 117.
• **Move Volumes to SG** — *Moving volumes between storage groups* on page 117.
• **Set Volumes > Emulation** — *Setting volume emulation* on page 98.
• **Set Volumes > Set Volume Attributes** — *Setting volume attributes* on page 197.
• **Set Volumes > Set Volume Identifiers** — *Setting volume identifiers* on page 198.
• **Set Volumes > Set Volume Status** — *Setting volume status* on page 196.
• **Set Volumes > Replication QoS** — *QoS for replication* on page 200.
• **Allocate/Free/Reclaim > Start** — *Managing thin pool allocations* on page 247.
• **Allocate/Free/Reclaim > Stop** — *Managing thin pool allocations* on page 247.
• **Configuration > Change Volume Configuration** — *Changing volume configuration* on page 192.
• **Configuration > Map** — *Mapping volumes* on page 194.
• **Configuration > Unmap** — *Unmapping volumes* on page 195.
• **Configuration > z/OS Map** — *z/OS map from the Volumes (Storage Groups) list view* on page 339 and *z/OS map FBA volumes from the Volumes (Storage Groups) list view (HYPERMAX OS 5977 or higher)* on page 342.
• **Configuration > z/OS Unmap** — *z/OS unmap from the Volumes (Storage Groups) list view* on page 339 and *z/OS unmap FBA volumes from the Volumes (Storage Groups) list view* on page 343.
• **Assign Dynamic Cache Partition** — *Assigning dynamic cache partitions* on page 837 (Only available on storage systems running 5876).
• **Assign Symmetrix Priority** — *Assigning array priority to individual volumes* on page 191 (Only available on storage systems running 5876).
• **Pin** — *Pinning and unpinning volumes* on page 175 (Only available on storage systems running 5876).
• **Unpin** — *Pinning and unpinning volumes* on page 175 (Only available on storage systems running 5876).

Click  to view the Volume in Storage Group details view.

The following properties display:

• **Masking Info** — Number of masking views associated with the storage group.

• **Storage Groups** — Number of associated storage groups.
- **SRP** — Number of associated SRPs.
- **FBA Front End Paths** — Number of associated FBA Front End Paths.
- **RDF Info** — RDF Info.
- **Volume Name** — Volume name.
- **Physical Name** — Physical name.
- **Volume Identifier** — Volume identifier.
- **Type** — Volume configuration.
- **Encapsulated Volume** — Whether external volume is encapsulated. Relevant for external disks only.
- **Encapsulated WWN** — World Wide Name for encapsulated volume. Relevant for external disks only.
- **Encapsulated Device Flag** — Encapsulated device flag.
- **Encapsulated Device Array** — Encapsulated device array.
- **Encapsulated Device Name** — Encapsulated device name.
- **Status** — Volume status.
- **Reserved** — Whether the volume is reserved.
- **Capacity (GB)** — Volume capacity in GBs.
- **Capacity (MB)** — Volume capacity in MBs.
- **Capacity (CYL)** — Volume capacity in cylinders.
- **Compression Ratio** — Volume emulation.
- **Emulation** — Volume emulation.
- **AS400 Gatekeeper** — AS400 Gatekeeper indication.
- **Symmetrix ID** — Symmetrix system on which the volume resides.
- **Symmetrix Vol ID** — Symmetrix volume name/number.
- **HP Identifier Name** — User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.
- **VMS Identifier Name** — Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
- **Nice Name** — Nice name generated by Symmetrix Enginuity.
- **WWN** — World Wide Name of the volume.
- **External Identity WWN** — External Identity World Wide Name of the volume.
- **DG Name** — Name of the device group in which the volume resides, if applicable.
- **CG Name** — Name of the device group in which the volume resides, if applicable.
- **Attached BCV** — Defines the attached BCV to be paired with the standard volume.
- **Attached VDEV TGT Volume** — Volume to which this source volume would be paired.
- **RDF Type** — RDF configuration.
- Geometry - Type — Method used to define the volume's geometry.
- Geometry - Number of Cylinders — Number of cylinders.
- Geometry - Sectors per Track — Number of sectors per track, as defined by the volume's geometry.
- Geometry - Tracks per Cylinder — Number of tracks per cylinder, as defined by the volume's geometry.
- Geometry - 512 Block Bytes — Number of 512 blocks, as defined by the volume's geometry.
- Geometry - Capacity (GB) — Geometry capacity in GBs.
- Geometry - Limited — Indicates whether the volume is geometry limited.
- SSID — Subsystem ID.
- Capacity (Tracks) — Capacity in tracks.
- SA Status — Volume SA status.
- Host Access Mode — Host access mode.
- Pinned — Whether the volume is pinned.
- RecoverPoint Tagged — Indicates whether volume is tagged for RecoverPoint.
- Service State — Service state.
- Defined Label Type — Type of user-defined label.
- Dynamic RDF Capability — RDF capability of the volume.
- Mirror Set Type — Mirror set for the volume and the volume characteristic of the mirror.
- Mirror Set DA Status — Volume status information for each member in the mirror set.
- Mirror Set Invalid Tracks — Number of invalid tracks for each mirror in the mirror set.
- Priority QoS — Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).
- Copy Pace - RDF — Copy pace priority during RDF operations.
- Copy Pace - Mirror Copy — Copy pace priority during mirror operations.
- Copy Pace - Clone — Copy pace priority during clone operations.
- Copy Pace - VLUN — Copy pace priority during virtual LUN operations.
- Dynamic Cache Partition Name — Name of the cache partition.
- Compressed Size (GB) — Compressed size (GB).
- Compressed Percentage — Compressed percentage.
- Compressed Size Per Pool (GB) — Compressed Size Per Pool (GB).
- XtremSW Cache Attached — Indicates whether XtremSW cache is attached to the volume.
- Base Address — Base address.
- AS400 Gatekeeper — AS400 Gatekeeper indication.
- Mobility ID Enabled — Mobility ID enabled indication.
- GCM — GCM Flag set indication.
Optimized Read Miss — Cacheless read miss status.
Persistent Allocation — Persistent Allocation indication.
PowerPath Hosts — Number of PowerPath hosts.
Mounted — Mounted indication.
Process — Process.
Last time used — Last time used.

Viewing Storage Group Compliance view

Before you begin

The user requires a minimum of Monitor permissions to perform this task.

Definitions:

- Workload Skew - Skew is represented by capacity and load pairs. There are two sources of skew for a storage group. One is using device stats. The other is using SG_PER_POOL chunks. There is an algorithm in WLP to merge these two lists to give us a usable skew profile. A skew profile is only useful if you have multiple chunks. If an SG has a single device, there is not enough data to calculate skew, the corresponding storage group per pool metrics can be used. Similarly, if an array has only one pool, the device stats are more meaningful for skew.

- Workload Mixture - The mixture is the distribution of various I/O types as percentages of the total IOPS. These are useful for determining, for example, whether a workload is heavy read or heavy write, whether I/Os are mostly random or mostly sequential.

To view the Storage Group (SG) Compliance view:

Procedure

1. Select the storage system.
2. Select STORAGE > Storage Groups to open the Storage Groups View.
3. Select a storage group and click to view its details.
4. Select VIEW ALL DETAILS.
5. Select the Compliance tab.

Charts are displayed for the following:

- Response Time chart - this chart displays wait time weighted response time and (if applicable) the target service level response time band. The following section explains the data in the chart.
  - Actual: running I/O to Storage Group - Wait time weighted response time is calculated in buckets and displayed. If a bucket has no data, 0 is displayed.
  - Actual: no I/O to Storage Group - 0s are displayed.
  - Planned: SLO Response Time Max and SLO Response Time Min are displayed as a data band across the timeline. This is labeled "Planned". If the service level is Optimized, no plan is displayed, because there is no Response Time band for Optimized.
  - Excluded Data: If a recurring exclusion has been set via the Exclusion Windows dialog, the windows are represented by vertical gray plot bands.
  - Last Processed: A 2px dotted plot line marks the most recent SPA HOURLY timestamp processed by SPA for a given metric. It is not
represented in the legend, but if you hover, you can see the timestamp associated. In normal successful/processing, this acts as a "Where am I" indicator. If WLP stops processing for some reason, it's a subtle debugging helper.

**IOPS chart** - This chart toggles between IO/sec and MB/sec, displaying IO rate weighted metric values, "planned" values, and (if set) Host IO Limits. The following section explains the data in the chart.

- Actual: running I/O to Storage Group - IO Rate weighted total IOPS (or total MBPS) are calculated in buckets and displayed. If a bucket has no data, 0 is displayed.
- Actual: no I/O to Storage Group - 0s are displayed.
- Planned: Host I/O Limits for Standalone SG - Host IO Limit is displayed as a static value across the timeline. Host IO Limit is only shown on the chart it impacts. For example, if MBPS host IO limit is set, and the user has IOPS selected, they won't see anything unless they toggle to MBPS.
- Planned: Host I/O Limits for Child SG, no limit for the parent SG - Host IO Limit is displayed as a static value across the timeline. Host IO Limit is only shown on the chart it impacts. For example, if MBPS host IO limit is set, and the user has IOPS selected, they won't see anything unless they toggle to MBPS.
- Planned: No Host I/O Limits for Child SG and parent SG - If a cascaded SG has a host IO limit set at the parent, but no direct limit of its own, the host IO limit of any given child would be the parent limit minus whatever the siblings are using.
- Planned: Host I/O Limits for Child SG and parent SG - If a cascaded SG has a host IO limit set at the parent, and a direct limit of its own, the host IO limit of any given child would be the more limiting of the parent limit minus whatever the siblings are using, or the child SGs own limit.
- Excluded Data: If a recurring exclusion has been set via the Exclusion Windows dialog, the windows are represented by vertical gray plot bands.
- Last Processed: A 2px dotted plot line marks the most recent SPA HOURLY timestamp processed by SPA for a given metric. It is not represented in the legend, but if you hover, you can see the timestamp associated. In normal successful/processing, this acts as a "Where am I" indicator. If WLP stops processing for some reason, it's a subtle debugging helper.

**Workload Skew chart** - This chart compares actual workload skew - represented by cumulative capacity and load percentages (ordered by access density) - to planned skew. If there is no IO data, Actual is displayed as 50% skew - a straight line from (0,0) to (100,100). If there is one Device in SG AND Only One Thin Pool, then the merged device ans sg per pool skew profile doesn't give us enough data points. Actual is displayed as 50% skew - a straight line from (0,0) to (100,100). If IO is running to the SG, the skew is a logarithmic curve (or stepped line graph in some cases).

**I/O Mixture chart** - This chart compares actual workload mixture to planned workload mixture. The inner pie represents the actual IO distribution. The outer donut represents the planned mixture. If there is no I/O to the storage group, the mixture distribution will be equal percentages for each IO type (20% read hit, 20% sequential write, etc.) and the tooltip will show the corresponding IO sizes as 0kB.
Select the **Show Plan** slider to turn on or turn off the display of the plan. The plan is reference point used for comparison, and is a two week expiring performance reservation for subsequent provisioning suitability calculations.

The following controls are available:

- **Exclude Data** - Managing Data Exclusion Windows on page 160
- **Save As a Template** - Creating storage templates on page 270
- **Reset Workload Plan** - Resetting Workload Plan on page 179
- **Set Host I/O Limits** - Setting host I/O limits on page 134

**Viewing storage group performance details**

**Before you begin**

- The storage system is running HYPERMAX OS 5977 or higher.
- To perform this operation, a Monitor role is required.
- The storage system must be local and registered for performance.

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Storage Groups** to open the **Storage Groups View**.
3. Select a storage group and click \( \text{ } \) to view its details.
4. Select **VIEW ALL DETAILS**.
5. Optional: Choose a day or time to retrieve performance related data.
6. Select the **Performance** tab.

Charts are displayed for the following:

- Read and Write response times
- Host MBs Read and Written per second
- Host reads and writes per second
- Read and Write response times
- FE Directors - Name, % Busy and queue depth utilization.
- FE Port - Name, % busy, and host I/Os per second.
- Related SGs - Name, response time, host I/Os per second, and host MBs per second.

**Select Storage Resource Pool**

Use this dialog box to select a Storage Resource Pool for the operation.

**Note**

To create the storage group outside of FAST control, set Storage Resource Pool to None; otherwise, leave this field set to the default.
Select SSID

Use this dialog box to select an SSID for the operation.

Task in Progress

Use this dialog box to monitor the progress of a configuration change operation.

Procedure

1. To view detailed information, click Show Task Details.
   Once a task completes, a success or failure message displays.

Select SRDF group

Use this dialog box to select a SRDF group.

Editing storage group volume details

To edit storage group details for a storage system running Hypermax OS 5977 or higher:

Procedure

1. Click the Volume Config tab.
2. To name the volumes you are adding to the storage group, select one of the following Volume Identifiers and type a Name.

   Note

   This option is only available when modifying storage groups with new volumes. Note that when modifying storage groups with some new and some existing volumes, the identifiers will only be applied to the new volumes.

   - **None**—Allows the system to name the volumes (Default).
   - **Name Only**—All volumes will have the same name.
   - **Name + Volume ID**—All volumes will have the same name with a unique Symmetrix volume ID appended to them. When using this option, the maximum number of characters allowed is 50.
   - **Name + Append Number**—All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the Append Number and increment by 1 for each additional volume. Valid Append Numbers must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.

3. Optional: Click Enable Compression checkbox.
4. Optional: Click the Enable Mobility ID checkbox to assign Mobility IDs to the volumes in the storage group. If you leave the checkbox unchecked, Compatibility IDs will be assigned to the volumes instead.
5. Optional: Click Allocate capacity for each volume checkbox.
6. Optional: Click Persist preallocated capacity through reclaim or copy checkbox.
7. Click the Volume Size tab.
8. Enter a volume size, capacity and capacity unit.
9. Optional: Add one or more volume sizes by hovering over the area to the right of the volume capacity and selecting +.
10. Optional: Click to remove a volume size.
11. Click APPLY.

The Storage Group page in the wizard displays Mixed Capacities for the row. Click Mixed Capacities to reopen this dialog.

Editing storage group details

To edit storage group details for a storage system running Enginuity 5876:

Procedure

1. To name the volumes you are adding to the storage group, select one of the following Volume Identifiers and type a Name

   - None—Allows the system to name the volumes (Default).
   - Name Only—All volumes will have the same name.
   - Name + VolumeID—All volumes will have the same name with a unique Symmetrix volume ID appended to them. When using this option, the maximum number of characters allowed is 50.
   - Name + Append Number —All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the Append Number and increment by 1 for each additional volume. Valid Append Numbers must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.
   - To only use BCVs in the storage group, select Use BCV volumes.
   - To only use volumes from a specific disk group, select the Disk Group. (applicable for regular volumes only)

2. Click OK.

Modify Custom Capacity dialog box

Use this dialog box to modify the capacity of a storage group with mixed capacities.

To modify the capacity of the storage group, type new values for the volumes and click OK to return to the Modifying Storage Groups dialog box.
Understanding FAST

Note

This section describes FAST operations for storage systems running HYPERMAX OS 5977 or higher.

Fully Automated Storage Tiering (FAST) automates management of storage system disk resources on behalf of thin volumes. FAST automatically configures disk groups to form a Storage Resource Pool by creating thin pools according to each individual disk technology, capacity and RAID type.

FAST technology moves the most active parts of your workloads (hot data) to high-performance flash disks and the least-frequently accessed storage (cold data) to lower-cost drives, leveraging the best performance and cost characteristics of each different drive type. FAST delivers higher performance using fewer drives to help reduce acquisition, power, cooling, and footprint costs. FAST is able to factor in the RAID protections to ensure write heavy workloads go to RAID 1 and read heavy workloads go to RAID 6. This process is entirely automated and requires no user intervention.

FAST further provides the ability to deliver variable performance levels through service levels. Thin volumes can be added to storage groups and the storage group can be associated with a specific service level to set performance expectations.

FAST monitors the storage groups performance relative to the service level and automatically provisions the appropriate disk resources to maintain a consistent performance level.

Understanding service levels

A service level is the response time target for the storage group. The service level allows you set the storage array with the desired response time target for the storage group. It automatically monitors and adapts to the workload in order to maintain (or meet) the response time target. The service level includes an optional workload type so you can further tune expectations for the workload storage group to provide just enough flash to meet your performance objective.

Renaming Service Levels

Before you begin

- To perform this operation, you must be a StorageAdmin.
- This feature requires HYPERMAX OS 5977 or higher.
- The service level must be unique from other service levels on the storage system and cannot exceed 32 characters. Only alphanumeric characters, underscores (_), and hyphens (-) are allowed. However, service level names cannot start or end with an underscore or hyphen.

Once a service level is renamed, all active management and reporting activities will be performed on the newly named service level. The original, pre-configured service level name will be maintained in the Service Level View for future reference. All other references to the original service level will display the new name.

Procedure

1. Select the storage system.
2. Select Storage > Service Levels to open the Service Level view.

3. Hover over the service level name and click .

4. Type the new name over the existing name. Type the new name over the existing name and click ✓ to complete the renaming process. To cancel the renaming, click ×.

Reverting to original service level names

Before you begin

- To perform this operation, you must be a StorageAdmin.
- This feature requires HYPERMAX OS 5977 or higher.
- The service level must be unique from other service levels on the storage system and cannot exceed 32 characters. Only alphanumeric characters, underscores (_), and hyphens (-) are allowed. However, service level names cannot start or end with an underscore or hyphen.

Procedure

1. Select the storage system.
2. Select Storage > Service Levels to open the Service Level view.
3. Hover over the service level name and click .
4. Type the original, pre-configured name. Type the new name over the existing name and click ✓ to complete the renaming process. To cancel the renaming, click ×.

Viewing service levels

Before you begin

This feature requires HYPERMAX OS 5977 or higher.

A service level is the response time target for the storage group. The service level allows you set the storage array with the desired response time target for the storage group. It automatically monitors and adapts to the workload in order to maintain (or meet) the response time target. The service level includes an optional workload type so you can further tune expectations for the workload storage group to provide just enough flash to meet your performance objective.

Procedure

1. Select the storage system.
2. Select STORAGE > Service Levels to open the Service Level view.

   For all-flash storage systems running HYPERMAX OS 5977, the only service level available is Diamond.

   Available service levels are displayed in card format. Each service level card shows the service level name (display name if it has been renamed), the expected average response time (in ms) and available headroom.
Clicking and selecting a card displays a table. The table gives more details for different workload types available for each service level. None workload type will be selected by default.

The details table is only visible for FBA service levels.

The columns in the table include workload type, target response time, headroom, I/O density, I/O size, write %, skew and usage count for each workload type. All columns are sortable and all columns (except workload type) can be hidden.

Hover near the write % to view a pop-out showing more details on the mixture and similarly hover near the skew % to view a pop-out showing more details about the skew.

3. Optional: To rename a service level, hover over the service level card and click ⬇️. Type the new name over the existing name and click ✓ to complete the renaming process. To cancel the renaming, click ✗.

4. Optional: To provision storage using a service level, select the service level card and a corresponding workload type and click Provision.

This opens the Provision Storage to Host wizard, with the service level and the workload type will be populated by default. For CKD Provisioning wizard, only the service level will be selected by default. For more information on using the wizard, refer to Using the Provision Storage wizard on page 102.

Changing service level

This functionality only applies to storage systems running HYPERMAX OS 5977 or higher and does not apply to all-flash storage systems.

For all-flash storage systems running HYPERMAX OS 5977 and higher, the only service level available is Diamond.

To change the service level:

Procedure

1. Select the storage system.
2. Select STORAGE > Storage Groups to open the Storage Groups View.
3. Select a storage group where performance data is available and click ⬤ to view its details.
4. Double click on the Compliance icon in the Details panel (alternatively, select VIEW ALL DETAILS in the Details panel and select the Compliance tab).
5. Click VIEW DETAILS (located at the top right of the Response Time panel).
6. Click Change Service Level.
7. Change the service level.
8. Click OK.

Understanding Storage Resource Pool details

Storage Resource Pool is a collection of data pools that provide FAST a domain for capacity and performance management. By default, a single default Storage Resource Pool is factory pre-configured. Additional Storage Resource Pools can be created with
a service engagement. FAST performs all its data movements within the boundaries of the Storage Resource Pool.

Modifying Storage Resource Pool details

Before you begin

- This feature requires HYPERMAX OS 5977 or higher.
- You must have Administrator or StorageAdmin permission.

Procedure

1. Select the storage system.
2. Select **Storage > Storage Resource Pools** to open the **Storage Resource Pools** view.
3. Click **Modify**.
4. Modify any number of the following:
   - **Storage Resource Pool Name**—Name of the storage resource pool. To change this value, type a new description and click **Apply**. The name of the storage resource pool must be unique and it cannot exceed 32 characters. It can include only alphanumeric, underscore, and hyphen characters, but cannot begin with an underscore or hyphen character.
   - **Description**—Optional description of the pool. To change this value, type a new description and click **Apply**. The description cannot exceed 127 characters. It can contain only alphanumeric, hyphen, underscore, space, period, and comma characters.
   - **Reserved Capacity % (0 - 80)**—The percentage of the capacity of the Storage Resource Pool to be reserved for volume write I/O activities. Valid values for the percentage are from 1 to 80. NONE disables it. For example, if you set the reserved capacity on a Storage Resource Pool to 30%, then the first 70% of the pool capacity is available for general purpose operations (host I/O allocations, local replication tracks and SRDF/A DSE allocations) and the final 30% of the pool capacity is reserved strictly for volume write I/O activities. Note that existing TimeFinder snapshot sessions created on volumes in the Storage Resource Pool are invalid if the free capacity of the Storage Resource Pool, as a percentage of the usable capacity, goes below the reserved capacity.
   - **Usable by RDFA DSE**—Specifies whether the Storage Resource Pool can be used for SRDF/A DSE operations. This field does not display for external SRPs. The maximum amount of storage from a Storage Resource Pool that can be used for DSE is controlled by the system wide dse_max_cap setting, as described in the *Solutions Enabler SRDF Family CLI User Guide*.
5. Click **OK**.

Viewing Storage Resource Pools

Before you begin

- This feature requires HYPERMAX OS 5977 or higher.

Procedure

1. Select the storage system.
2. Select **STORAGE > Storage Resource Pools** to open the **Storage Resource Pools** view.
The following properties display:

- **Name** — Name of the storage resource pool.
- **Used Usable Capacity (%)** — Used usable capacity, expressed as a percentage.
- **Total Usable Capacity (TB)** — Total usable capacity.
- **Allocated Subscribed Capacity (%)** — Allocated subscribed capacity, expressed as a percentage.
- **Total Subscribed Capacity (TB)** — Total subscribed capacity.

The following controls are available:

- **Modify** — Modifying Storage Resource Pool details on page 156
- **Add EDisks** — Adding external disks on page 276
- **Click** to view the following details:
  - **Name** — Name of the storage resource pool.
  - **Description** — Description.
  - **Default Emulation** — The default emulation for the pool (FBA or CKD).
  - **Overall Efficiency** — The current compression efficiency on this storage resource pool.
  - **Compression State** — Indicates whether compression is enabled or disabled for this storage resource pool.
  - **Effective Used Capacity (%)** — The effective used capacity, expressed as a percentage.
  - **Usable Capacity (TB)** — Usable capacity of all the disk groups in the Storage Resource Pool, excluding any external disk groups used for FTS encapsulation.
  - **Allocated Capacity (TB)** — Sum of the volume allocations, snapshot allocations, and SRDF/A DSE allocations on the Storage Resource Pool.
  - **Free Capacity (GB)** — Difference between the usable total and usable allocated capacities.
  - **Subscription (TB)** — Percentage of the configured sizes of all the thin volumes subscribed against the Storage Resource Pool.
  - **Reserved Capacity % (0 - 80)** — Percentage of the Usable Capacity that will be reserved for non-snapshot activities. Existing TimeFinder snapshot sessions created on volumes in the Storage Resource Pool can go invalid if the Free Capacity of the Storage Resource Pool, as a percentage of the Usable Capacity, goes below the Reserved Capacity.
  - **Usable by RDFA DSE** — Specifies whether the Storage Resource Pool can be used for SRDF/A DSE operations. This field does not display for external SRPs.
  - **FBA Service Levels** — Number of FBA service levels.
  - **Disk Groups** — Number of Disk Groups.

The panel also provides links to views displaying objects contained in the pool. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking the number next to **Disk Groups** will open a view listing the disk groups in the storage resource pool.
Changing Storage Resource Pools for storage groups

This procedure explains how to change the Storage Resource Pool of a parent storage group, with child service levels using different Storage Resource Pools. In eNAS environments, you can also perform this operation from the File Storage Groups page (System > System Dashboard > File Dashboard > File Storage Groups).

Before you begin:
- The storage system must be running HYPERMAX OS 5977 or later.
- You must have Administrator or StorageAdmin permission.

To change the Storage Resource Pool for storage groups:

Procedure
1. Select the storage system.
2. Under STORAGE, select Storage Groups.
3. Select the storage group, click , and select Change SRP to open the Change SRP dialog box.
4. Select the new SRP.
5. (Optional) Change the Service Level for the SG. Service levels specify the characteristics of the provisioned storage, including maximum response time, workload type, and priority. This field defaults to None if you set the Storage Resource Pool to None. Possible values are:

<table>
<thead>
<tr>
<th>Service level</th>
<th>Performance type</th>
<th>Use case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamond</td>
<td>Ultra high</td>
<td>HPC, latency sensitive</td>
</tr>
<tr>
<td>Platinum</td>
<td>Very high</td>
<td>Mission critical, high rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OLTP</td>
</tr>
<tr>
<td>Gold</td>
<td>High</td>
<td>Very heavy I/O, database logs,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>datasets</td>
</tr>
<tr>
<td>Silver</td>
<td>Price/Performance</td>
<td>Database datasets, virtual</td>
</tr>
<tr>
<td></td>
<td></td>
<td>applications</td>
</tr>
<tr>
<td>Bronze</td>
<td>Cost optimized</td>
<td>Backup, archive, file</td>
</tr>
<tr>
<td>Optimized (Default)</td>
<td></td>
<td>Places the most active data</td>
</tr>
<tr>
<td></td>
<td></td>
<td>on the highest performing storage and the least active on the most cost-effective storage.</td>
</tr>
</tbody>
</table>

For all-flash storage systems, the only service level available is Diamond and it is selected by default.

6. (Optional) Refine the service level by selecting the Workload Type to assign it. (This step is not applicable for storage systems running PowerMaxOS 5978.)
7. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
Service level compliance

Each service level and workload type has a response band associated with it. When a storage group (workload) is said to be compliant, it means that it is operating within the associated response time band.

When assessing the compliance of a storage group, Workload Planner calculates its weighted response time for the past 4 hours and for the past 2 weeks, and then compares the two values to the maximum response time associated with its given service level. If both calculated values fall within (under) the service level defined response time band, the compliance state is STABLE. If one of them is in compliance and the other is out of compliance, then the compliance state is MARGINAL. If both are out of compliance, then the compliance state is CRITICAL.

Creating Compliance Reports

This procedure explains how to create Compliance reports. Compliance Reports allow you to view storage group performance against service levels over a period of time.

Before you begin:

- This feature requires HYPERMAX OS 5977 or later.
- The user must be a StorageAdmin permissions or higher.

To create Compliance Reports:

Procedure

1. Select the storage system.
2. Select SG COMPLIANCE.
3. Within the Compliance panel, click VIEW COMPLIANCE REPORT.
4. Click Schedule.
5. On the General tab, do any number of the following:
   a. Type a Name for the report.
   b. Type a Description for the report.
   c. Select the time zone in which the report will be generated (Generated Time Zone).
6. On the Schedule tab, do any number of the following:
   a. Select the First Runtime.
   b. Select the Day(s) to Run.
   c. Select the number of days that the report should be retained.
7. Optional: On the Email tab, select Send report to and type an email address.
8. Click OK.

Viewing compliance reports

This procedure explains how to view storage group performance against service levels over a period of time.

Before you begin:

- This feature requires HYPERMAX OS 5977 or later.
The user must be a StorageAdmin permissions or later.

To view service level compliance reports:

Procedure

1. Select the storage system.
2. Select SG COMPLIANCE.
3. Within the Compliance panel, click VIEW COMPLIANCE REPORT.
4. Customize the report by doing the following:
   a. Select the time period. For the time period you select, the storage group’s compliance is assessed in 30 minute intervals, and then its overall compliance state is displayed based on the method described in Service level compliance on page 159. For example, if you select Last 24 hours, the storage group’s compliance state is assessed 48 times, and then its calculated compliance state is displayed in this report.
   b. Click and select whether to view the compliance information as a chart or as numbers.

The following properties display:

- Storage Group — Name of the storage group.
- Service Level — Service level associated with the storage group.
- % Stable — Percentage of time the storage group performed within the service level target.
- % Marginal — Percentage of time the storage group performed below the service level target.
- % Critical — Percentage of time the storage group performed well below the service level target.

The following controls are available:

- Export — Save the report as a PDF file.
- Schedule — Creating Compliance Reports on page 159.
- Monitor — Performance Dashboards on page 522

Save Report Results dialog box

Use this dialog box to save service level compliance reports in PDF.

Managing Data Exclusion Windows

This procedure explains how to manage Data Exclusion Windows for calculating headroom and suitability.

Peaks in storage system statistics can occur due to:

- anomalies or unusual events
- recurring maintenance during off-hours that fully loads the storage system

Due to the way this data is condensed and used, unexpected headroom and suitability results can occur.

There are two ways to improve the handling of these cases:

- One-time exclusion period — when the one-time exclusion period value is set, all statistics before this time are ignored. This helps resolve the first case above,
where a significant one time peak distorts the results due to reliance on two weeks of data points. This is set system-wide for all components.

- **Recurring exclusion period**—You can select one or more 4 hour windows to use in admissibility checks. This is set system-wide for all components. Recurring exclusion periods are repeating periods of selected weekday or time slot combinations where collected data is ignored for the purposes of compliance and admissibility considerations. The data is still collected and reported, but it is not used in those calculations.

Before you begin:
- This feature requires HYPERMAX OS 5977 or higher.
- The user must have StorageAdmin permissions or higher.

To manage Data Exclusion Windows:

**Procedure**
1. Select the storage system.
2. Select **SG Compliance**.
3. In the **Actions** panel, select **EXCLUDE DATA**.

**Results**

The **Compliance Settings** page allows you to view and set the one-time exclusion period and recurring exclusion periods for a selected storage system. It consists of two panels. The **One-time Exclusion Period** panel displays 84 component utilizations (two weeks worth of data) in a single chart that allows you to set the one-time exclusion period value from a given time slot, resulting in all time slots prior to the selected time slot being ignored for the purposes of calculating compliance and admissibility values. The **Recurring Exclusion Periods** panel displays the same data, but in a one-week format that allows you to select repeating recurring exclusion periods during which any collected data is ignored.

Each bar in the chart represents a utilization score calculated for that time slot. The score itself is the highest value of four component types, that is, the “worst performing” of the four components is the one that determines the overall value returned. The exact type and identifier of the selected component can be seen in the tool tip for a specific bar. The four component types that are represented in the bars are:
- Front End Port
- Back End Port
- RDF Port
- Thin Pool

The bars in both panels represent the same data using the same color coding scheme. The colors of the bars signify the following states:
- Green represents a utilization value that meets the best practice limit.
- Red represents a utilization value that exceeds the best practice limit.
- Blue represents a utilization value this is being ignored before the one-time exclusion period.
- Gray represents a utilization value that is being ignored as part of a window.

No Bar – If no data was collected or calculated during a time slot, there is no bar present.

The **One-time Exclusion Period** panel consists of a chart that is labeled with the component utilization value as the y-axis and the time slot as the x-axis. Each time slot
is a four hour window during which data was collected and a utilization score was calculated. There is also a horizontal line representing the best practice utilization of 100%. The x-axis is labeled with the dates of the time slots, that is, the dates of the midnight time slots are labeled with that date and other time slots are blank.

The top-right of this panel has a filter which allows you to include all components used in utilizations calculations or filter for only those used in headroom calculations. This can be helpful when headroom values are causing suitability problems in other areas, but those issues are masked by other component utilizations on this chart. The filters are: All components, for suitability (the default selection) and Back-end components only, for headroom. When you select a value, the page is reloaded with data from the server, filtered according to the selection made. Both charts are updated to reflect this data.

When the user selects a value the page will be reloaded with data from the server, filtered according to the selection made. Both charts will be updated to reflect this data.

You can select and set a time slot before which all collected data will be ignored. You select the time slot by clicking on the desired bar. The selected bar and all previous bars are changed to the one-time exclusion period coloring reflecting this selection. In addition, one-time exclusion period selection is also dynamically displayed in the Recurring Exclusion Periods chart as selections are made. If you try to set the selection to the last bar on the right an error is displayed and the action will not be allowed. In addition, selection is also dynamically displayed in the Windows chart as selections are made. You can deselect a selected bar by clicking it again. The chart then reverts to the value set when the page was loaded.

One-time exclusion period bars are only displayed in the Recurring Exclusion Periods chart under these conditions:

- Both buckets corresponding to the Recurring Exclusion Periods chart slot are before the one-time exclusion period.
- One of the buckets is before the one-time exclusion period and the other bucket has no data collected.

The panel has two buttons to set and clear any changes made:

- **Set One-time Exclusion**—writes the selected one-time exclusion period value to the database. This value will then be in effect and will be shown in all future views of this page. This button is enabled when a one-time exclusion period is selected. Clicking OK confirms the operation.
- **Clear One-time Exclusion**—clears any previously set one-time exclusion value. This button is only enabled if a one-time exclusion value is set when the page is first loaded. Clicking OK confirms the operation.

The Recurring Exclusion Periods panel consists of seven charts, one for each day of the week. Each chart has a bar for each four hour time slot during which data is collected and a utilization score is calculated. Each bar represents two bars shown in the One-time Exclusion Period Panel chart. The bar shown in this chart is the highest value ("worst performing") bar of the two One-time Exclusion Period Panel bars.

One-time exclusion period bars are only displayed in the Recurring Exclusion Periods chart under the following conditions:

- Both buckets corresponding to the Recurring Exclusion Periods chart slot are in the one-time exclusion period.
- One of the buckets is in the one-time exclusion period and the other bucket has no data collected.
In this panel, you click a time slot to select or deselect it. Clicking on a selected time slot will deselect it. As selections are made, both charts will be dynamically updated with the appropriate color coding.

The panel has two buttons to set and clear any changes made:

- **Set Recurring Exclusions**—writes the selected recurring exclusions period value(s) to the database. These values will then be in effect and will be shown in all future views of this page. This button is enabled when a recurring exclusion period is selected. Clicking OK confirms the operation.

- **Clear Recurring Exclusions**—clears any previously set recurring exclusion period values. This button is only enabled if a recurring exclusion period value is set when the page is first loaded. Clicking OK confirms the operation.

At the bottom of the page is a panel that contains the legend indicating the meanings associated with the different bar colors. On the right hand side in this panel is text detailing the last time a one-time exclusion period or Window was changed. If you hover over this text, the name of the user (fully qualified user name) that performed the last update operation is displayed. If the database has never had a one-time exclusion period or Window set, the field and tool tip text displays “Not yet modified”.

**Alerts**

There is a system alert generated each time a user changes a one-time exclusion period value or a recurring exclusion period value.

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**Symmetrix tiers**

**Creating tiers**

**Before you begin**

- This feature requires Enginuity 5876.
- The maximum number of tiers that can be defined on a storage system is 256.
- When a disk group or thin pool is specified, its technology type must match the tier technology.
- Disk groups can only be specified when the tier include type is static.
- A standard tier cannot be created if it will:
  - Lead to a mix of static and dynamic tier definitions in the same technology.
  - Partially overlap with an existing tier. Two tiers partially overlap when they share only a subset of disk groups. For example, TierA partially overlaps with TierB when TierA contains disk groups 1 & 2 and TierB contains only disk group 2. (Creating TierA will fail.)

**To create a tier:**

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Tiers** to open the Tiers list view.
3. Click **Create** to open the **Create Tier** dialog box.
   - When this dialog box first opens, the chart displays the configured and unconfigured space on the selected storage system. Once you select a disk group or thin pool, this chart displays the configured and unconfigured space of the selected object.
4. Type a Tier Name.
Tier names must be unique and cannot exceed 32 characters. Only alphanumeric characters, hyphens (-), and underscores (_) are allowed, however, the name cannot start with a hyphen or an underscore. Each tier name must be unique per Symmetrix system (across both DP and VP tier types), ignoring differences in case.

5. If the storage system on which you are creating the tier is licensed to perform FAST and FAST VP operations, select a Tier Type.

Possible values are:
- **DP Tier**—A disk group tier is a set of disk groups with the same technology type. A disk group tier has a disk technology type and a protection type. To add a disk group to a tier, the group must only contain volumes on the tier's disk technology type and match the tier protection type.
- **VP Tier**—A virtual pool tier is a set of thin pools. A virtual pool tier has a disk technology type and a protection type. To add a thin pool to a tier, the thin pool must only contain DATA volumes on the tier's disk technology type and match the tier protection type.

6. If creating a VP tier, select the Emulation type of the thin pools to include in the tier. Only thin pools containing volumes of this emulation type will be eligible for inclusion in the tier.

7. Select the type of Disk Technology on which the tier will reside. Only disk groups or thin pools on this disk technology will be eligible for inclusion in the tier.

8. If you selected External disk technology for the tier, then select the type of External Technology.

9. Select the RAID Protection Level for the tier. Only disk groups or thin pools on this disk technology will be eligible for inclusion in the tier.

10. Depending on the type of tier you are creating, select the disk groups or virtual pools to include in the tier.

11. Optional: Select Include all future disk groups on matching technology for this tier.

   Tiers created in this manner are considered dynamic tiers. Tiers created without this option are considered static tiers.

12. Click OK.

Modifying tiers

**Before you begin**
- This feature requires Enginuity 5876.
- You can only modify tiers that are not part of a policy. For instructions on removing a tier from a policy, refer to Modifying FAST policies.
- You cannot create blank tiers in Unisphere (that is, tiers without disk groups or thin pools); however, you can use Unisphere to add disk groups or thin pools to blank tiers that were created in Solutions Enabler.

To modify a tier:

**Procedure**
1. Select the storage system.
2. Select STORAGE > Tiers to open the Tiers list view.
3. Select the tier and click **Modify**.
4. Add or remove disk groups/thin pools by selecting/clearing the corresponding check box.
5. Click **OK**.

### Renaming tiers

**Before you begin**
- This feature requires Enginuity 5876.
- Tier names must be unique and cannot exceed 32 characters. Only alphanumeric characters, hyphens ( - ), and underscores ( _ ) are allowed, however, the name cannot start with a hyphen or an underscore. Each tier name must be unique per storage system (across both DP and VP tier types), ignoring differences in case.

To rename a tier:

**Procedure**
1. Select the storage system.
2. Select **STORAGE > Tiers** to open the **Tiers** list view.
3. Select the tier, click , and click **Rename**.
4. Type a new name for the tier.
5. Click **OK**.

### Deleting tiers

**Before you begin**
- This feature requires Enginuity 5876.
- You cannot delete tiers that are already part of a policy. To delete such a tier, you must first remove the tier from the policy. For instructions, refer to Modifying FAST policies.

To delete a tier:

**Procedure**
1. Select the storage system.
2. Select **STORAGE > Tiers** to open the **Tiers** list view.
3. Select the tier and click .
4. Click **OK**.

### Viewing Symmetrix tiers

**Before you begin**
This feature requires Enginuity 5876.

**Procedure**
1. Select the storage system.
2. Select **STORAGE > Tiers** to open the **Tiers** list view.
   - The **Tiers** list view allows you to view and manage the tiers on a Symmetrix system.
The following properties display:

- **Name**—Name of the tier.
- **Type**—Tier type. Possible values are:
  - Disk Group — A disk group tier is a set of disk groups with the same technology type. A disk group tier has a disk technology type and a protection type. To add a disk group to a tier, the group must only contain volumes on the tier's disk technology type and match the tier protection type.
  - Virtual Pool — A virtual pool tier is a set of thin pools. A virtual pool tier has a disk technology type and a protection type. To add a thin pool to a tier, the thin pool must only contain DATA volumes on the tier's disk technology type and match the tier protection type.
- **Technology**—Disk technology on which the tier resides.
- **Emulation**—Emulation type of the thin pools in the tier.
- **Protection**—RAID protection level assigned to the volumes in the tier.
- **Used Capacity**—Amount of storage that has already been used on the tier, in GB.
- **Capacity (GB)**—Amount of free/unused storage on the tier, in GB.

The following controls are available:

- ![Viewing Symmetrix tier details](on page 166)
- **Create** — Creating tiers on page 163
- **Modify** — Modifying tiers on page 164
- ![Deleting tiers](on page 165)
- **Rename** — Renaming tiers on page 165

### Viewing Symmetrix tier details

**Before you begin**

This feature requires Enginuity 5876.

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Tiers** to open the **Tiers** list view.
3. Select the tier and click ![Viewing Symmetrix tier details](on page 166) to open its **Tier Demand Report** panel or its **Details** panel.

The **Tier Demand Report** panel provides a graphic representation of the tier's used capacity over free space.

The following properties display in the **Details** panel:

- **Name** — Name of the tier.
  
  [OutOfTier]: If on a given technology there exists volumes that do not reside on any tier they will be shown as [OutOfTier]. This can happen when the
protection type of volumes does not match the tier protection type, or when tiers are only defined on a subset of disk groups in a technology.

- **Is Static** — Whether the tier is static (Yes) or dynamic (No). With a dynamic tier, the FAST controller will automatically add all future disk groups on matching disk technology to the tier. Tiers without this option enabled are considered static.

- **Type** — Tier type. Possible values are:
  - **DP** — A disk group tier is a set of disk groups with the same technology type. A disk group tier has a disk technology type and a protection type. To add a disk group to a tier, the group must only contain volumes on the tier’s disk technology type and match the tier protection type.
  - **VP** — A virtual pool tier is a set of thin pools. A virtual pool tier has a disk technology type and a protection type. To add a thin pool to a tier, the thin pool must only contain DATA volumes on the tier’s disk technology type and match the tier protection type.

- **Technology** — Disk technology on which the tier resides.
- **Disk Location** — Internal or external.

- **RAID Protection** — RAID protection level assigned to the volumes in the tier.

- **Attribute** — Status of the tier on the technology type. Possible values are:
  - Tier in a FAST Policy associated with storage groups.
  - Tier in a FAST Policy unassociated with storage groups.
  - Tier not in any FAST Policy.

- **Total Capacity (GB)** — Amount of free/unused storage on the tier, in GB.

- **Free Capacity (GB)** — Unconfigured space in Gigabytes in this tier. Free capacity for each disk group in the tier will only count toward tier free capacity if the disk group has enough usable disks to support the tier target protection type.

- **FAST Usage (GB)** — Sum of hypers of all volumes in FAST storage group with matching RAID protection that reside on this tier.

- **FAST Free (GB)** — If the tier is in a FAST policy associated with a storage group, the FAST Free capacity in Gigabytes is the sum of FAST Usage, Free capacity and Space occupied by Not Visible Devices (Unmapped/Unmasked). If the tier is not in any FAST policy or in policies where none of the policies are associated to a storage group, then the FAST Available capacity is same as FAST Usage.

- **Maximum SG Demand (GB)** — The calculated upper limit for the storage group on the tier.

- **Excess (GB)** — Difference between FAST Free and Max SG Demand. If the tier is not in a FAST policy or in policies where none of the policies are associated to a storage group, then this value is Not applicable.

- **Number of Thin Pools** — Number of Thin Pools. Clicking the number next to **Number of Thin Pools** opens a view listing the associated thin pools.
Viewing thin pools in a storage tier

**Procedure**

1. Select the storage system.
2. Select **Storage > Tiers** to open the **Tiers** list view.
3. Select the tier and click **i** to open its **Details** view.
4. Click the number next to **Number of Thin Pools** to open the tier’s **Thin Pool** view.

This view allows you to view and manage a tier's thin pool.

The following properties display:

- **Name**—Pool name.
- **Technology**—Disk technology type.
- **Configuration**—Protection configuration.
- **Emulation**—Pool emulation type based on the first volume added to the pool.
- **Allocated Capacity** — Percent capacity allocated to the pool.
- **Enabled Capacity (GB)**—Pool capacity in Gigabytes.

The following controls are available:

- **Viewing thin pool details on page 248**
- **Create**—Creating thin pools on page 242
- **Modify**—
- **Expand**—Expanding thin pools on page 243
- **Delete**—Deleting thin pools on page 245
- **Start Write Balancing**—Starting and stopping thin pool write balancing on page 245
- **Stop Write Balancing**—Starting and stopping thin pool write balancing on page 245
- **Bind**—Binding/Unbinding/Rebinding thin volumes on page 260

**FAST policies**

Creating FAST policies

**Before you begin**

- This feature requires Enginuity 5876.
- The maximum number of policies allowed per storage system is 256.
- Policies must contain either disk group tiers or virtual pool tiers, but not a combination of both disk group and virtual pool tiers.
- Disk group tier policies can contains from one to three tiers.
- Virtual pool tier policies can contain from one to four tiers. Only one out of the four tiers can be an external tier.
Each tier must be unique and there can be no overlapping disk groups/thin pools.

The first tier added to a policy determines the type of tier the policy will contain.

A policy cannot have an empty tier.

You cannot create blank policies (that is, policies without at least one tier) in Unisphere; however, you can create such policies in Solutions Enabler. The Solutions Enabler Array Controls and Management CLI User Guide contains instructions on creating blank policies. Unisphere does allow you to manage blank policies.

You cannot add a standard tier to a policy if it will result in a configuration where two tiers share a common disk group.

A FAST policy is a set of one to three DP tiers or one to four VP tiers, but not a combination of both DP and VP tiers. Policies define a limit for each tier in the policy. This limit determines how much data from a storage group associated with the policy is allowed to reside on the tier.

Storage groups are sets of volumes. Storage groups define the volumes used by specific applications. Storage groups are associated with FAST policies, and all of the volumes in the storage group come under FAST control. The FAST controller can move these volumes (or data from the volumes) between tiers in the associated policy.

A storage group associated with a FAST policy may contain standard volumes and thin volumes, but the FAST controller will only act on the volumes that match the type of tier contained in the associated policy. For example, if the policy contains thin tiers, then the FAST controller will only act on the thin volumes in the associated storage group.

Procedure

1. Select the storage system.
2. Select STORAGE > FAST Policies.
3. Click Create.
4. Type a Policy Name. Policy names must be unique and cannot exceed 32 characters. Only alphanumeric characters, hyphens ( - ), and underscores ( _ ) are allowed, however, the name cannot start with a hyphen or an underscore.
5. Select the host type.
6. Select the volume Emulation.
7. Select a tier to add to the policy and then specify a storage group capacity for the tier (% MAX of Storage Group). This value is the maximum amount (%) of the associated storage group's logical capacity that the FAST controller can allocate to the tier. This value must be from 1 to 100. The total capacities for a policy must equal to or be greater than 100.
8. Repeat the previous step for any additional tiers you want to add.
9. Click OK.

Modifying FAST policies

Before you begin

- This feature requires Enginuity 5876.
- Policy names must be unique and cannot exceed 32 characters. Only alphanumeric characters, hyphens ( - ), and underscores ( _ ) are allowed, however, the name cannot start with a hyphen or an underscore.
Procedure

1. Select the storage system.
2. Select STORAGe > FAST Policies.
3. Select a policy and click Modify.
4. Optional: Modify the Policy Name. Policy names must be unique and cannot exceed 32 characters. Only alphanumeric characters, hyphens (-), and underscores (_) are allowed, however, the name cannot start with a hyphen or an underscore.
5. Optional: Change the host type.
6. Optional: Change the volume Emulation.
7. Optional: Select a tier to modify for the policy and then specify a storage group capacity for the tier (% MAX of Storage Group). This value is the maximum amount (%) of the associated storage group's logical capacity that the FAST controller can allocate to the tier. This value must be from 1 to 100. The total capacities for a policy must equal to or be greater than 100.
8. Repeat the previous step for any additional tiers you want to modify.
9. Click OK.

Deleting FAST policies

Before you begin

• This feature requires Enginuity 5876.
• You cannot delete a policy that has one or more storage groups associated with it. To delete such a policy, you must first disassociate the policy from the storage groups.

To delete a FAST Policy:

Procedure

1. Select the storage system.
2. Select STORAGe > FAST Policies.
3. Select the policy and click Delete.
4. Click OK.

Associating FAST policies with storage groups

Before you begin

Storage groups and FAST policies can only be associated under the following conditions:

• The storage system is running Enginuity 5876.
• The target FAST policy needs to have a least one pool that is part of the source policy in re-association activity.
• The volumes in the new storage group are not already in a storage group associated with a FAST policy.
• The policy has at least one tier.
• The storage group only contains meta heads; meta members are not allowed.
• The storage group does not contain moveable volumes. When a storage group is associated with a policy, you cannot add non-moveable volumes to it. Non-moveable volumes include:
The storage group cannot contain a volume that is part of another storage group already associated with another policy.

The storage system has fewer than the maximum number of allowed associations (8,192).

The procedure for associating FAST policies and storage groups, depends on whether you are associating a storage group with a policy or policy with a storage group.

To associate a FAST policy with a storage group:

**Procedure**

1. Select the storage system.
2. Select STORANGE > FAST Policies.
3. Select the policy and click Associate Storage Groups.
4. Select one or more storage groups to be associated with the FAST policy.
5. To have FAST factor the R1 volume statistics into move decisions made for the R2 volume, select Enable FAST VP RDF Coordination.
   
   This attribute can be set on a storage group, even when there are no SRDF volumes in the storage group. This feature is only available if the storage system is part of an SRDF setup. Both R1 volumes and R2 volumes need to be running Enginuity version 5876 or higher for the FAST VP system to coordinate the moves.
6. Click OK

**Associating storage groups with FAST policies**

**Before you begin**

Storage groups and FAST policies can only be associated under the following conditions:

- The storage system is running Enginuity 5876.
- The target FAST policy needs to have a least one pool that is part of the source policy in re-association activity.
- The volumes in the new storage group are not already in a storage group associated with a FAST policy.
- The policy has at least one tier.
- The storage group only contains meta heads; meta members are not allowed.
- The storage group does not contain moveable volumes. When a storage group is associated with a policy, you cannot add non-moveable volumes to it. Non-moveable volumes include:
  - CKD EAV
The storage group cannot contain a volume that is part of another storage group already associated with another policy.

The storage system has fewer than the maximum number of allowed associations (8,192).

To associate a storage group with a FAST policy:

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Storage Groups**.
3. Select the storage group, click , and select **FAST > Associate**.
4. Select a policy and click **OK**.

Disassociating FAST policies and storage groups

**Procedure**

1. Select the storage system.
2. Select **Storage > Storage Groups** to open the **Storage Groups** list view.
3. Select the storage group, click , and select **FAST > Disassociate**.
4. Click **OK**.

Reassociating FAST polices and storage groups

**Before you begin**

- This feature requires Enginuity 5876.
- The storage group name must be valid.
- The storage group and policy must already exist on the storage system.
- The storage group must be in an association before performing a reassociation.
- The new policy for the storage group, must have the same emulation as the storage group. Mix emulation association will result in an error.
- The storage group cannot be associated with an empty policy, and the reassigned policy must contain at least one tier.
- The total of the capacity percentage for the target FAST policy must add up to at least 100%.
- If the FAST policy contains VP Tiers, all of the thin devices in the storage group must be bound to any VP pool in a tier in the policy. None of the thin devices can be bound to a pool outside of the policy.

This procedure explains how to reassociate a storage group with a new policy. When reassociating a storage group, all the current attributes set on the original association
automatically propagate to the new association. This feature eliminates the previous process of disassociating a storage group, then associating the group to a new policy, and entering the attributes, such as priority, on the association.

**Procedure**
1. Select the storage system.
2. Select **Storage > Storage Groups** to open the **Storage Groups** list view.
3. Select the storage group, click , and select **FAST > Reassociate**.
4. Select a policy and click **OK**.

**Viewing FAST policies**

**Before you begin**
This feature requires Enginuity 5876.

**Procedure**
1. Select the storage system.
2. Select **STORAGE > FAST Policies**.

   Use the **FAST Policies** list view to view and manage FAST policies on a storage system. The following properties display:
   - **Name**—Name of the policy.
   - **Type**—Type of the policy.
   - **Tier 1**—Storage tier associated with the policy.
   - **Tier 2**—Storage tier associated with the policy.
   - **Tier 3**—Storage tier associated with the policy.
   - **Tier 4**—Storage tier associated with the policy.
   - Up to 4 tiers is supported only for FAST VP policies. FAST policies support up to 3 tiers.
   - **Storage Groups**—Storage groups associated with the policy.

The following controls are available:

- **Viewing FAST policy details** on page 174
- **Create**—Creating FAST policies on page 168
- **Modify**—
- **Delete**—Deleting FAST policies on page 170
- **Associate Storage Group**—Associating storage groups with FAST policies on page 171

**Viewing storage group for FAST policies**

**Procedure**
1. Select the storage system.
2. Select **STORAGE > FAST Policies**.
3. Select the policy, click 🔄, and select the Details panel.

4. Click the number next to Storage Groups.

   The following properties display:
   - **Name**—Name of the storage group.
   - **FAST Policy**—Policy associated with the storage group.
   - **Capacity**—Total capacity of the storage group in GB.
   - **Volumes**—Number of volumes contained in the storage group.
   - **Masking Views**—Number of masking views associated with the storage group.

Refer to Viewing storage groups on page 137 for information on properties and controls for the storage group.

### Viewing FAST policy details

**Before you begin**

This feature requires Enginuity 5876.

**Procedure**

1. Select the storage system.

2. Select STORAGE > FAST Policies.

3. Select the policy and click 🔄 to open its Tier Demand Report panel or its Details panel.

   The Tier Demand Report panel includes graphic representations of the used and free space available for each tier in the policy. In addition, each chart includes markers for the following metrics:
   - **Max SG Demand**—The calculated upper limit for the storage group on the tier.
   - **Available to FAST**—The amount of storage available for FAST operations on the tier.

In the Details panel, the following properties display:

- **Name** — Name of the policy. To rename the policy, type a new name over the existing and click Apply. Policy names must be unique and cannot exceed 32 characters. Only alphanumeric characters, hyphens (-), and underscores (_) are allowed, however, the name cannot start with a hyphen or an underscore.

- **Tier 1 - 3 (for FAST DP)**

- **Tier 1 - 4 (for FAST VP)** — Symmetrix tier associated with the policy, followed by the maximum amount (%) of the associated storage group's logical capacity that the FAST controller can allocate to the tier. This value must be from 1 to 100. The total capacities for a policy must be greater than or equal to 100.

- **Storage Groups** — Number of Storage Groups. Clicking the number next to Storage Groups will open a view listing the associated storage groups.
• Number of Tiers — Number of Tiers. Clicking the number next to **Number of Tiers** will open a view listing the tiers in the policy.

**Viewing FAST storage groups**

This feature is only supported on storage systems running Enginuity OS 5876. Up to 4 tiers is supported only for FAST VP policies. FAST policies support up to 3 tiers.

**Procedure**

1. Select the storage system.
2. Select **SG COMPLIANCE** on the dashboard.
3. Select **VIEW FAST STORAGE GROUPS**.

   The following properties display:
   - **Name** — Name of the storage group.
   - **FAST Policy** — FAST Policy associated with the storage group.
   - **Compliant** — Icon indicating compliance.
   - **Tier 1 %** — Storage tier percentage associated with the policy.
   - **Tier 2 %** — Storage tier percentage associated with the policy.
   - **Tier 3 %** — Storage tier percentage associated with the policy.
   - **Tier 4 %** — Storage tier percentage associated with the policy.
   - **Out of Policy %** — Out of Policy percentage.

**Pinning and unpinning volumes**

**Before you begin**

This feature requires Enginuity 5876.

Pinning volumes prevents any automated process such as FAST from moving them. However, you can still migrate a pinned volume with Virtual LUN Migration.

**Note**

The capacity of pinned volumes is counted for compliance purposes.

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Volumes**.
3. Select the volume type by selecting a tab.
4. Select one or more volumes, click , and select one of the following:
   - **FAST > Pin** — To pin the volumes.
   - **FAST > Unpin** — To unpin the volumes.
5. Click OK.
Time windows

Understanding time windows

Time windows are used by FAST, FAST VP, and Symmetrix Optimizer to specify when data can be collected for performance analysis and when moves/swaps can execute.

There are two types of time windows:

- **Performance time windows**—Specify when performance samples can be taken for analysis.
- **Move time windows**—Specify when moves/swaps are allowed to start or not start.

In addition, performance and move time windows can be further defined as open or closed:

- **Open**—When creating performance time windows, this specifies that the data collected in the time window should be included in the analysis. When creating move time windows, this specifies that the moves can start within the time window. This type of time window is also referred to as inclusive.
- **Closed**—When creating performance time windows, this specifies that the data collected in the time window should be excluded from analysis. When creating move time windows, this specifies that the moves cannot start within the time window. This type of time window is also referred to as exclusive.

Creating and modifying time windows

Before you begin

- This feature requires Enginuity OS 5876.
- Time windows are used by FAST and Optimizer. Changes made to FAST time windows may also affect Optimizer.
- The maximum number of time windows that can be defined on a storage system is 128.

Procedure

1. To create time windows:
   1. Select the storage system.
   2. Navigate to DASHBOARD > SG COMPLIANCE.
   3. From within the **FAST Status Report** panel, select FAST VP or FAST DP (If the storage system is licensed for both FAST DP and FAST VP) for which the time window will apply.
   4. Click next to the type of time window you want to create or modify. Depending on your selection, either the **Performance Time Window** or the **Move Time Window** dialog opens.
   5. If you are creating or modifying an open time window, select the day(s) or week in which to define the time window and click **ADD**.
   6. Select one of the following options:
      - **Always open** — Creates a single open time window for the entire week (Sunday to Saturday).
• **All weekend (Fri:18:00 - Mon:00:00)** — Creates a single open time window for the weekend (17:00 Friday to 8:00 Monday).

• **9:00-17:00, Monday-Friday** — Creates five time windows, one for each day of the work week.

• **17:00-8:00, Monday-Friday** — Creates five time windows, one for each of night of the work week.

• **Custom** — Allows you to define your own time window.

7. Click OK.

8. If you are creating or modifying a closed time window, select the **Start Time** checkbox and click **ADD**.

9. Select the start date and time and the end date and time and click **OK**.

10. Define the following parameters:

    • **Workload Analysis Period** — Specifies the amount of workload sampling to maintain for sample analysis. Possible values are specified in units of time (hours, days, or weeks) and can range from 2 hours to 4 weeks, with the default being one week.

    • **Time to Sample before First Analysis** — Specifies the minimum amount of workload sampling to complete before analyzing the samples for the first time. When setting this parameter, be sure to allow enough time (usually a week) to establish a good characterization of the typical workload. This parameter allows you to begin operations before the entire Workload period has elapsed. Possible values range from 2 hours to the value specified for the **Workload Analysis Period** parameter, with the default being eight hours.

11. Click **SAVE**.

### Deleting time windows

**Before you begin**

Time windows are used by FAST.

**Procedure**

1. To delete time windows:
   1. Select the storage system.
   2. Navigate to **DASHBOARD > SG COMPLIANCE**.
   3. From within the **FAST Status Report** panel, select FAST VP or FAST DP (If the storage system is licensed for both FAST DP and FAST VP) for which the time window will apply.

4. Click next to the type of time window you want to create or modify.

   Depending on your selection, either the **Performance Time Window** or the **Move Time Window** dialog opens.

5. If you are deleting an open time window, select the day(s) and click **REMOVE**.

6. If you are deleting a closed time window, select the **Start Time** checkbox and click **REMOVE**.
FAST Movement Time Window dialog box
Use this dialog box to manage movement time windows, including the following tasks:
- Creating and modifying time windows on page 176
- Deleting time windows on page 177

FAST Performance Time Window dialog box
Use this dialog box to manage performance time windows, including the following tasks:
- Creating and modifying time windows on page 176
- Deleting time windows on page 177

Manage Closed Movement Time Windows dialog box
Use this dialog box to manage closed movement time windows, including the following tasks:
- Creating and modifying time windows on page 176
- Deleting time windows on page 177

Manage Closed Performance Time Windows dialog box
Use this dialog box to manage closed movement time windows, including the following tasks:
- Creating and modifying time windows on page 176
- Deleting time windows on page 177

Manage Open Movement Time Windows dialog box
Use this dialog box to manage open movement time windows, including the following tasks:
- Creating and modifying time windows on page 176
- Deleting time windows on page 177

Manage Open Performance Time Windows dialog box
Use this dialog box to manage open performance time windows, including the following tasks:
- Creating and modifying time windows on page 176
- Deleting time windows on page 177

Understanding Workload Planner
Workload Planner is a FAST component used to display performance metrics for applications and to model the impact of migrating the workload from one storage system to another.
Workload Planner is supported on storage systems running Enginuity 5876 or HYPERMAX OS 5977.
For storage groups to be eligible for Workload Planning, they must meet the following criteria:
• On a locally attached storage system registered for performance. See Registering storage systems on page 596 for instructions on registered storage systems.
• Belong to only one masking view.
• Under FAST control:
  - For storage systems running HYPERMAX OS 5977, they must be associated with a service level.
  - For storage systems running Enginuity 5876, they must be associated with a FAST policy.
• Contain only FBA volumes.

In addition, the Unisphere server must be on an open systems host.

Delete a reference workload

This dialog allows you to delete a reference workload. Click OK to confirm.

Resetting Workload Plan

Before you begin
To perform this operation, a StorageAdmin role is required.
Resetting the workload plan requires one week of data.

This procedure explains how to set the performance baseline expectations of a storage group to the characteristics currently measured for the previous two weeks.

Procedure
1. Select the storage system.
2. Select STORAGE > Storage Groups.
3. Select the storage group and click the Compliance icon to open its details view.
4. If not already displaying, click the Compliance tab.
5. Click Reset Workload Plan.
6. Review the Current Scores and the projected New Baseline.
7. If satisfied, click OK.

Results
Once complete, the Workload Planning tab updates with the newly calculated performance metrics.

Managing volumes

For storage systems running HYPERMAX OS 5977 or higher, the Volumes view provides you with a single place from which to view and manage all the volumes types on the system.

Note
For instructions on managing volumes on storage systems running Enginuity versions 5876, refer to Managing volumes on page 180.
To view volumes associated with a host initiator, refer to Viewing volumes associated with host initiator on page 319.

To use the Volumes view:
Procedure

1. Select the storage system.
2. Select Storage > Volumes to open the Volumes list view.
   
   For field and control descriptions, refer to the following volume-specific help pages:
   - TDEV—Viewing thin volumes on page 225
   - DATA—Viewing DATA volumes on page 242
   - CKD—Viewing CKD volumes on page 94

Managing volumes

For storage systems running Enginuity OS version 5876, the Volumes view provides you with a single place from which to view and manage all the volume types on the system.

Note

For instructions on managing volumes on storage systems running HYPERMAX OS 5977, refer to Managing volumes on page 179.

To use the Volumes view:

Procedure

1. Select the storage system.
2. Select Storage > Volumes to open the Volumes view.
   - The Regular Volumes list view is displayed by default (see Viewing regular volumes on page 220).
   - Click the Virtual tab to see the Virtual Volumes list view (see Viewing virtual volumes on page 226).
   - Click the Meta tab to see the Virtual Volumes list view (see Viewing meta volumes on page 211).
   - Click the Private tab to see the Virtual Volumes list view (see Viewing private volumes on page 217).

Creating volumes

This procedure explains how to create volumes.

Procedure

1. Select the storage system.
2. Select STORAGE > Volumes and click Create to open the Create Volume dialog box.
3. Do the following, depending on the storage operating environment and the type of volumes you are creating:
   - HYPERMAX OS 5977 or higher:
     - TDEV—Creating thin volumes on page 187
     - CKD—Creating CKD volumes on page 334
Creating DATA volumes

This procedure explains how to create DATA volumes on storage systems running Enginuity version 5876.

Procedure

1. Select the storage system.
2. Select STORAGE > Thin Pools to open the Thin Pools list view.
3. Select the thin pool and click to open its Details view.
4. Click the number next to Number of Data Volumes.
5. Click Create Volumes.
6. Select DATA as the Configuration.
7. Select the Disk Technology.
   - External disk technology is an option if the storage system has FTS (Federated Tiered Storage) enabled and available external storage.
8. Select the Emulation type.
9. Select the RAID Protection level.
10. Specify the capacity by typing the Number of Volumes, and selecting a Volume Capacity. You can also manually enter a volume capacity.
11. To add the new volumes to a specific thin pool, select one from Add to Pool. Pools listed are filtered on technology, emulation, and protection type.
12. Click Advanced Options to continue setting the advanced options, as described next.

The advanced options presented depend on the value selected for Add to Pool. Complete any of the following steps that are appropriate:

a. Select the Disk Group (number and name) in which to create the volumes. The list of disk groups is already filtered based on the technology type selected above.
Creating private volumes

The following private volumes can be created:

- Creating DATA volumes on page 181
- Creating diskless volumes on page 182
- Creating DRV volumes on page 183
- Creating gatekeeper volumes on page 183
- Creating SAVE volumes on page 185

Creating diskless volumes

This procedure explains how to create diskless volumes on storage systems running Enginuity version 5876.

Procedure

1. Select the storage system.
2. Select STORAGE > Volumes and click the Virtual tab.
3. Filter on Type and select DLDEV.
4. Click Create.
5. Select the Configuration type.
6. Select the Emulation type.
7. Specify the capacity by typing the Number of Volumes, and selecting a Volume Capacity. You can also manually enter the volume capacity.
8. To add the new volumes, select one from Add to Pool.
9. Click Advanced Options to continue setting the advanced options, as described next.

Setting advanced options

a. Modify the Volume Identifier.

b. To assign Dynamic Capability to the volumes, select one of the following. Otherwise, leave this field set to None.
   - RDF1_Capable — Creates a dynamic R1 RDF volume.
   - RDF2_Capable — Creates a dynamic R2 RDF volume.
   - RDF1_OR_RDF2_Capable — Creates a dynamic R1 or R2 RDF volume.

The Define Meta panel only displays when attempting to create a volume larger than the value specified in the Minimum Auto Meta Size.
c. If Auto Meta is enabled on the system, and if you are attempting to create volumes larger than the **Minimum Meta Capacity**, specify values for the following in the Define Meta panel:

- **Member capacity (Cyl/MB/GB)** — Size of the meta members to use when creating the meta volumes.
- **Configuration (Striped/Concatenated)** — Whether to create striped or concatenated meta volumes.

10. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

## Creating DRV volumes

This procedure explains how to create DRV volumes on storage systems running Enginuity version 5876.

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Volumes** and click the **Private** tab.
3. Filter on Type and select DRV.
4. Select DRV as the **Configuration**.
5. Click **Create**.
6. Select the **Configuration** type.
7. Select the **Emulation** type.
8. Specify the capacity by typing the **Number of Volumes**, and selecting a **Volume Capacity**. You can also manually enter a volume capacity.
9. To add the new volumes, select one from **Add to Pool**.
10. Click **Advanced Options** to continue setting the advanced options, as described next.

   **Setting Advanced options:**
   
   To create the volumes from a specific disk group, select one (disk group number and name) from **Disk Group**.
   
   If Auto meta is enabled on the system then it displays as enabled with a green check mark.

11. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

## Creating gatekeeper volumes

This procedure explains how to create gatekeeper volumes on storage systems running Enginuity version 5876.
Procedure
1. Select the storage system.
2. Select STORAGE > Volumes and click the Regular panel.
3. Select the volume and click Create.
4. Select Gatekeeper as the Configuration.
5. Select the Emulation type.
6. Type the Number of Volumes to create.
7. Do one of the following:
   • Click Add to Job List to add this task to the job list, from which you can
     schedule or run the task at your convenience. For more information, refer to
     Scheduling jobs on page 812 and Previewing jobs on page 812.
   • Expand Add to Job List, and click Run Now to perform the operation now.

Creating regular volumes

This procedure explains how to create regular volumes on storage systems running
Enginuity version 5876.

Procedure
1. Select the storage system.
2. Select STORAGE > Volumes and click the Regular panel.
3. Click Create.
4. Select the Configuration.
5. Select the Disk Technology.
   External disk technology is an option if the storage system has FTS (Federated
   Tiered Storage) enabled and available external storage.
6. Select the Emulation type.
7. Select the RAID Protection level.
8. Specify the capacity to create by typing the Number of Volumes, and selecting
   a Volume Capacity. You can also manually enter a volume capacity.
9. Click Advanced Options to continue setting the advanced options, as described
    next.

Setting Advanced options:
   a. z/OS Only: Type the SSID for the new volume, or click Select... to open a
      dialog from which you can select an SSID. This is required for volumes on
      storage systems with ESCON or FICON directors (or mixed systems).
   b. To create the volumes from a specific Disk Group, select one (disk group
      number and name).
   c. To name the new volumes, select one of the following Volume Identifiers
      and type a Name:
         • None — Allows the system to name the volumes (Default).
         • Name Only — All volumes will have the same name.
         • Name + VolumeID — All volumes will have the same name with a unique
           storage system volume ID appended to them. When using this option, the
           maximum number of characters allowed is 50.
• **Name + Append Number** — All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the **Append Number** and increment by 1 for each additional volume. Valid **Append Numbers** must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.

For more information on naming volumes, refer to Setting volume names on page 198.

d. To assign **Dynamic Capability** to the volumes, select one of the following; otherwise, leave this field set to **None**.

- **RDF1_Capable** — Creates a dynamic R1 RDF volume.
- **RDF2_Capable** — Creates a dynamic R2 RDF volume.
- **RDF1_OR_RDF2_Capable** — Creates a dynamic R1 or R2 RDF volume.

e. If Auto Meta is enabled on the system, and if you are attempting to create volumes larger than the **Minimum Meta Capacity**, specify values for the following in the **Define Meta** panel:
- **Member capacity (Cyl/MB/GB)** — Size of the meta members to use when creating the meta volumes.
- **Configuration (Striped/Concatenated)** — Whether to create striped or concatenated meta volumes.

10. Do one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
- Expand **Add to Job List**, and click **Run Now** to perform the operation now.

---

**Creating SAVE volumes**

This procedure explains how to create SAVE volumes on storage systems running Enginuity version 5876.

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Volumes** and click the **Private** tab.
3. Filter on Type and select **SAVE**.
4. Select **SAVE** as the **Configuration**.
5. Select the **Disk Technology**.
6. **External** disk technology is an option if the Symmetrix system has FTS (Federated Tiered Storage) enabled and available external storage.
7. Select the **Emulation** type.
8. Select the **RAID Protection** level.
9. Specify the capacity by typing the **Number of Volumes**, and selecting a **Volume Capacity**. You can also manually enter a volume capacity.
10. To add the new volumes to a specific pool, select one from **Add to pool**. SNAP and SRDF/A DSE pools listed are filtered on technology, emulation, and protection type selected above.
11. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.
   - Click **Advanced Options** to continue setting the advanced options, as described next.

   If Auto meta is enabled on the system then it displays as enabled with a green check mark.

**Setting Advanced options:**

   a. Select the **Disk Group** (number and name) in which to create the volumes. The list of disk groups is already filtered based on technology type selected above.

   b. To enable the new volumes in the pool, select **Enable volume in pool**.

   If Auto meta is enabled on the system then it displays as enabled with a green check mark.

   c. Do one of the following:
      - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
      - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

---

**Creating thin volumes**

This procedure explains how to create thin volumes on storage systems running Enginuity version 5876. For instructions on creating thin volumes on storage systems running HYPERMAX OS 5977 or higher, refer to **Creating thin volumes** on page 187.

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Volumes**, click on the **Virtual** tab and select **Create**.
3. Select **Configuration (TDEV or BCV + TDEV or Virtual Gatekeeper)**.
4. Select the **Emulation** type.
5. Specify the capacity by typing the **Number of Volumes**, and selecting a **Volume Capacity**. You can also manually enter a volume capacity.
6. To bind the new volumes to a specific thin pool, select one from **Bind to Pool**. Only thin pools with enabled DATA volumes and matching emulation are available for binding (except AS/400 which will bind to an FBA pool).
7. Click **Advanced Options** to continue setting the advanced options

**Setting Advanced options:**

   a. To name the new volumes, select one of the following **Volume Identifiers** and type a **Name**:
      - **None** — Allows the system to name the volumes (Default).
      - **Name Only** — All volumes will have the same name.
• **Name + VolumeID** — All volumes will have the same name with a unique Symmetrix volume ID appended to them. When using this option, the maximum number of characters allowed is 50.

• **Name + Append Number** — All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the **Append Number** and increment by 1 for each additional volume. Valid **Append Numbers** must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.

For more information on naming volumes, refer to Setting volume names on page 198.

b. To **Allocate Full Volume Capacity**, select the option.

c. If you selected to allocate capacity in the previous step, you can mark the allocation as persistent by selecting **Persist preallocated capacity through reclaim or copy**. Persistent allocations are unaffected by standard reclaim operations and any TimeFinder/Clone, TimeFinder/Snap, or SRDF copy operations.

d. To assign **Dynamic Capability** to the volumes, select one of the following; otherwise, leave this field set to **None**.

- **RDF1_Capable** — Creates a dynamic R1 RDF volume.
- **RDF2_Capable** — Creates a dynamic R2 RDF volume.
- **RDF1_OR_RDF2_Capable** — Creates a dynamic R1 or R2 RDF volume.

e. If Auto Meta is enabled on the system, and if you are attempting to create volumes larger than the **Minimum Meta Capacity**, specify values for the following in the **Define Meta** panel:

- **Member capacity (Cyl/MB/GB)** — Size of the meta members to use when creating the meta volumes.
- **Configuration (Striped/Concatenated)** — Whether to create striped or concatenated meta volumes.

8. Do one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
- Expand Add to Job List, and click **Run Now** to perform the operation now.
- Click **Advanced Options** to continue setting the advanced options, as described next.

Creating thin volumes

This procedure explains how to create thin volumes on storage systems running HYPERMAX OS 5977. For instructions on creating thin volumes on storage systems running Enginuity 5876, refer to Creating thin volumes on page 186.

**Procedure**

1. Select the storage system.

2. Select **STORAGE > Volumes** and click **Create** to open the Create Volume dialog box.

3. Select TDEV as the **Configuration**.
4. Select the Emulation type.

5. Specify the capacity by typing the Number of Volumes, and selecting a Volume Capacity. You can also manually enter a volume capacity.

6. Optional: To add the volumes to a storage group, click Select, select the storage group, and then click OK.

7. Click Advanced Options to set the advanced options:
   - Optional: Click the Enable Mobility ID checkbox to assign Mobility IDs to the volume. If you leave the checkbox unchecked, a Compatibility ID will be assigned to the volume instead.
   - If creating thin volumes or a thin BCVs, you can specify to Allocate Full Volume Capacity. In addition, you can mark the preallocation on the thin volume as persistent by selecting Persist preallocated capacity through reclaim or copy. Persistent allocations are unaffected by standard reclaim operations.
   - To name the new volumes, select one of the following Volume Identifiers and type a Name:
     - None — Allows the system to name the volumes (Default).
     - Name Only — All volumes will have the same name.
     - Name + VolumeID — All volumes will have the same name with a unique Symmetrix volume ID appended to them. When using this option, the maximum number of characters allowed is 50.
     - Name + Append Number — All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the Append Number and increment by 1 for each additional volume. Valid Append Numbers must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.

For more information on naming volumes, refer to Setting volume names on page 198.

8. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Creating virtual gatekeeper volumes

Before you begin

The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to create virtual gatekeeper volumes.

Procedure

1. Select the storage system.
2. Select STORAGE > Volumes and click Create to open the Create Volume dialog box.
3. Select Virtual Gatekeeper as the Configuration.
Creating VDEV volumes

Procedure

1. Select the storage system.
2. Select STORAGE > Volumes and click the Virtual tab.
3. Filter on Type and select VDEV.
4. Select VDEV as the Configuration.
5. Select the Emulation type.
6. Specify the capacity by typing the Number of Volumes, and selecting a Volume Capacity.
   If Auto meta is enabled on the system then it displays as enabled with a green check mark.
7. z/OS Only: Type the SSID for the new volume, or click Select... to open a dialog from which you can select an SSID. This is required for volumes on storage systems with ESCON or FICON directors (or mixed systems).
8. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.
   - Click Advanced Options to continue setting the advanced options, as described next.

Setting Advanced options:

a. View Enable SCSI3 Persistent Reservation status — For Enginuity 5876 and higher this feature is pre-set by SYMAP and cannot be changed. It is displayed as enabled for Enginuity 5876 and higher, except for CDK and AS/400 emulations.

b. If Auto Meta is enabled for the system, and if you are attempting to create volumes larger than the Minimum Meta Capacity, specify values for the following in the Define Meta panel:
   - Member capacity (Cyl/MB/GB) — Size of the meta members to use when creating the meta volumes.
   - Configuration (Striped/Concatenated) — Whether to create striped or concatenated meta volumes.

c. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more
Select Storage Group

Use this dialog box to select a storage group for the operation.

Deleting volumes

This procedure explains how to delete volumes.

Procedure

1. Select the storage system.
2. Select STORAGE > Volumes.
3. Navigate to the volume that you wish to delete.
4. Select the volume and click \[\]

Duplicating volumes

Before you begin

You cannot duplicate RDF, SFS, or VAULT volumes.

If you are duplicating a thin volume that is bound to a pool, the newly created volumes will be bound to the same pool.

If you are duplicating a DATA volume that is part of a pool, the newly created DATA volumes will be part of the same pool. The initial state of the volume will be DISABLED.

The following explains how to duplicate volumes.

Procedure

1. Select the storage system.
2. Select STORAGE > Volumes.
3. Navigate to the volume that you wish to duplicate.
4. Select the volume, click \[\], and click Configuration > Duplicate Volume.
5. Type the Number of Volumes (duplicates) to make.
6. z/OS Only: You can optionally change the SSID number for the new volumes by typing a new value, or clicking Select... to open a dialog from which you can select an SSID. By default, this field displays the SSID of the volume you are copying.
7. Click Advanced Options to continue setting the advanced options.

To name the new volumes, select one of the following Volume Identifiers and type a Name:

- None — Allows the system to name the volumes (Default).
- Name Only — All volumes will have the same name.
• **Name + VolumeID** — All volumes will have the same name with a unique Symmetrix volume ID appended to them. When using this option, the maximum number of characters allowed is 50.

• **Name + Append Number** — All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the **Append Number** and increment by 1 for each additional volume. Valid **Append Numbers** must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.

For more information on naming volumes, refer to Setting volume names on page 198.

8. Do one of the following:

   • Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.

   • Expand **Add to Job List** and click **Run Now** to create the volumes now.

### Assigning array priority to individual volumes

**Before you begin**

This feature requires Enginuity 5876.

This procedure explains how to prioritize the service time of the host I/O to an individual volume. To prioritize the service time of the host I/O to groups of volumes (device groups or storage groups), refer to Assigning array priority to groups of volumes on page 191.

To assign host priority to individual volumes:

**Procedure**

1. Select the storage system.
2. Select **Storage > Volumes**.
3. Click on the appropriate volume panel.
4. Select the volume, click , and select Assign Symmetrix Priority.
5. Select an array priority from 1 (the fastest) to 16 (the slowest) and click **OK**.

### Assigning array priority to groups of volumes

**Before you begin**

This feature requires Enginuity 5876.

This procedure explains how to prioritize the service time of the host I/O to groups of volumes (device groups or storage groups).

**Procedure**

1. Select the storage system.
2. Do one of the following:
   - To assign priority to storage groups, select **STORAGE > Storage Groups** to open the Storage Groups list view.
Select the storage group, click Assign Symmetrix Priority, and select Assign Symmetrix Priority to open the Assign Symmetrix Priority dialog box.

To assign priority to device groups, select DATA PROTECTION > Device Groups to open the Device Groups list view.

Select the device group, click Assign Symmetrix Priority, and select Assign Symmetrix Priority to open the Assign Symmetrix Priority dialog box.

3. Select an array priority from 1 (the fastest) to 16 (the slowest) and click OK.
4. Click OK.

Changing volume configuration

Before you begin

- On storage systems running Enginuity 5876 or higher, you cannot increase or decrease the mirror protection of a volume.
- When adding DRV attributes, volumes must be unmapped.
- Full swap operations require the R1 and R2 devices to be the same size.
- Only the head of a metavolume can have its type changed. The metamembers will automatically have the changes applied.
- You cannot convert one member of a RAID set to unprotected without converting all the members to unprotected.
- When adding/removing SRDF attributes, there are no restrictions on I/O. The SRDF pair must be split or failed over. If failed over, the R1 device must be unmapped.
- When adding/removing BCV attributes, there are no restrictions on I/O. The standard/BCV pair must be split.

This procedure explains how to change a volume's configuration.

Procedure

1. Select the storage system.
2. Select STORAGE > Volumes.
3. Navigate to the volume.
4. Select the volume, click Configuration > Change Volume Configuration.
5. Select a New Configuration for the selected volumes. Only valid configurations are listed. The remaining fields in the dialog box are active or inactive depending on the configuration type.
6. z/OS Only: Type the SSID for the new volume created by removing a mirror, or click Select... to open a dialog from which you can select an SSID.

This is required for volumes on storage systems with ESCON or FICON directors (or mixed systems). This field is optional on storage systems running Enginuity 5876 or higher when reducing the number of mirrors.

7. Do one of the following:
- Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
- Expand Add to Job List and click Run Now to run the job now.

Expanding existing volumes

Before you begin
- Requires HYPERMAX OS 5977 or later (HYPERMAX OS 5977.1125.1125 or later for CKD volumes).
- You must be logged in as an Administrator.
- You can expand a volume up to 64 TB (for FBA volumes) or 1,182,006 cylinders (for CKD volumes).
- When expanding a CKD volume above 565,250 cylinders, the new size must be a multiple of 1113 cylinders. If you specify an amount that is not a multiple, the system rounds it up.
- Consider consulting with your operating system vendor or cluster vendor for support of online LUN expansion
- You cannot expand a FBA volume when any of the following operations are in progress:
  - Free all
  - Reclaim
  -Deallocation
- Restrictions apply when a volume:
  - is a gatekeeper
  - is an ACLX
  - is Celerra FBA
  - is AS400
  - is VP encapsulated
  - is part of a SnapVX session defined
  - is being replicated
  - is part of an SRDF pair
  - is part of an ORS session
  - a TDAT
- For CKD volumes, you cannot expand a volume that is:
  - A CKD 3380 volume
  - Marked as Soft Fenced

Procedure
1. Select the storage system.
2. Select STORAGE > Volumes, click , and click Expand Volume to open the Expand Volume dialog box.
   The Expand Volume dialog box appears.
3. In the **Volume Capacity** field of the **Expand Volume** dialog box, type or select the new capacity of the volume. The **Total Capacity** and **Additional Capacity** figures update automatically.

SRDF storage group volume capacity can be expanded using the controls. In the case of SRDF Storage Group volumes, you need to specify a SRDF group number so that the dialog allowing you to remote volumes can also be displayed (see **Expanding remote volumes** on page 515).

4. To reserve the volume, select **Reserve Volumes**.

5. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Mapping volumes

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Volumes**.
3. Navigate to the volume.
4. Select the volume, click , and click **Configuration > Map**.
5. Select one or more **Ports**.

**Note**

When performing this operation on storage systems running HYPERMAX OS 5977 or higher, only ACLX-disabled ports will be available for selection.

6. To reserve the volumes, select **Reserve Volumes**. In addition you can also type reserve **Comments** and select an **Expiration**. The default values for **Reserve Volumes** and **Comments** are set in the Symmetrix preferences for volumes reservations. If the volumes are not automatically reserved you can optionally reserve them here.

7. Click **Next**.

8. To change an automatically generated LUN address, do the following; otherwise, click **Next** to accept the generated address.
   - a. Double-click the address to open the **Set Dynamic LUN Address** dialog box.
   - b. To use a new **Starting LUN**, double-click it and type a new address over it, or select an address and click **Next Available LUN** to increment the generated address to the next available address. When done, click **Apply Starting LUN**.
   - c. Click **OK** to return to the mapping wizard.
   - d. Click **Next**.

9. Verify your selections in the **Summary** page. To change any of your selections, click **Back**. Note that some changes may require you to make additional changes to your configuration.
10. Do one of the following:
   - **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to *Scheduling jobs* on page 812 and *Previewing jobs* on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**Unmapping volumes**

This procedure explains how to unmap volumes.

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Volumes**.
3. Navigate to the volume.
4. Select the volume, click **Unmap**, and click **Configuration > Unmap**.
5. Select one or more ports.
6. To reserve the volumes, select **Reserve Volumes**. In addition you can also type reserve **Comments** and select an **Expiration**. The default values for **Reserve Volumes** and **Comments** are set in *Setting preferences* on page 49 for volumes reservations. If the volumes are not automatically reserved you can optionally reserve them here.
7. Click **Next**.
8. Verify your selections in the **Summary** page. To change any of your selections, click **Back**. Note that some changes may require you to make additional changes to your configuration.
9. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to *Scheduling jobs* on page 812 and *Previewing jobs* on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**Setting optimized read miss**

**Before you begin**

The optimized read miss feature is supported only for EFD volumes with FBA or AS400 D910 emulation attached to an XtremSW Cache Adapter. However, starting with Enginuity 5876.280, you can use optimized read miss without a XtremeSW Cache Adapter. To use optimized read miss without the adapter, you must set the **Optimized Read Miss** mode to **On**.

The optimized read miss feature reduces I/O processing overhead of read miss operations for both DA and DX emulations. The feature is supported on storage systems running Enginuity 5876.163.105 or higher. This feature is not supported on storage systems running HYPERMAX OS 5977 or higher.

This procedure explains how to set the optimized miss feature at the volume level. You can also perform this operation at the storage group or the device group level.
Procedure

1. Select the storage system.
2. Select STORAGE > Volumes.
3. Navigate to the volume.
4. Select the volume, click , and select Set Optimized Read Miss.
5. Select a Set Optimized Read Miss mode:
   - **System Default**—Storage system determines whether to enable or disable optimized read miss mode for the specified volumes/group.
   - **Off**—Disables optimized read miss mode, regardless of the configuration.
   - **On**—Enables optimized read miss mode for both XtremCache and non-XtremCache EFD-only configurations.
6. Click OK.

Setting volume status

**Before you begin**

You cannot set the status of an unbound thin volume.

To set volume status for individual volumes:

Procedure

1. Select the storage system.
2. Select STORAGE > Volumes.
3. Navigate to the volume.
4. Select the volume, click , and click Set Volumes > Status.
5. Set the volume status. Possible values are:
   - **Read/Write Enable** — Changes the write-protect status of the volumes to be read and write enabled on the specified director port(s) for any locally attached hosts.
   - **Write Disable** — Changes the write-protect status of the volumes to be write disabled on the specified director ports for any locally attached hosts. This option will only work on volumes that are in a write enabled state.
   - **Device Ready** — Changes the User Ready status of the volumes to Ready.
   - **Device Not Ready** — Changes the User Ready status of the volumes to Not Ready.
   - **Hold** — Causes the Hold bit to be placed on a volume. The Hold bit is automatically placed on the target volume of a Snap session.
   - **Unhold** — Causes the Hold bit to be removed from a volume. The Hold bit is automatically removed from the target volume of a snap session when the snap session is removed.
6. Optional: For HYPERMAX OS 5977 or higher, select SRDF/Metro.
7. Optional: To force the operation when the operation would normally be rejected, select SymForce , if available.
8. If the selected volumes are mapped, you can select to change the status for a particular Director or all directors.

9. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Setting volume attributes

**Before you begin**

You cannot set attributes for DATA volumes.

Setting attributes for CKD volumes is not supported. If attempting to set attributes for multiple volumes of type FBA and CKD, a warning is displayed stating that the action will be applied only to FBA volumes.

Setting the volume attribute for a volume restricts how it can be accessed.

To set volume attributes:

**Procedure**

1. Select the storage system.
2. Select STORAGE > Volumes.
3. Navigate to the volume.
4. Select a volume, click , and click Set Volumes > Attribute.
5. Set any number of the following attributes. Note that the attributes available depend on the type of selected volumes.
   - **Emulation** — Sets the emulation type for the volumes. The default is No Change. This option will appear dimmed for masked/mapped volumes, as this feature is not supported on masked/mapped volumes. This feature only applies/appears for storage systems running Enginuity 5876.
   - **Dynamic RDF Capability** — Sets the volume to perform dynamic RDF operations. This feature only applies/appears for storage systems running Enginuity 5876. Possible operations are:
     - **No Change** — Keeps the RDF capability the same.
     - **Dynamic RDF Capability** — Sets the volume to perform dynamic RDF operations. This feature only applies/appears for Symmetrix systems running Enginuity 5876. Possible operations are:
       - **RDF1 or RDF2 Capable** — Allows the volume to be R1 or R2 (RDF swaps allowed). Select this attribute to create an R21 volume used in a Cascaded RDF operation.
       - **RDF1 Capable** — Allows the volume to be an R1 (no RDF swaps).
       - **RDF 2 Capable** — Allows the volume to be an R2 (no RDF swaps).
   - **SCSI3 Persistent Reservation** — This can be set to enabled or disabled. Maintains any reservations (flags) whether the system goes online or offline. This field will appear dimmed for diskless volumes.
6. Do one of the following:
Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.

Expand Add to Job List, and click Run Now to perform the operation now.

**Setting volume identifiers**

This operation can be invoked from multiple locations in the Unisphere user interface. Depending on where the operation is invoked, some of the steps below may not apply.

**Procedure**

1. Select the storage system.
2. Select STORAGE > Volumes.
3. Navigate to the volume.
4. Select the volume, click \(\ldots\), and click Set Volumes > Identifier.
5. Set the volume identifiers:
   - Type the **Volume Identifier Name**. Volume identifier names must be unique from other volumes on the Symmetrix system and cannot exceed 64 characters. Only alphanumeric characters and underscores (\_\_) are allowed.
   - Type the **Volume HP Identifier Name**. HP identifier names must be a user-defined volume name (not to exceed 64 alpha-numeric characters and underscores (\_\_)) applicable to HP-mapped volumes. This value is mutually exclusive of the VMS ID. This attribute will appear grayed out for diskless volumes.
   - Type the **Volume VMS Identifier Name**. VMS identifier names must be a numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID. This attribute will appear grayed out for diskless volumes.
6. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

**Setting volume names**

When creating or duplicating volumes; or creating or expanding storage groups, you can optionally name the new volumes.

When naming volumes, you should be aware of the following:

- Volume names cannot exceed 64 characters. Only alphanumeric characters, underscores (\_\_), and periods (.) are allowed.
- Volume names plus an optional suffix cannot exceed 64 characters. If using a numerical suffix, volume names cannot exceed 50 characters (prefix) and the trailing numerical suffix number cannot exceed 14 characters. If not using a numerical suffix, all 64 characters can be specified for the volume name. The maximum starting suffix is 1000000.
• This feature is not supported for the following types of volumes: SFS, DRV, Meta members, SAVE, DATA, Vault, and diskless.

Editing volume capacities

Procedure
1. Select the storage system.
2. Select STORAGE > Volumes and click Create.
3. Click to open the Edit Volume Capacities dialog.
4. Use the drop-down menus to choose the number of volumes, the capacity and the unit to be used to measure capacity (TB, GB, MB or cylinders). Click to add another volume size.
5. Click Apply to apply your changes or Cancel to reject them.

Volume edit operations

The following volume edit operations are available:
• Editing volume capacities (see Editing volume capacities on page 199).
• Editing CKD volume capacities (see Editing CKD volume capacities on page 335).

Setting copy pace (QoS) for device groups

Procedure
1. Select the storage system.
2. Select Data Protection > Device Groups.
3. Select the device group, click , and select Replication QoS.
4. Select Operation Type from the following valid values:
   • SRDF — Sets the copy pace priority during SRDF operations.
   • Mirror Copy — Sets the copy pace priority during mirror operations.
   • Clone — Sets the copy pace priority during clone operations.
   • VLUN — Sets the copy pace priority during virtual LUN migrations. This option is only available on arrays running Enginuity 5876 or higher.
5. Select the Copy Pace from the following valid value:
   • 0 -16 — Sets the copy pace, with 0 (the default) as the fastest and 16 as the slowest.
   • STOP — Stops the copy. Not supported when the Operation Type is BCV, or the array is running an Enginuity version lower than 5876.
   • URGENT — Sets the copy pace to urgent, which may be faster than the default (0). Not supported when the Operation Type is BCV, or the array is running an Enginuity version lower than 5876.
6. If performing this operation on a group: Select the type of volumes on which to perform the operation.
7. Click OK.
QOS for replication

The QoS (Quality of Service) feature adjusts the data transfer (copy) pace on individual volumes or groups of volumes (DGs or SGs) for certain operations. By increasing the response time for specific copy operations, the overall performance of other storage volumes increases.

The following tasks are supported:

- Setting copy pace (QoS) for storage groups on page 200
- Setting copy pace (QoS) for device groups on page 199
- Setting copy pace (QoS) for volumes on page 201

Setting copy pace (QoS) for storage groups

Procedure

1. Select the storage system.
2. Select STORAGE > Storage Groups to open the Storage Groups list view.
3. Perform one of the following actions:
   - For all volumes in the storage group: Select the storage group, click , and select Replication QoS to open the Set Replication Priority QoS dialog box.
   - For some volumes in the storage group:
     a. Select a storage group.
     b. Click , and select the number next to Volumes to open the Volumes list view.
     c. Select the volumes, click , and select Set Volumes > Replication QoS.
4. Optional: Select the Show Selected Group Copy Pace checkbox.
5. Select Operation Type from the following valid values:
   - SRDF — Sets the copy pace priority during RDF operations.
   - Mirror Copy — Sets the copy pace priority during mirror operations.
   - Clone — Sets the copy pace priority during clone operations.
   - VLUN — Sets the copy pace priority during virtual LUN migrations. This option is only available on arrays running Enginuity 5876 or higher.
6. Select the Copy Pace from the following valid values:
   - 0 - 16 — Sets the copy pace, with 0 (the default) as the fastest and 16 as the slowest.
   - STOP — Stops the copy. Not supported when the Operation Type is BCV, or the array is running an Enginuity version lower than 5876.
   - URGENT — Sets the copy pace to urgent, which may be faster than the default (0). Not supported when the Operation Type is BCV.
7. Click OK.

Setting copy pace (QoS) for volumes

**Procedure**

1. Select the storage system.
2. Select **Storage > Volumes**.
3. Navigate to the volume.
4. Select one or more volumes, click , and select **Replication QoS**.
5. Select **Operation Type** from the following valid values:
   - **SRDF** — Sets the copy pace priority during RDF operations.
   - **Mirror Copy** — Sets the copy pace priority during mirror operations.
   - **Clone** — Sets the copy pace priority during clone operations.
   - **VLUN** — Sets the copy pace priority during virtual LUN migrations. This option is only available on arrays running Enginuity 5876 or higher.
6. Select the **Copy Pace** from the following valid values:
   - **0 -16** — Sets the copy pace, with 0 (the default) as the fastest and 16 as the slowest.
   - **STOP** — Stops the copy. Not supported when the **Operation Type** is BCV, or the array is running an Enginuity version lower than 5876.
   - **URGENT** — Sets the copy pace to urgent, which may be faster than the default (0). Not supported when the **Operation Type** is BCV, or the array is running an Enginuity version earlier than 5876.
7. Click OK.

Managing Meta Volumes

Creating meta volumes

**Before you begin**

- Meta volumes are supported on storage systems running Enginuity 5876.
- Bound thin volumes can be used as meta heads; however, bound thin volumes cannot be used as meta members.
- Unmapped thin volumes can be formed into striped meta volumes.
- Mapped or unmapped thin volumes can be formed into concatenated meta volumes.
- For a complete list of restrictions and recommendations on creating meta volumes, refer to the *Solutions Enabler Array Controls and Management CLI User Guide*.
- When creating meta volumes, will attempt to instill best practices in the creation process by setting the following defaults in the **Create Meta Volume** wizard:
  - **Meta Volume Configuration** = Striped
  - **Meta Volume Member Count including Head** = 8

Note that these best practices do not apply to volumes created with the CKD-3390 emulation type.
Procedure

1. Select the storage system.
2. Select STOR\$GE > Volumes and click the Meta tab.
3. Click Create.
4. Select the Emulation type.
5. If creating FBA volumes, select whether to create them from Create Volumes or Use Existing Volumes volumes.
6. If creating FBA or AS/400 volumes, select the Meta Volume Configuration (Concatenated or striped).
7. Select a method for forming the meta volumes.
8. Click Next.
9. Do the following, depending on the method you selected:
   - Using Existing Virtual Volumes:
     a. Type the Number of Meta Volumes to form.
     b. Specify the Meta Volume Capacity by typing the Meta Volume Member Count including Head, and selecting a Meta Volume Member Capacity.
     c. Select a Volume Configuration for the members.
     d. To reserve the volumes, select Reserve. In addition, you can also type reserve Comments and select an Expiration Date.
        The default values for Reserve and Comments are set in Setting preferences on page 49 for volumes reservations. If the volumes are not automatically reserved, you can optionally reserve them here.
     e. If you are creating CKD meta volumes, type or select an SSID.
     f. If you are creating striped meta volumes, you can optionally select the size of the meta volumes, by clicking Advanced Options, and selecting a Striped Size.
        The striped size can be expressed in blocks or cylinders. Possible sizes in 512 byte blocks are 1920, 3840, 7680, 15360, 30720, and 61440. The stripe size must be 1920, which is the default for all versions of Enginuity. If no stripe size is specified when creating a striped meta, all Enginuity codes will consider the default stripe size as 1920 blocks of 512 bytes each.
     g. Click Next.
   - Using Existing Standard Provisioned Volumes:
     a. Type the Number of Meta Volumes to form.
     b. Specify the Meta Volume Capacity by typing the Meta Volume Member Count including Head, and selecting a Meta Volume Member Capacity.
     c. Select a Volume Configuration.
     d. Select the RAID Protection level for the meta volumes.
     e. Select the type of Disk Technology on which the meta volumes will reside.
     f. Select the Disk Group (Request/Available) containing the meta volumes.
     g. To reserve the volumes, select Reserve Volumes.
h. Click Next.
  • By Manually Selecting Existing Volumes (Advanced):
    a. Select from the listed volumes.
    b. To reserve the volumes, select Reserve Volumes.
    c. Click Next.
  • Using New Standard Provisioned Volumes:
    a. Specify the Number of Meta Volumes.
    b. Specify the Meta Volume Capacity by typing the Meta Volume Member Count including Head, and selecting a Meta Volume Member Capacity.
    c. Select a Volume Configuration.
    d. Select the RAID Protection level for the meta volumes.
    e. Select the type of Disk Technology on which the meta volumes will reside.
    f. Select a Disk Group.
    g. If you are creating CKD meta volumes, type or select an SSID.
    h. Click Next.
  • Using New Virtual Volumes:
    a. Specify the Number of Meta Volumes.
    b. Specify the Meta Volume Capacity by typing the Meta Volume Member Count including Head, and selecting a Meta Volume Member Capacity.
    c. Select a Volume Configuration.
    d. Click Next.

10. Verify your selections in the Summary page. To change any of your selections, click Back.
    Note that some changes may require you to make additional changes to your configuration.

11. Do one of the following:
    • Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
    • Expand Add to Job List, and click Run Now to perform the operation now.

Adding meta members

**Before you begin**

- Meta volumes are supported on storage systems running Enginuity 5876.
- To expand a bound striped thin meta volume on a storage system running Enginuity 5876 or higher without having to unbind the volume, however, you must select the Protect Data option.
- When expanding meta thin volumes with BCV meta protection, the volumes must be fully allocated to a pool and they must have the Persist preallocated capacity through reclaim or copy option set on them. This is because binding thin meta BCV volumes is done through the pool and not through the thin BCV volume selection. For more information on allocating thin pool capacity for thin volumes, refer to Managing thin pool allocations on page 247.
Procedure
1. Select the storage system.
2. Select STORAGE > Volumes and click the Meta tab.
3. Select the meta volume and click Add Member.
4. For striped metas only: To protect the original striped meta data, do the following:
   a. Select the Protect Data option.
   b. Type or select the name of the BCV meta head to use when protecting the data.
      By default, this field is filled in with the first available BCV.
5. Select one or more volumes to add to the meta volume.
6. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Removing meta members

Before you begin
- Meta volumes are supported on storage systems running Enginuity 5876.
- You can only remove members from concatenated meta volumes.

Procedure
1. Select the storage system.
2. Select STORAGE > Volumes and click the Meta tab.
3. Select the meta volume and click to open its Details view.
4. Click the number next to META Members to open the Meta Members list view.
5. Select one or more members and click Remove Meta Member to open the Remove Meta Volume Member dialog box.
6. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Dissolving meta volumes

Before you begin
Meta volumes are supported on storage systems running Enginuity 5876.

Procedure
1. Select the storage system.
2. Select STORAGE > Volumes and click the Meta tab.
3. Select the meta volume and click **Dissolve**.

4. Optional: If required, select **Delete Meta Members after dissolve**.
   
   Note that selecting **Delete meta members after dissolve** requires the operation to be run immediately (it cannot be scheduled).

5. Do one of the following:
   
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
   
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Converting meta volumes

**Before you begin**

Meta volumes are supported on storage systems running Enginuity 5876.

This procedure explains how to change the configuration of a meta volume.

**Procedure**

1. Select the storage system.

2. Select **STORAGE > Volumes** and click the **Meta** tab.

3. Select the meta volume and click **Convert**.

4. If converting from concatenated to striped, you can optionally specify to protect the original striped data by selecting **Protect Data** and typing or selecting the BCV meta head to use when protecting the data. By default, the BCV field is filled in with the first available BCV.

5. Do one of the following:
   
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
   
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Viewing CKD volumes

See below for procedure to view CKD volumes from the **Hosts > Mainframe** dashboard. To see the CKD volumes in a CU image, see **Viewing CKD volumes in CU image** on page 95.

**Procedure**

1. Select the storage system.

2. Select **HOSTS > Mainframe** and click on **CKD Volumes** in the **Summary** panel.
   
   The **CKD Volumes** list view is displayed. Use this list view to view and manage the volumes.

   The following properties display: however, not all properties may be available for every volume type:

   - **Name**—Assigned volume name.
   - **Type**—Type of volume.
   - **Allocated %”—% of the volume that is allocated.
   - **Capacity (GB)”—Volume capacity in Gigabytes.
**Status**—Volume status.

**Emulation**—Emulation type for the volume.

**Host Paths**—Number of masking records for the volume.

**Reserved**—Indicates whether the volume is reserved.

**Split**—The name of the associated split.

**CU Image**—The number of the associated CU image.

**Base Address**—Base Address.

The following controls are available, however, not all controls may be available for every volume type:

- Viewing CKD volume details on page 206
- Creating volumes on page 180
- Expanding existing volumes on page 193
- Deleting volumes on page 190
- Creating storage groups on page 114
- Setting volume emulation on page 98
- Setting volume attributes on page 197
- Setting volume identifiers on page 198
- Setting volume status on page 196
- QoS for replication on page 200
- Setting the SRDF GCM flag on page 438
- Resetting original device identity on page 436
- Managing thin pool allocations on page 247
- Managing thin pool allocations on page 247
- Changing volume configuration on page 192
- Duplicating volumes on page 190
- z/OS map from the volume list view on page 337
- z/OS unmap from the volume list view on page 338

**Viewing CKD volume details**

**Procedure**

1. Select the storage system.
2. Select HOSTS > Mainframe.
3. Select a CKD volume and click to open the Details view.
Note

Depending on the method you used to open this view, some of the following properties may not appear.

The following properties are displayed:

- **Masking Info** — Number of other pools.
- **Storage Groups** — Number of Storage Groups.
- **SRP** — Number of Storage Resource pools (SRPs).
- **CKD Front End Paths** — Number of CKD Front End Paths.
- **RDF Info** — RDF Info.
- **CU Image Number** — CU image number.
- **Split** — Split identifier.
- **Volume Name** — Volume name.
- **Physical Name** — Physical name.
- **Volume Identifier** — Volume identifier.
- **Type** — Volume configuration.
- **Encapsulated Volume** — Whether external volume is encapsulated. Relevant for external disks only.
- **Encapsulated WWN** — World Wide Name for encapsulated volume. Relevant for external disks only.
- **Encapsulated Device Flag** — Encapsulated device flag.
- **Encapsulated Device Array** — Encapsulated device array.
- **Encapsulated Device Name** — Encapsulated device name.
- **Status** — Volume status.
- **Reserved** — Whether the volume is reserved.
- **Capacity (GB)** — Volume capacity in GBs.
- **Capacity (MB)** — Volume capacity in MBs.
- **Capacity (CYL)** — Volume capacity in cylinders.
- **Compression Ratio** — Compression ratio.
- **Emulation** — Volume emulation.
- **AS400 Gatekeeper** — AS400 Gatekeeper indication.
- **Symmetrix ID** — Symmetrix system on which the volume resides.
- **Symmetrix Vol ID** — Symmetrix volume name/number.
- **HP Identifier Name** — User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.
- **VMS Identifier Name** — Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
- **Nice Name** — Nice name generated by Symmetrix Enginuity.
- **WWN** — World Wide Name of the volume.
- **External Identity WWN** — External Identity World Wide Name of the volume.
- **DG Name** — Name of the device group in which the volume resides, if applicable.
- **CG Name** — Name of the device group in which the volume resides, if applicable.
- **Attached BCV** — Defines the attached BCV to be paired with the standard volume.
- **Attached VDEV TGT Volume** — Volume to which this source volume would be paired.
- **RDF Type** — RDF configuration.
- **Geometry - Type** — Method used to define the volume's geometry.
- **Geometry - Number of Cylinders** — Number of cylinders.
- **Geometry - Sectors per Track** — Number of sectors per track, as defined by the volume's geometry.
- **Geometry - Tracks per Cylinder** — Number of tracks per cylinder, as defined by the volume's geometry.
- **Geometry - 512 Block Bytes** — Number of 512 blocks, as defined by the volume's geometry.
- **Geometry - Capacity (GB)** — Geometry capacity in GBs.
- **Geometry - Limited** — Indicates whether the volume is geometry limited.
- **SSID** — Subsystem ID.
- **Capacity (Tracks)** — Capacity in tracks.
- **SA Status** — Volume SA status.
- **Host Access Mode** — Host access mode.
- **Pinned** — Whether the volume is pinned.
- **RecoverPoint Tagged** — Indicates whether volume is tagged for RecoverPoint.
- **Service State** — Service state.
- **Defined Label Type** — Type of user-defined label.
- **Dynamic RDF Capability** — RDF capability of the volume.
- **Mirror Set Type** — Mirror set for the volume and the volume characteristic of the mirror.
- **Mirror Set DA Status** — Volume status information for each member in the mirror set.
- **Mirror Set Invalid Tracks** — Number of invalid tracks for each mirror in the mirror set.
- **Priority QoS** — Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).
- **Copy Pace - RDF** — Copy Pace - RDF.
- **Copy Pace - Mirror Copy** — Copy Pace - Mirror Copy.
- **Copy Pace - Clone** — Copy Pace - Clone.
- **Copy Pace - VLUN** — Copy Pace - VLUN.
- **Dynamic Cache Partition Name** — Name of the cache partition.
- **Compressed Size (GB)** — Compressed Size (GB)
• **Compressed Percentage** — Compressed Ratio (%)
• **Compressed Size Per Pool (GB)** — Compressed Size Per Pool (GB)
• **XtremSW Cache Attached** — Indicates whether XtremSW cache is attached to the volume.
• **Base Address** — Base address.
• **AS400 Gatekeeper** — AS400 Gatekeeper indication.
• **Mobility ID Enabled** — Indication if Mobility ID is enabled.
• **GCM** — GCM indication.
• **Optimized Read Miss** — Cacheless read miss status.
• **Persistent Allocation** — Persistent Allocation indication.
• **PowerPath Hosts** — Number of PowerPath hosts.
• **Mounted** — Mounted indication.
• **Process** — Process.
• **Last time used** — Last time used.

The **Details** view links you to views displaying objects contained in and associated with the virtual volume. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking **Storage Group** opens a view listing the storage groups associated with the volume.

### Viewing CKD volume front end paths

This procedure explains how to view CKD volume front end paths.

**Procedure**

1. Select the storage system.
2. Select **Hosts > CU Images** to open the **CU Images** list view.
3. Select the **CU image** and click **1**.
4. Click on the number in the **Number of Volumes** field to open the **CKD Volumes** list view.
5. Select a CKD volume and click **1** to open its **Details** view.
6. Click on the number in the **CKD Front End Paths** field to open the **CKD Front End Path** list view.
7. The following properties display:
   - **Director Identifier**—Director name.
   - **Port**—Port number.
   - **Base Address**—Assigned base address.
   - **Alias Count**—Number of aliases mapped to the port.
   - **Director Port Status**—Indicates port status.

### Viewing DLDEV volumes

This procedure explains how to view DLDEV volumes.
Procedure

1. Select the storage system.
2. Select STORAGE > Volumes and click the Virtual or Meta tab.
3. Filter on DLDEV type.
4. To view the properties and controls, see Viewing virtual volumes on page 226 or Viewing meta volumes on page 211.

Viewing DLDEV volume details

This procedure explains how to view DLDEV volume details.

Procedure

1. Select the storage system.
2. Select STORAGE > Volumes and click the Virtual or Meta tab.
3. Filter on DLDEV type.
4. Select a DLDEV volume and click to open its Details view.
5. To view the properties, see Viewing virtual volume details on page 227 or Viewing meta volume details on page 212.

Viewing masking information

This procedure explains how to view masking information.

Procedure

1. Select the storage system.
2. Select STORAGE > Storage Groups.
3. Select a storage group and click to open its Details view.
4. Click the number next to Volumes.
5. Select a volume and click to open its Details view.
6. Click the number next to Masking Info to open the volume's Masking Info view.

The following properties display:

- **Director Port** — Storage system director and port.
- **Identifier** — Volume identifier name.
- **Type** — Director type.
- **User Generated Name** — User-generated name.
- **Logged In** — Indicates if the initiator is logged into the host/target.
- **On Fabric** — Indicates if the initiator is zoned in and on the fabric.
- **Port Flag Overrides** — Flag indicating if any port flags are overridden by the initiator: Yes/No.
- **FCID LockDown** — Flag indicating if port lockdown is in effect: Yes/No.
- **Heterogeneous Host** — Whether the host is heterogeneous.
• **LUN Offset** — Whether LUN offset is enabled. This feature allows you to skip over masked holes in an array of volumes.

• **Visibility** — Whether the port is visible to the host.

### Viewing meta volumes

This procedure explains how to view meta volumes.

Meta volumes are supported on storage systems running Enginuity 5876.

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Volumes** and click the **Meta** tab.

Use the this list view to display and manage the volumes. Filter on a volume type.

The following properties display:

• **Name** — Assigned volume name.

• **Type** — Type of volume.

• **Meta Config** — Type of meta volume addressing.

• **Status** — Volume status.

• **Capacity (GB)** — Volume capacity in Gigabytes.

• **Emulation** — Emulation type for the volume.

The following controls are available:

• ![Viewing meta volume details](#) — Viewing meta volume details on page 212

• **Create** — Creating diskless volumes on page 182

• **Add Member** — Adding meta members on page 203

• **Dissolve** — Dissolving meta volumes on page 204

• **Convert** — Converting meta volumes on page 205

• **Set Volumes > Attribute** — Setting volume attributes on page 197

• **Set Volumes > Identifier** — Setting volume identifiers on page 198

• **Set Volumes > Status** — Setting volume status on page 196

• **Set Volumes > Replication QoS** — QoS for replication on page 200

• **Configuration > Change Volume Configuration** — Changing volume configuration on page 192

• **Configuration > Duplicate Volume** — Duplicating volumes on page 190

• **Configuration > Map** — Mapping volumes on page 194

• **Configuration > Unmap** — Unmapping volumes on page 195

• **RecoverPoint > Tag** — Tagging and untagging volumes for RecoverPoint (storage group level) on page 476

• **RecoverPoint > Untag** — Tagging and untagging volumes for RecoverPoint (storage group level) on page 476

• **FAST > Pin** — Pinning and unpinning volumes on page 175
Viewing meta volume details

This procedure explains how to view meta volume details.

Meta volumes are supported on storage systems running Enginuity 5876.

Procedure

1. Select the storage system.
2. Select STORAGE > Volumes and click the Meta tab.
3. Select a meta volume and click \( \text{\textdagger} \) to open the Details view.

The following properties display:

- **META Members**—Number of Meta members.
- **Storage Groups**—Number of Storage Groups.
- **FBA Front End Paths**—Number of FBA Front End Paths.
- **Back End Paths**—Number of Back End Paths.
- **Volume Name**—Volume name.
- **RDF Info**—RDF Info.
- **Physical Name**—Physical name.
- **Volume Identifier**—Volume identifier.
- **Type**—Volume configuration.
- **Encapsulated Volume**—Whether external volume is encapsulated. Relevant for external disks only.
- **Encapsulated WWN**—World Wide Name for encapsulated volume. Relevant for external disks only.
- **Encapsulated Device Flag**—Encapsulated device flag.
- **Encapsulated Device Array**—Encapsulated device array.
- **Encapsulated Device Name**—Encapsulated device name.
- **Status**—Volume status.
- **Reserved**—Whether the volume is reserved.
- **Capacity (GB)**—Volume capacity in GBs.
- **Capacity (MB)**—Volume capacity in MBs.
- **Capacity (CYL)**—Volume capacity in cylinders.
- **Emulation**—Volume emulation.
- **Symmetrix ID**—Symmetrix system on which the volume resides.
<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symmetrix Vol ID</td>
<td>Symmetrix volume name/number.</td>
</tr>
<tr>
<td>HP Identifier Name</td>
<td>User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.</td>
</tr>
<tr>
<td>VMS Identifier Name</td>
<td>Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.</td>
</tr>
<tr>
<td>Nice Name</td>
<td>Nice name generated by Symmetrix Enginuity.</td>
</tr>
<tr>
<td>WWN</td>
<td>World Wide Name of the volume.</td>
</tr>
<tr>
<td>External Identity WWN</td>
<td>External Identity World Wide Name of the volume.</td>
</tr>
<tr>
<td>Mobility ID Enabled</td>
<td>Indication if Mobility ID is enabled.</td>
</tr>
<tr>
<td>DG Name</td>
<td>Name of the device group in which the volume resides, if applicable.</td>
</tr>
<tr>
<td>CG Name</td>
<td>Name of the device group in which the volume resides, if applicable.</td>
</tr>
<tr>
<td>Attached BCV</td>
<td>Defines the attached BCV to be paired with the standard volume.</td>
</tr>
<tr>
<td>Attached VDEV TGT Volume</td>
<td>Volume to which this source volume would be paired.</td>
</tr>
<tr>
<td>RDF Type</td>
<td>SRDF configuration.</td>
</tr>
<tr>
<td>Geometry - Type</td>
<td>Method used to define the volume's geometry.</td>
</tr>
<tr>
<td>Geometry - Number of Cylinders</td>
<td>Number of cylinders.</td>
</tr>
<tr>
<td>Geometry - Sectors per Track</td>
<td>Number of sectors per track, as defined by the volume's geometry.</td>
</tr>
<tr>
<td>Geometry - Tracks per Cylinder</td>
<td>Number of tracks per cylinder, as defined by the volume's geometry.</td>
</tr>
<tr>
<td>Geometry - 512 Block Bytes</td>
<td>Number of 512 blocks, as defined by the volume's geometry.</td>
</tr>
<tr>
<td>Geometry - Capacity (GB)</td>
<td>Geometry capacity in GBs.</td>
</tr>
<tr>
<td>Geometry - Limited</td>
<td>Indicates whether the volume is geometry limited.</td>
</tr>
<tr>
<td>GCM</td>
<td>Indication if GCM is set.</td>
</tr>
<tr>
<td>SSID</td>
<td>Subsystem ID.</td>
</tr>
<tr>
<td>Capacity (Tracks)</td>
<td>Capacity in tracks.</td>
</tr>
<tr>
<td>SA Status</td>
<td>Volume SA status.</td>
</tr>
<tr>
<td>Host Access Mode</td>
<td>Host access mode.</td>
</tr>
<tr>
<td>Pinned</td>
<td>Whether the volume is pinned.</td>
</tr>
<tr>
<td>Service State</td>
<td>Service state.</td>
</tr>
<tr>
<td>Defined Label Type</td>
<td>Type of user-defined label.</td>
</tr>
<tr>
<td>Dynamic RDF Capability</td>
<td>RDF capability of the volume.</td>
</tr>
<tr>
<td>Mirror Set Type</td>
<td>Mirror set for the volume and the volume characteristic of the mirror.</td>
</tr>
<tr>
<td>Mirror Set DA Status</td>
<td>Volume status information for each member in the mirror set.</td>
</tr>
</tbody>
</table>
- **Mirror Set Invalid Tracks** — Number of invalid tracks for each mirror in the mirror set.
- **Priority QoS** — Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).
- **Dynamic Cache Partition Name** — Name of the cache partition.
- **XtremSW Cache Attached** — Indicates whether XtremSW cache is attached to the volume.
- **Optimized Read Miss** — Cacheless read miss status.
- **Persistent Allocation** — Persistent Allocation.

There are links to views displaying objects contained in and associated with the volume. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking the number next to META Members opens a view listing the members for the meta volume, excluding the meta head.

### Viewing meta volume meta members

This procedure explains how to view meta volume meta members.

**Procedure**

1. Select the storage system.
2. Select STORAGE > Volumes and click the Meta tab.
3. Select a meta volume and click to open its Details view.
4. Click the number next to META Members to open the Meta Members list view.

Use the Meta Members list view and manage the members of a meta volume, excluding the meta head.

This list view can be accessed from other volumes that contain meta volumes, that is regular and virtual volumes can contain meta volumes.

The follow properties display:

- **Name** — Meta volume name.
- **Type** — Meta volume configuration.
- **Status** — Volume status.
- **Capacity (GB)** — Volume capacity (GB).

The following controls are available:

- [Viewing meta volume member details on page 214](#)
- Add Meta Member — Adding meta members on page 203
- Remove Meta Member — Removing meta members on page 204

### Viewing meta volume member details

This procedure explains how to view meta volume member details.

Meta volumes are supported on storage systems running Enginuity 5876.
Procedure

1. Select the storage system.
2. Select STORAGE > Volumes and click the Meta tab.
3. Select a meta volume and click to open its Details view.
4. Click the number next to META Members to open the Meta Members list view.
5. Select a meta volume and click to open its Details view.

This list view can be accessed from other volumes that contain meta volumes, that is regular and virtual volumes can contain meta volumes.

Use this view to view meta volume member details.

The following properties display:

- **Physical Name**—Volume's physical name.
- **Volume Identifier**—Volume ID.
- **Type**—Volume configuration.
- **Encapsulated Volume**—Whether external volume is encapsulated. Relevant for external disks only.
- **Encapsulated WWN**—World Wide Name for encapsulated volume. Relevant for external disks only.
- **Encapsulated Device Flag**—Encapsulated device flag.
- **Encapsulated Device Array**—Encapsulated device array.
- **Encapsulated Device Name**—Encapsulated device name.
- **Status**—Volume status.
- **Reserved**—Whether the volume is reserved.
- **Capacity (GB)**—Volume capacity in GBs.
- **Capacity (MB)**—Volume capacity in MBs.
- **Capacity (CYL)**—Volume capacity in cylinders.
- **Emulation**—Volume emulation.
- **Stripe Size**—Stripe size.
- **Meta Index**—Meta Index.
- **Symmetrix ID**—Storage system on which the volume resides.
- **Symmetrix Vol ID**—Symmetrix volume name/number.
- **HP Identifier Name**—User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.
- **VMS Identifier Name**—Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
- **Nice Name**—Nice name generated by Symmetrix Enginuity.
- **WWN**—World Wide Name of the volume.
- **External Identity WWN**—External Identity World Wide Name of the volume.
- **Mobility ID Enabled** — Indication that the mobile ID is enabled or not.
- **DG Name** — Name of the device group in which the volume resides, if applicable.
- **CG Name** — Name of the device group in which the volume resides, if applicable.
- **Attached BCV** — Defines the attached BCV to be paired with the standard volume.
- **Attached VDEV TGT Volume** — Volume to which this source volume would be paired.
- **RDF Type** — RDF configuration.
- **Geometry - Type** — Method used to define the volume's geometry.
- **Geometry - Number of Cylinders** — Number of cylinders.
- **Geometry - Sectors per Track** — Number of sectors per track, as defined by the volume's geometry.
- **Geometry - Tracks per Cylinder** — Number of tracks per cylinder, as defined by the volume's geometry.
- **Geometry - 512 Block Bytes** — Number of 512 blocks, as defined by the volume's geometry.
- **Geometry - Capacity (GB)** — Geometry capacity in GBs.
- **Geometry - Limited** — Indicates whether the volume is geometry limited.
- **GCM** — GCM indication.
- **SSID** — Subsystem ID.
- **Capacity (Tracks)** — Capacity in tracks.
- **SA Status** — Volume SA status.
- **Host Access Mode** — Host access mode.
- **Pinned** — Whether the volume is pinned.
- **RecoverPoint Tagged** — Whether RecoverPoint is tagged.
- **Service State** — Service state.
- **Defined Label Type** — Type of user-defined label.
- **Dynamic RDF Capability** — RDF capability of the volume.
- **Mirror Set Type** — Mirror set for the volume and the volume characteristic of the mirror.
- **Mirror Set DA Status** — Volume status information for each member in the mirror set.
- **Mirror Set Invalid Tracks** — Number of invalid tracks for each mirror in the mirror set.
- **Priority QoS** — Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).
- **Dynamic Cache Partition Name** — Name of the cache partition.
- **XtremSW Cache Attached** — Indicates whether XtremSW cache is attached to the volume.
- **Optimized Read Miss** — Cacheless read miss status.
• **Persistent Allocation** — Persistent Allocation.

**Viewing other pool information**

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Volumes** and click the **Virtual** tab.
3. Filter on TDEV or volume type with TDEV, such as BCV+TDEV.
4. Select a thin volume and click **i** to open its **Details** view.
5. Click the number next to **Other Pool Info** to open the **Other Pool Info** view.

Use this view to view other pool information.

The following properties display:

- **Name**—Thin volume name.
- **Pool Name**—Name of pool.
- **Allocated %**—Percentage of pool allocated to the thin volume.
- **Capacity (GB)**—Amount of pool allocated to the thin volume.

**Viewing private volumes**

This procedure explains how to view the properties of private volumes.

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Volumes** and click the **Private** tab.

Use the this list view to view and manage the volumes. Filter on a volume type.

The following properties display:

- **Name**—Assigned volume name.
- **Type**—Type of volume.
- **Status**—Volume status.
- **Capacity (GB)**—Volume capacity in Gigabytes.
- **Emulation**—Emulation type for the volume.

The following controls are available:

- **i** — **Viewing private volume details** on page 218
- **Create** — **Creating private volumes** on page 182
- **Delete** — **Deleting volumes** on page 190
- **Configuration > Change Volume Configuration**—Changing volume configuration on page 192
- **Configuration > Duplicate Volume**—**Duplicating volumes** on page 190
- Assign Dynamic Cache Partition—Assigning dynamic cache partitions on page 837

Viewing private volume details

This procedure explains how to view private volume details.

Procedure

1. Select the storage system.
2. Select STOR AGE > Volumes and click the Private tab.
3. Select a private volume and click to open its Details view.

The following properties display:

- **FBA Front End Paths**—Number of FBA Front End Paths.
- **RDF Info**—RDF Info.
- **Volume Name**—Volume name.
- **Back End Paths**—Number of Back End Paths.
- **Physical Name**—Physical name.
- **Volume Identifier**—Volume identifier.
- **Type**—Volume configuration.
- **Encapsulated Volume**—Whether external volume is encapsulated. Relevant for external disks only.
- **Encapsulated WWN**—World Wide Name for encapsulated volume. Relevant for external disks only.
- **Encapsulated Device Flag**—Encapsulated device flag.
- **Encapsulated Device Array**—Encapsulated device array.
- **Encapsulated Device Name**—Encapsulated device name.
- **Status**—Volume status.
- **Reserved**—Whether the volume is reserved.
- **Capacity (GB)**—Volume capacity in GBs.
- **Capacity (MB)**—Volume capacity in MBs.
- **Capacity (CYL)**—Volume capacity in cylinders.
- **Emulation**—Volume emulation.
- **Symmetrix ID**—Symmetrix system on which the volume resides.
- **Symmetrix VolID**—Symmetrix volume name/number.
- **HP Identifier Name**—User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.
- **VMS Identifier Name**—Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
- **Nice Name**—Nice name generated by Symmetrix Enginuity.
- **WWN**—World Wide Name of the volume.
- **External Identity WWN**—External Identity World Wide Name of the volume.
- **DG Name** — Name of the device group in which the volume resides, if applicable.
- **CG Name** — Name of the device group in which the volume resides, if applicable.
- **Attached BCV** — Defines the attached BCV to be paired with the standard volume.
- **Attached VDEV TGT Volume** — Volume to which this source volume would be paired.
- **RDF Type** — RDF configuration.
- **Geometry - Type** — Method used to define the volume's geometry.
- **Geometry - Number of Cylinders** — Number of cylinders.
- **Geometry - Sectors per Track** — Number of sectors per track, as defined by the volume's geometry.
- **Geometry - Tracks per Cylinder** — Number of tracks per cylinder, as defined by the volume's geometry.
- **Geometry - 512 Block Bytes** — Number of 512 blocks, as defined by the volume's geometry.
- **Geometry - Capacity (GB)** — Geometry capacity in GBs.
- **Geometry - Limited** — Indicates whether the volume is geometry limited.
- **GCM** — GCM indication.
- **SSID** — Subsystem ID.
- **Capacity (Tracks)** — Capacity in tracks.
- **SA Status** — Volume SA status.
- **Host Access Mode** — Host access mode.
- **Pinned** — Whether the volume is pinned.
- **RecoverPoint Tagged** — Indicates whether volume is tagged for RecoverPoint.
- **Service State** — Service state.
- **Defined Label Type** — Type of user-defined label.
- **Dynamic RDF Capability** — RDF capability of the volume.
- **Mirror Set Type** — Mirror set for the volume and the volume characteristic of the mirror.
- **Mirror Set DA Status** — Volume status information for each member in the mirror set.
- **Mirror Set Invalid Tracks** — Number of invalid tracks for each mirror in the mirror set.
- **Priority QoS** — Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).
- **Dynamic Cache Partition Name** — Name of the cache partition.

The Details view links you to views displaying objects contained in and associated with the volume. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking the number next to **Back End Paths** opens a view listing the back end paths associated with the volume.
Viewing regular volumes

This procedure explains how to view regular volumes

Procedure

1. Select the storage system.
2. Select STORAGE > Volumes and click the Regular tab.

Use the this list view to view and manage the volumes. Filter on a volume type. The following properties display:

- **Name**—Assigned volume name.
- **Type**—Type of volume.
- **Status**—Volume status.
- **Capacity (GB)** — Volume capacity in Gigabytes.
- **Emulation**—Emulation type for the volume.

The following controls are available:

- **Viewing regular volume details** on page 221
- **Create**—Creating diskless volumes on page 182
- **Deleting volumes** on page 190
- **Set Volumes > Attribute**—Setting volume attributes on page 197
- **Set Volumes > Identifier**—Setting volume identifiers on page 198
- **Set Volumes > Status**—Setting volume status on page 196
- **Set Volumes > Replication QoS**—QOS for replication on page 200
- **Configuration > Change Volume Configuration**—Changing volume configuration on page 192
- **Configuration > Duplicate Volume**—Duplicating volumes on page 190
- **Configuration > Map**—Mapping volumes on page 194
- **Configuration > Unmap**—Unmapping volumes on page 195
- **Configuration > z/OS Map**—z/OS map from the volume list view on page 337
- **Configuration > z/OS Unmap**—z/OS unmap from the volume list view on page 338
- **RecoverPoint > Tag**—Tagging and untagging volumes for RecoverPoint (storage group level) on page 476
- **RecoverPoint > Untag** — Tagging and untagging volumes for RecoverPoint (storage group level) on page 476
- **FAST > Pin**—Pinning and unpinning volumes on page 175
- **FAST > Unpin**—Pinning and unpinning volumes on page 175
- **Assign Dynamic Cache Partition**—Assigning dynamic cache partitions on page 837
Viewing regular volume details

This procedure explains how to view regular volume details.

Procedure

1. Select the storage system.
2. Select STORAGE > Volumes and click the Regular tab.
3. Select a regular volume and click to open the Details view.

The Details view allows you to view and manage a volume.

Properties panel

The following properties display:

- **Masking Info** — Masking Info.
- **Storage Groups** — Number of Storage Groups.
- **FBA Front End Paths** — Number of FBA Front End Paths.
- **RDF Info** — RDF Info.
- **Volume Name** — Volume name.
- **Back End Paths** — Number of Back End Paths.
- **Physical Name** — Physical name.
- **Volume Identifier** — Volume identifier.
- **Type** — Volume configuration.
- **Encapsulated Volume** — Whether external volume is encapsulated. Relevant for external disks only.
- **Encapsulated WWN** — World Wide Name for encapsulated volume. Relevant for external disks only.
- **Encapsulated Device Flag** — Encapsulated device flag.
- **Encapsulated Device Array** — Encapsulated device array.
- **Encapsulated Device Name** — Encapsulated device name.
- **Status** — Volume status.
- **Reserved** — Whether the volume is reserved.
- **Capacity (GB)** — Volume capacity in GBs.
- **Capacity (MB)** — Volume capacity in MBs.
- **Capacity (Cylinders)** — Volume capacity in cylinders.
- **Emulation** — Volume emulation.
- **AS400 Gatekeeper** — AS400 Gatekeeper indication.
- **Symmetrix ID** — Symmetrix system on which the volume resides.
- **Symmetrix Volume ID** — Symmetrix volume name/number.
- **HP Identifier Name** — User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.

- **VMS Identifier Name** — Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.

- **Nice Name** — Nice name generated by Symmetrix Enginuity.

- **WWN** — World Wide Name of the volume.

- **External Identity WWN** — External Identity World Wide Name of the volume.

- **DG Name** — Name of the device group in which the volume resides, if applicable.

- **CG Name** — Name of the device group in which the volume resides, if applicable.

- **Attached BCV** — Defines the attached BCV to be paired with the standard volume.

- **Attached VDEV TGT Volume** — Volume to which this source volume would be paired.

- **RDF Type** — RDF configuration.

- **Geometry - Type** — Method used to define the volume's geometry.

- **Geometry - Number of Cylinders** — Number of cylinders.

- **Geometry - Sectors per Track** — Number of sectors per track, as defined by the volume's geometry.

- **Geometry - Tracks per Cylinder** — Number of tracks per cylinder, as defined by the volume's geometry.

- **Geometry - 512 Block Bytes** — Number of 512 blocks, as defined by the volume's geometry.

- **Geometry - Capacity (GB)** — Geometry capacity in GBs.

- **Geometry - Limited** — Indicates whether the volume is geometry limited.

- **GCM** — GCM indication.

- **SSID** — Subsystem ID.

- **Capacity (Tracks)** — Capacity in tracks.

- **SA Status** — Volume SA status.

- **Host Access Mode** — Host access mode.

- **Pinned** — Whether the volume is pinned.

- **RecoverPoint Tagged** — Indicates whether volume is tagged for RecoverPoint.

- **Service State** — Service state.

- **Defined Label Type** — Type of user-defined label.

- **Dynamic RDF Capability** — RDF capability of the volume.

- **Mirror Set Type** — Mirror set for the volume and the volume characteristic of the mirror.

- **Mirror Set DA Status** — Volume status information for each member in the mirror set.

- **Mirror Set Invalid Tracks** — Number of invalid tracks for each mirror in the mirror set.
• **Priority QoS** — Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).

• **Dynamic Cache Partition Name** — Name of the cache partition.

• **Copy Pace - RDF** — Copy pace priority during RDF operations.

• **Copy Pace - Mirror Copy** — Copy pace priority during mirror operations.

• **Copy Pace - Clone** — Copy pace priority during clone operations.

• **Copy Pace - VLUN** — Copy pace priority during virtual LUN operations.

• **XtremSW Cache Attached** — Indicates whether XtremSW cache is attached to the volume.

• **Optimized Read Miss** — Cacheless read miss status.

• **Persistent Allocation** — Persistent Allocation indication.

The **Details** view links you to views displaying objects contained in and associated with the volume. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking the number next to **Storage Groups** opens a view listing the storage groups associated with the volume.

### Viewing reserved volumes

**Procedure**

1. Select the storage system.

2. In the dashboard, click the **System Health** tab.

3. In the **Action** panel, click **View Reservations**.

4. Select the reservation and click 🔄.

5. Click the number next to **Reserved Volumes**.

The **Reserved Volume** list view is displayed.

Use the **Reserved Volumes** list view to display and manage the volumes held in a reservation.

The following properties display:

• **Name** — Assigned volume name.

• **Type** — Type of volume.

• **Capacity (GB)** — Volume capacity in Gigabytes.

• **Status** — Volume status.

• **Reserved** — Indicates whether the volume is reserved.

• **Emulation** — Emulation type for the volume.

The following controls are available:

• 🔄 — **Viewing reserved volume details** on page 224.
Viewing reserved volume details

Procedure

1. Select the storage system.
2. In the dashboard, click the System Health tab.
3. In the Action panel, click View Reservations.
4. Select the reservation and click i.
   Opens the Details view.
5. Click the number next to Reserved Volumes to open the Reserved Volumes list view.

The following properties display:

- **Name**—Volume name.
- **Volume Identifier**—Volume identifier.
- **Type**—Volume configuration.
- **Encapsulated Volume**—Whether external volume is encapsulated. Relevant for external disks only.
- **Status**—Volume status.
- **Reserved**—Whether the volume is reserved.
- **Capacity (GB)**—Volume capacity in GBs.
- **Capacity (MB)**—Volume capacity in MBs.
- **Capacity (Cylinders)**—Volume capacity in cylinders.
- **Emulation**—Volume emulation.
- **Symmetrix ID**—Storage system on which the volume resides
- **Symmetrix Volume ID**—Symmetrix volume name/number.
- **HP Identifier Name**—User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.
- **VMS Identifier Name**—Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
- **Nice Name**—Nice name generated by Symmetrix Enginuity.
- **WWN**—World Wide Name of the volume.
- **DG Name**—Name of the device group in which the volume resides, if applicable.
- **CG Name**—Name of the consistency group in which the volume resides, if applicable.
- **Attached BCV**—Defines the attached BCV to be paired with the standard volume.
- **Attached VDEV TGT Volume**—Volume to which this source volume would be paired.
- **RDF Type**—RDF configuration.
Viewing SAVE volumes

This procedure explains how to view SAVE volumes.

**Procedure**
1. Select **STORAGE > Volumes** and click the **Private** tab.
2. Filter on SAVE type.
3. To view the properties and controls, see Viewing private volumes on page 217.

Viewing SAVE volume details

This procedure explains how to view SAVE volume details.

**Procedure**
1. Select the storage system.
2. Select **STORAGE > Volumes** and click the **Private** tab.
3. Filter on SAVE type.
4. Select a SAVE volume and click ![Details](image) to open its **Details** view.
5. To view the properties, see Viewing private volume details on page 218.

Viewing storage resource pool information

This procedure explains how to view storage resource pool information.

**Procedure**
1. Select the storage system.
2. Select **Storage > Volumes** to open the **Volumes** list view.
3. Select the volume and click ![Details](image) to open its **Details** view.
4. Click the number next to **SRP** to go to the **Storage Resource Pool** view for the volume.
   
   The following properties display:
   - **Name**—Volume name.
   - **SRP Name**—Storage resource pool name.
   - **Allocated**—Volume capacity allocated.
   - **Capacity**—Total volume capacity.
   - **Allocated %**—Percent of volume used.

Viewing thin volumes

This procedure explains how to view thin volumes.

**Procedure**
1. Select the storage system.
2. Select **STORAGE > Volumes** and click the **Virtual** tab.
3. Filter on a thin volume type, such as TDEV.
4. To view the properties and controls, see Viewing virtual volumes on page 226.

**Viewing thin volume details**

This procedure explains how to view thin volume details.

**Procedure**

1. Select the storage system.
2. Select STORAGE > Volumes and click the Virtual tab.
3. Filter on a thin volume type, such as TDEV.
4. Select a thin volume and click ♦ to open its Details view.
5. To view the properties, see Viewing virtual volume details on page 227.

**Viewing thin volume bound pool information**

This procedure explains how to view thin volume bound pool information.

**Procedure**

1. Select the storage system.
2. Select STORAGE > Volumes and click one of the panels.
3. Select the thin volume and click ♦ to open its Details view.
4. Click the number next to Bound Pool Info to open the Bound Pool Info view.

The following properties display:

- **Name**—Thin volume name.
- **Pool Name**—Name of pool.
- **Allocated %**—Percentage of pool allocated to the thin volume.
- **Capacity (GB)**—Capacity in GB.
- **Allocated (GB)**—Number of GB allocated from the pool for exclusive use by the thin volume.
- **Subscription %**—Ratio between the DATA volume pool’s enabled capacity and the thin volume subscribed capacity.
- **Written (GB)**—Number of allocated GB in the DATA volume pool that the thin volume has used.
- **Shared Tracks**—Whether tracks are shared between thin volumes.
- **Persistent Allocation**—Indicates persistent allocations: All, some, or none.

**Viewing virtual volumes**

This procedure explains how to view virtual volumes.

**Procedure**

1. Select the storage system.
2. Select STORAGE > Volumes and click the Virtual tab.

Use the this list view to view and manage the volumes. Filter on a volume type.
The following properties display:

- **Name**—Assigned volume name.
- **Type**—Type of volume.
- **Emulation**—Emulation type for the volume.
- **Capacity (GB)**—Volume capacity in Gigabytes.
- **Status**—Volume status.

The following controls are available:

- Viewing virtual volume details on page 227
- Create—Creating VDEV volumes on page 189
- Deleting volumes on page 190
- Set Volumes > Attribute—Setting volume attributes on page 197
- Set Volumes > Identifier—Setting volume identifiers on page 198
- Set Volumes > Status—Setting volume status on page 196
- Set Volumes > Replication QoS—QoS for replication on page 200
- Configuration > Change Volume Configuration—Changing volume configuration on page 192
- Configuration > Duplicate Volume—Duplicating volumes on page 190
- Configuration > Map—Mapping volumes on page 194
- Configuration > Unmap—Unmapping volumes on page 195
- RecoverPoint > Tag—Tagging and untagging volumes for RecoverPoint (storage group level) on page 476
- RecoverPoint > Untag—Tagging and untagging volumes for RecoverPoint (storage group level) on page 476
- Allocate/Free/Reclaim > Start—Managing thin pool allocations on page 247
- Allocate/Free/Reclaim > Stop—Managing thin pool allocations on page 247
- FAST > Bind—Binding/Unbinding/Rebinding thin volumes on page 260
- FAST > Unbind—Binding/Unbinding/Rebinding thin volumes on page 260
- FAST > Rebind—Binding/Unbinding/Rebinding thin volumes on page 260
- FAST > Pin—Pinning and unpinning volumes on page 175
- FAST > Unpin—Pinning and unpinning volumes on page 175
- Assign Dynamic Cache Partition—Assigning dynamic cache partitions on page 837
- VLUN Migration—VLUN Migration dialog box on page 263
- Set Optimized Read Miss—Setting optimized read miss on page 195

**Viewing virtual volume details**

This procedure explains how to view virtual volume details.
Procedure

1. Select the storage system.
2. Select STORAGE > Volumes and click the Virtual panel.
3. Select a volume and click to open its Details view.

The Details view allows you to view and manage a volume. The following properties display:

- **Bound Pool Info** — Number of bound pools.
- **Other Pool Info** — Number of other pools.
- **Masking Info** — Number of other pools.
- **Storage Groups** — Number of Storage Groups.
- **FBA Front End Paths** — Number of FBA Front End Paths.
- **RDF Info** — RDF Info.
- **Volume Name** — Volume name.
- **Physical Name** — Physical name.
- **Volume Identifier** — Volume identifier.
- **Type** — Volume configuration.
- **Encapsulated Volume** — Whether external volume is encapsulated. Relevant for external disks only.
- **Encapsulated WWN** — World Wide Name for encapsulated volume. Relevant for external disks only.
- **Encapsulated Device Flag** — Encapsulated device flag.
- **Encapsulated Device Array** — Encapsulated device array.
- **Encapsulated Device Name** — Encapsulated device name.
- **Status** — Volume status.
- **Reserved** — Whether the volume is reserved.
- **Capacity (GB)** — Volume capacity in GBs.
- **Capacity (MB)** — Volume capacity in MBs.
- **Capacity (CYL)** — Volume capacity in cylinders.
- **Emulation** — Volume emulation.
- **AS400 Gatekeeper** — AS400 Gatekeeper indication.
- **Symmetrix ID** — Symmetrix system on which the volume resides.
- **Symmetrix Vol ID** — Symmetrix volume name/number.
- **HP Identifier Name** — User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.
- **VMS Identifier Name** — Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
- **Nice Name** — Nice name generated by Symmetrix Enginuity.
- **WWN** — World Wide Name of the volume.
- **External Identity WWN** — External Identity World Wide Name of the volume.
- **DG Name** — Name of the device group in which the volume resides, if applicable.
- **CG Name** — Name of the device group in which the volume resides, if applicable.
- **Attached BCV** — Defines the attached BCV to be paired with the standard volume.
- **Attached VDEV TGT Volume** — Volume to which this source volume would be paired.
- **RDF Type** — RDF configuration.
- **Geometry - Type** — Method used to define the volume's geometry.
- **Geometry - Number of Cylinders** — Number of cylinders.
- **Geometry - Sectors per Track** — Number of sectors per track, as defined by the volume's geometry.
- **Geometry - Tracks per Cylinder** — Number of tracks per cylinder, as defined by the volume's geometry.
- **Geometry - 512 Block Bytes** — Number of 512 blocks, as defined by the volume's geometry.
- **Geometry - Capacity (GB)** — Geometry capacity in GBs.
- **Geometry - Limited** — Indicates whether the volume is geometry limited.
- **GCM** — GCM indication.
- **SSID** — Subsystem ID.
- **Capacity (Tracks)** — Capacity in tracks.
- **SA Status** — Volume SA status.
- **Host Access Mode** — Host access mode.
- **Pinned** — Whether the volume is pinned.
- **RecoverPoint Tagged** — Indicates whether volume is tagged for RecoverPoint.
- **Service State** — Service state.
- **Defined Label Type** — Type of user-defined label.
- **Dynamic RDF Capability** — RDF capability of the volume.
- **Mirror Set Type** — Mirror set for the volume and the volume characteristic of the mirror.
- **Mirror Set DA Status** — Volume status information for each member in the mirror set.
- **Mirror Set Invalid Tracks** — Number of invalid tracks for each mirror in the mirror set.
- **Priority QoS** — Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).
- **Dynamic Cache Partition Name** — Name of the cache partition.
- **Compressed Size (GB)** — Compressed Size (GB)
- **Compressed Ratio (%)** — Compressed Ratio (%)
- **Compressed Size Per Pool (GB)** — Compressed Size Per Pool (GB)
- **XtremSW Cache Attached** — Indicates whether XtremSW cache is attached to the volume.
- **Optimized Read Miss** — Cacheless read miss status.
- **Persistent Allocation** — Persistent Allocation indication.

The Details view links you to views displaying objects contained in and associated with the virtual volume. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking **Storage Group** opens a view listing the two storage groups associated with the volume.

### Viewing volume back end paths

This procedure explains how to view volume back end paths.

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Volumes** and click one of the panels.
3. Select a volume and click to open its Details view.
4. Click the number next to **Back End Paths**.

This view allows you to view the back end paths associated with the volume.

The following properties display:

- **Name** — Name.
- **Director Identifier** — Director identifier.
- **DA Interface** — DA interface ID.
- **SCSI ID** — Disk SCSI ID.
- **DA Volume Number** — DA volume ID.
- **Hyper Number** — Hyper ID.
- **Hyper Capacity** — Hyper capacity.
- **Member Status** — Hyper member status.
- **Member Number** — Hyper member number.
- **Disk Group Pretty Name** — Name of disk group.
- **Disk Capacity** — Capacity of disk.
- **Spindle** — Spindle ID.

### Viewing volume FBA front end paths

This procedure explains how to view volume FBA front end paths.

**Procedure**

1. Select the storage system.
2. Select a volume and click to open its Details view.
3. Click the number next to **FBA Front End Paths** to open the **FBA Front End Paths** list view.

Use the FBA Front End Paths list view to view the FBA front end paths associated with a volume.

The following properties display:
• **Director Identifier** — Director name.
• **Port** — Port number.
• **VBus** — VBus number.
• **TID** — Disk SCSI ID.
• **Symm LUN** — Symmetrix LUN number.
• **PDeVName** — Physical device name.
• **Director Port Status** — Director port status.

### Viewing volume RDF information

This procedure explains how to view volume RDF information.

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Volumes** and click one of the tabs.
3. Select a volume and click to open its Details view.
4. Click the number next to **RDF Info** to open the RDF Info list view.

The following properties display:

- **Remote SymmID** — Remote Symmetrix serial ID.
- **RDev** — Symmetrix volume name.
- **RDev Config** — Volume configuration.
- **Capacity (GB)** — Volume capacity.
- **RDFG** — RDF group containing the volume.
- **Pair State** — State of the pair of which the volume is part.
- **RDF Feature** — SRDF copy type.
- **CSRMT** — CSRMT — RDFA Flags:

<table>
<thead>
<tr>
<th>Consistency:</th>
<th>X = Enabled, . = Disabled, - = N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status:</td>
<td>A = Active, I = Inactive, - = N/A</td>
</tr>
<tr>
<td>RDF Mode:</td>
<td>S = Single-session, M = MSC, - = N/A</td>
</tr>
<tr>
<td>MSC Cleanup:</td>
<td>C = MSC Cleanup required, - = N/A</td>
</tr>
<tr>
<td>Transmit Idle:</td>
<td>X = Enabled, . = Disabled, - = N/A</td>
</tr>
<tr>
<td>SE Status:</td>
<td>A = Active, I = Inactive, - = N/A</td>
</tr>
<tr>
<td>Autostart:</td>
<td>X = Enabled, . = Disabled, - = N/A</td>
</tr>
</tbody>
</table>

- **R1 Inv** — Number of invalid tracks on the R1 volume.
- **R2 Inv** — Number of invalid tracks on the R2 volume.
- **RA Status** — Status of the RDF director.
- **Link Status** — Indicates link state.
- **RDF State** — Volume RDF state.
Remote RDF State—Remote volume RDF state.

RDF Status—Volume RDF status.

Device Config RDFA WPACE Exempt—Indicates is write pacing exemption capability is enabled or disabled.

Effective RDFA WPACE Exempt—Indicates if effective write pacing exemption capability is enabled or disabled.

Select Volume Range dialog box

Use this dialog box to select the range of volumes for the operation.

The following properties display:

Volume Range—Range of volumes.

CU Image Number—CU image containing the volumes.

SSID—Subsystem ID assigned to the volumes.

Base Address—Base addresses assigned to the volumes.

Aliases—Aliases assigned to the volumes.

Advanced Options dialog

Refer to the parent help topic for information on the Advanced Options dialog.

Viewing disk groups

Procedure

1. Select the storage system.

2. Select STORAGE > Disk Groups to open the Disk Groups list view.

Use this list view to view and manage disk groups.

The following properties display:

- Name—Name of disk group; format is: number -- name.
- Technology—Technology type for the disk group.
- Disk Location—Indicates whether disk is internal or external.
- Disks—Number of disks in the disk group.
- Used Capacity (%)—Percent total used capacity of the disk group, displayed in bar graph format and the actual percent number.
- Total Capacity (GB)—Total capacity in GB of the disk group.

The following controls are available:

- Viewing disk group details on page 233
- Rename—Change the name of a disk group.
- Deleting disk groups on page 239
Viewing disk group details

Procedure
1. Select the storage system.
2. Select STORAGE > Disk Groups to open the Disk Groups list view.
3. Select the disk group from the list, click 1, and do one of the following:
   - Click the Details tab.
     The following properties display:
     - **Name**—Name of disk group; format is: `number -- name`.
     - **Technology**—Technology type for the disk group.
     - **Used Capacity (GB)**—Used capacity.
     - **Free Capacity (GB)**—Free capacity.
     - **Total Capacity (GB)**—Total capacity.
     - **Speed (RPM)**—Speed of the disks in the group.
     - **From Factor**—Form factor.
     - **Disk Location**—Whether the disks in the group are internal or external.
     - **Number of Disks**—Number of disks.
     - **Number of Spare Disks**—Number of spare disks.
   - Click the Disk Group Usage Report tab.
     A visual representation of used capacity as a percentage of overall capacity is displayed.

Viewing disks in disk group

Procedure
1. Select the storage system.
2. Select STORAGE > Disk Groups to open the Disk Groups list view.
3. Select the disk group from the list, click 1, and click the Details tab.
4. Click the number next to **Number of Disks** to open the Disks list view.
   Use the Disks list view to view and manage data disks in the disk group.
   The following properties display:
   - **Spindle**—Disk Spindle ID.
   - **Dir**—Disk director ID.
   - **Int**—DA SCSI path.
   - **TID**—Disk SCSI ID.
   - **Vendor ID**—Disk vendor.
   - **Product Revision**—Product version number.
   - **Hypers**—Number of disk hypers.
   - **Total Capacity (GB)**—Disk capacity.
Viewing disk details

Procedure

1. Select the storage system.
2. Select STORAGE > Disk Groups to open the Disk Groups list view.
3. Select the disk group, click ⌁, and click the Details tab to open its Details view.
4. Click the number next to Number of Disks to open the Disks for Disk Group list view.
5. Select the disk group from the list, click ⌁, and do one of the following:
   - Click the Details tab.
     The following properties display:
     - **Spindle**—Spindle ID.
     - **Disk ID**—Disk Identification.
     - **Int**—DA SCSI path.
     - **TID**—Disk SCSI ID.
     - **External WWN**—World Wide Name of the external LUN.
     - **Disk Group**—Disk group number.
     - **Disk Location**—Location of disk.
     - **Disk Technology**—Disk technology type.
     - **Speed (RPM)**—Physical disk revolutions per minute.
     - **Form Factor**—Form factor of the disk.
     - **Vendor ID**—Disk vendor ID.
     - **Product ID**—Product ID.
     - **Product Revision**—Product revision number.
     - **Serial ID**—Serial number.
     - **Disk Blocks**—Number of disk blocks.
     - **Actual Disk Blocks**—Actual number of disk blocks.
     - **Block Size**—Size of each block.
     - **Total Capacity (GB)**—Useable disk capacity in Gigabytes.
     - **Free Capacity (GB)**—Free disk capacity in Gigabytes.
     - **Actual Capacity (GB)**—Actual disk capacity in Gigabytes.
     - **Used (%)**—Percentage of used disk capacity to the total disk capacity.
     - **Rated Disk Capacity (GB)**—Rated capacity of the disk.
- **Spare Disk**—Indicates if disk is a spare.
- **Encapsulated**—If the disk is external, this indicates if it is encapsulated (True) or not (False).
- **Disk Service State**—Indicates disk service state.

The Details panel provides links to views for objects contained in or associated with the disk group. Each group link is followed by the name of the group, or by a number, indicating the number of objects in the corresponding view. For example, clicking **Number of Hypers** opens the view listing the hypers contained in the disk.

- Click the **Disk Group Usage Report** tab. A visual representation of used capacity as a percentage of overall capacity is displayed.

### Viewing disk hyper volumes

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Disk Groups** to open the **Disk Groups** list view.
3. Select the disk group, click **i**, and click the **Details** tab.
4. Click the number next to **Number of Disks** to open the **Disks for Disk Group** list view.
5. Select a disk, click **i**, and click the **Details** tab.
6. Click the number next to **Number of Hypers** to open the **Hypers for Disk** list view.

Use the **Hypers for Disk** list view to view the hyper volumes in a disk group. The following properties display:

- **Hyper**—Volume hyper number.
- **Volumes**—Disk adapter logical volume number (1 - n).
- **Hyper Type**—Hyper type.
- **Mirror**—Mirror position of hyper.
- **Capacity (GB/Cyl)**—Disk capacity in GB/Cylinders.
- **Symm Volume**—Symmetrix volume number.
- **Hyper Status**—Hyper status.
- **Emulation**—Emulation of hyper volume.

The following control is available:

- **i**—Viewing hyper volume details on page 235

### Viewing hyper volume details

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Disk Groups** to open the **Disk Groups** list view.
3. Select the disk group, click \( i \), and click the Details tab.
4. Click the number next to **Number of Disks** to open the **Disks for Disk Group** list view.
5. Select a disk, click \( i \), and click the Details tab.
6. Click the number next to **Number of Hypers** to open the **Hypers for Disk** list view.
7. Select a hyper volume and click \( i \) to open its Details view.
8. Use the hyper volume Details view to view the properties of a hyper volume.

The following properties display:
- **Hyper Number**—Volume hyper number.
- **DA Volume**—Disk adapter logical volume number (1 - n).
- **Hyper Type**—Hyper type.
- **Mirror**—Mirror position of hyper.
- **Capacity (GB/Cyl)**—Disk capacity in GB/Cylinders.
- **Symm Volume**—Symmetrix volume number.
- **Raid Group**—RAID-S group number.
- **Original Mirror**—Mirror position of hyper.
- **Hyper Status**—Hyper status.
- **Emulation**—Emulation of hyper volume.

**Viewing list for a hyper type**

Depending on your selection, a list is displayed for one of the following:
- MetaHypers
- Raid5Hyper
- Raid5MetaHyper
- Raid6Hyper
- Raid6MetaHyper
- Hypers
- TWM
- MetaTWM
- MetaMembers

**Viewing volumes for disk**

**Procedure**
1. Select the storage system.
2. Select **STORAGE > Disk Groups** to open the **Disk Groups** list view.
3. Select the disk group, click \( i \), and click the Details tab.
4. Click the number next to **Number of Disks** to open the **Disks for Disk Group** list view.
5. Select a disk and click to open the details view for the disk.
6. Click the number next to Number of Volumes to open the Volumes view.

Viewing paths for disks

Procedure
1. Select the storage system.
2. Select STORAGE > Disk Groups to open the Disk Groups list view.
3. Select the disk group, click , and click the Details tab.
4. Click the number next to Disks to open the Disks for Disk Group list view.
5. Select a disk, click , and click the Details tab.
6. Click the number next to Number of Paths to open the Paths for Disk list view.

Use the Paths for Disk list view to view the paths for a disk.
The following properties display:
- Dir—Director Identifier. Possible values are a director number or the word "Multi," which indicates that the hyper can see multiple directors.
- Port—Director port number.
- Remote Port WWN—World Wide Name of the port.
- Active Path—Whether active path is being used (True/False).
- Failover—Whether failover is being used (True/False).

Viewing spare disks in disk group

Procedure
1. Select the storage system.
2. Select STORAGE > Disk Groups to open the Disk Groups list view.
3. Select the disk group and click .
4. In the Details panel, click the number next to Number of Spare Disks to open the Spare Disks for Disk Group view.

Use the Spare Disks for Disk Group view to view the spare disks in a disk group.
The following properties display:
- Dir—Director ID.
- Int—DA SCSI path.
- TID—Disk SCSI ID.
- Hypers—Number of hypers.
- Disk Group—Disk group number where disk is contained.
- Speed (RPM)—Physical disk revolutions per minute.
- Total Capacity (GB)—Total disk in GB.
Failed Dir—Failed disk director ID.
Failed DA Number—Failed disk DA number.
Failed DA Int—Failed disk DA SCSI path.
Failed Disk SCSI ID—Failed disk SCSI ID.
Failed Spindle ID—Failed disk Spindle ID.

The following controls are available:

- Viewing spare disk details on page 238

Viewing spare disk details

Procedure
1. Select the storage system.
2. Select STORAGE > Disk Groups to open the Disk Groups list view.
3. Select the disk group and click .
4. In the Details panel, click the number next to Number of Spare Disks to open the Spare Disks for Disk Group view.
5. Select a disk and click to open the its Details view.

Use the disk Details view to view the properties of a spare disk. The following properties display:

- Spindle—Spindle ID
- Dir—Director ID
- Int—DA SCSI path
- TID—Disk SCSI ID
- External WWN—External world wide name
- Disk Group—Disk group number
- Disk Location—Location of disk
- Disk Technology—Disk technology type
- Speed (RPM)—Physical disk revolutions per minute
- Form Factor—Form factor
- Vendor ID—Disk vendor ID
- Product ID—Product ID
- Product Revision—Product revision number
- Serial ID—Serial number
- Disk Blocks—Number of disk blocks
- Actual Disk Block—Actual number of disk blocks
- Block Size—Size of each disk block
- Total Capacity (GB)—Total disk capacity in Gigabytes
- Free Capacity (GB)—Free disk capacity in Gigabytes
• **Actual Capacity (GB)**—Actual disk capacity in Gigabytes
• **Used Capacity (GB)**—Used disk capacity in Gigabytes
• **Used (%)**—Percentage of used disk capacity to the total disk capacity
• **Rated Disk Capacity (GB)**—Rated disk capacity in Gigabytes
• **Spare Disk**—Indication if the disk is a spare disk
• **Encapsulated**—Indication if the disk is encapsulated
• **Disk Service State**—Disk service state

### Removing disks from disk groups

**Note**
Only empty external disk groups can be deleted.

**Procedure**
1. Select the storage system.
2. Select **STORAGE > Disk Groups**.
3. Select the disk group from the list and click ![ Details](#) to open its **Details** view.
4. From the **Details** panel, click the number next to **Number of Disks** to open the **Disks** view.
5. Select a disk from the list and click **Remove Disk**.
6. Click **OK**.

### Deleting disk groups

**Before you begin**
Only empty external disk groups can be deleted.

**Procedure**
1. Select the storage system.
2. Select **STORAGE > Disk Groups** to open the **Disk Groups** list view.
3. Select a disk group and click ![ Delete](#).
4. Click **OK**.

### Renaming disk groups

**Procedure**
1. Select the storage system.
2. Select **STORAGE > Disk Groups**.
3. Select the disk group and click **Rename**.
4. Type the new disk group name and click **OK**.
Creating DATA volumes

This procedure explains how to create DATA volumes on storage systems running Enginuity version 5876.

Procedure

1. Select the storage system.
2. Select STORAGE > Thin Pools to open the Thin Pools list view.
3. Select the thin pool and click to open its Details view.
4. Click the number next to Number of Data Volumes.
5. Click Create Volumes.
6. Select DATA as the Configuration.
7. Select the Disk Technology.
   
   **External** disk technology is an option if the storage system has FTS (Federated Tiered Storage) enabled and available external storage.
8. Select the Emulation type.
9. Select the RAID Protection level.
10. Specify the capacity by typing the Number of Volumes, and selecting a Volume Capacity. You can also manually enter a volume capacity.
11. To add the new volumes to a specific thin pool, select one from Add to Pool. Pools listed are filtered on technology, emulation, and protection type.
12. Click Advanced Options to continue setting the advanced options, as described next.

   The advanced options presented depend on the value selected for Add to Pool. Complete any of the following steps that are appropriate:
   a. Select the Disk Group (number and name) in which to create the volumes. The list of disk groups is already filtered based on the technology type selected above.
   b. To enable the new volumes in the pool, select Enable volume in pool.
   c. To rebalance allocated capacity across all the DATA volumes in the pool, select Start Write Balancing.
   d. Click APPLY.
13. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Activating and deactivating DATA volumes

Before you begin

You can only activate deactivated DATA volumes with used tracks.

This procedure explains how to activate or deactivate DATA volumes in a thin pool. Activating volumes is essentially the same thing as enabling volumes; however, the
activate operation is not allowed if draining is in progress. After activation, the volumes will go into the Enabled state.

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Volumes**.
3. Click the **Private** tab.
4. File on DATA type.
5. Do one of the following:
   - Select one or more volumes, click , and select **Set Volumes > Activate**.
   - Select one or more volumes, click , and select **Set Volumes > Deactivate**.
6. Click **OK**.

### Enabling and disabling DATA volumes

**Before you begin**

To disable a volume, all sessions must be terminated, and have no used tracks.

This procedure explains how to enable or disable DATA volumes for use in a pool. The volumes in the pool do not all have to be in the same state (enabled or disabled). If all the volumes in a pool are disabled, then the pool is disabled. If at least one volume in a pool is enabled, then the pool is enabled.

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Volumes**.
3. Click the **Private** tab.
4. File on DATA type.
5. Do one of the following:
   - Select one or more volumes, click , and select **Set Volumes > Enable**.
   - Select one or more volumes, click , and select **Set Volumes > Disable**.
6. Click **OK**.

### Start and stop draining DATA volumes

This procedure explains how to start or stop draining DATA volumes.

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Volumes**.
3. Click the **Private** tab.
4. File on DATA type.
5. Do one of the following:
   - Select one or more volumes, click , and select **Draining > Start**.
   - Select one or more volumes, click , and select **Draining > Stop**.
6. Click **OK**.

### Viewing DATA volumes

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Volumes** and click the **Private** tab.
3. Filter on DATA type.
4. To view the properties and controls, see **Viewing private volumes** on page 217.

### Viewing DATA volume details

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Volumes** and click the **Private** tab.
3. Filter on DATA type.
4. Select a DATA volume and click to open its **Details** view.
5. To view the properties, see **Viewing private volume details** on page 218.

### Creating thin pools

When creating thin pools, Unisphere works on a best effort basis, meaning that it attempts to satisfy as much as possible of the requested pool from existing DATA volumes, and then creates the volumes necessary to meet any shortfall.

**Before you begin:**

Thin pools contain DATA volumes of the same emulation and the same configuration.

When creating thin pools, will attempt to instill best practices in the creation process by updating the default Protection level according to the selected Disk Technology:

<table>
<thead>
<tr>
<th>Technology</th>
<th>Default protection level</th>
</tr>
</thead>
<tbody>
<tr>
<td>EFD</td>
<td>RAID5(3+1)</td>
</tr>
<tr>
<td>FC</td>
<td>2-Way Mirror</td>
</tr>
<tr>
<td>SATA</td>
<td>RAID6(6+2)</td>
</tr>
</tbody>
</table>

To create a thin pool:
**Procedure**

1. Select the storage system.
2. Select STORAGE > Thin Pools to open the Thin Pools list view.
3. Click Create to open the Create Thin Pool dialog box.
   
   When this dialog box first opens, the chart displays the configured and unconfigured space on the selected storage system. Once you select a disk technology later in this procedure, and therefore a disk group, this chart will display the configured and unconfigured space of the selected group.
4. Type the Thin Pool Name.
   
   Thin pool names can contain up to 12 alpha-numeric characters. The only special characters allowed are the hyphen (-) and the underscore (_); however, the name cannot start or end with a or hyphen or underscore.
5. Select the Disk Technology on which the pool will reside.
6. Select the RAID Protection level for the DATA volumes to use in the pool.
7. Select an Emulation type for the pool.
8. Specify the number of volumes, volume capacity and capacity unit.
9. Click Advanced Options - see Creating or Expanding or Modifying thin pools on page 257.
10. Verify your selections in the Create Thin Pool - Summary page, and do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List and click Run Now to create the pool now.

**Expanding thin pools**

**Before you begin**

Unisphere supports best practices, which state that volumes from different drive technologies should not be mixed in the same thin pool. To this end, Unisphere will only expand a thin pool with volumes from the same disk group as the volumes already in the pool. This is an important distinction from Solutions Enabler, which does not impose this restriction.

Expanding thin pools refers to the process of increasing the amount of pool storage accessible to a thin volume by either adding a predefined capacity to the pool, or by increasing the pool’s capacity by a percentage.

To expand a thin pool:

**Procedure**

1. Select the storage system.
2. Select Storage > Thin Pools to open the Thin Pools list view.
3. Select the thin pool and click Expand to open the Expand Thin Pool dialog box.
   
   The chart on this dialog box displays the configured and unconfigured space of the disk group containing the pool’s DATA volumes.
4. Select how to expand the pool, either by Capacity or Percentage:
- **Capacity**—The *Volume Capacity* field defaults to the first data volume size in the pool. All volume sizes contained in the pool are available. Type the *Extra Pool Capacity* and select the unit of capacity.

- **Percentage**—Type an amount in the *Percentage Increase* field.

5. Click **Advanced Options** - see Creating or Expanding or Modifying thin pools on page 257.

6. Do one of the following:

   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   
   - Expand **Add to Job List** and click **Run Now** to create the pool now.

---

### Draining thin pools

This procedure explains how to re-balance data across all the DATA volumes in a thin pool. This procedure is typically performed after expanding a thin pool.

**Before you begin:**

- The drain operation is not supported with any ongoing replication operation.

- You can only drain deactivated DATA volumes. For instructions, refer to Activating and deactivating DATA volumes on page 240.

- The drain must not cause the enabled volumes to end up with greater than 90% utilization in the pool. To calculate this, adds the total used tracks on the enabled volumes and the total used tracks on the volumes that will be drained and divides this sum by the total number of tracks on all the enabled volumes. If the result is greater than 90% the drain request is blocked.

- The number of volumes that are draining at any time are limited to 20% total of the number of volumes to drain (or draining) plus the number of enabled volumes. This limits the impact on the system.

- This feature is only supported on storage systems running Enginuity 5876 or higher.

**To drain thin pools:**

**Procedure**

1. Select the storage system.

2. Select **STORAGE > Thin Pools** to open the *Thin Pools* list view.

3. Select the thin pool and click ![Icon](image) to open its *Details* view.

4. Click the number next to *Number of Data Volumes* to open the *DATA Volumes* list view.

5. Select one or more volumes, click ![Icon](image), and select **Start Draining**.

6. Click **OK**.

   This will put the volumes in a Draining state.

7. Monitor the draining until it reaches an acceptable percentage. This will require you to refresh the view. If you do not monitor the draining, eventually all data will be drained from the volumes and they will go into a Disable state.
8. When a volume reaches an acceptable level, select it, click ✎, and select Stop Draining.
9. Click OK in the confirmation dialog. This will put the volume in an Enabled state.
10. If you are draining multiple devices, repeat steps 5 to 9 until all the volumes are drained to an acceptable percentage.

Starting and stopping thin pool write balancing

Before you begin
- You can only perform this procedure on an enabled thin pool with at least one thin volume bound to it.
- While write balancing is going on, all pool operations can still occur.
- Write balancing requires Enginuity 5876 or higher.

Write balancing thin pools refers to the process of rebalancing allocated capacity across all the DATA volumes in the pool. This procedure is typically performed after expanding a thin pool.

To write balance a thin pool:

Procedure
1. Select the storage system
2. Select STORAGE > Thin Pools to open the Thin Pools list view.
3. Start write balancing by clicking ✎, and clicking Start Write Balancing.
4. Click OK.
   This will put the pool in a Balancing state.
5. Monitor the balancing until it reaches an acceptable percentage
6. Select the thin pool, click ✎, and select Stop Write Balancing.
7. Click OK.

Deleting thin pools

Before you begin:
You can only delete empty thin pools. For instructions, refer to Adding or removing thin pool members on page 246.

To delete a thin pool:

Procedure
1. Select the storage system.
2. Select STORAGE > Thin Pools to open the Thin Pools list view.
3. Select the thin pool and click Delete.
4. Click OK.
Adding or removing thin pool members

This procedure explains how to add or remove members from a thin pool.

Before you begin:

- The storage system must be running Enginuity 5876.
- Before you can remove a thin pool member (data volume), you must first disable it.
- Unisphere supports best practices, which state that volumes from different drive technologies should not be mixed in the same thin pool. To this end, the Add Volumes to Thin Pool dialog box will only allow you to add volumes from the same disk group as the volumes already in the pool. This is an important distinction from Solutions Enabler, which does not impose this restriction.

To add or remove thin pool members:

**Procedure**

1. Select the storage system.
2. Select **Storage > Thin Pools** to open the Thin Pools list view.
3. Select the thin pool and click ![Open thin pool details view](#) to open the thin pool's details view.
4. Click the number next to **Number of Data Volumes** to open the **DataVolumes** view.
5. Click **Add Volumes to Pool** to open the Add Volumes to Thin Pool wizard.
   a. Locate the volumes by selecting/typing values for any number of the following criteria:
      - **Capacity equal to** — Filters the list for volumes with a specific capacity.
      - **Volume ID** — Filters the list for a volume with specific ID.
      - **Volume Identifier Name** — Filters the list for the specified volume name.
      - **Volume Configuration** — Filters the list for the specified configuration.
      - **Emulation** — Filters the list for the specified emulation.
   b. Click **NEXT**.
   c. In the **Available Volumes** table, select the volumes.
   d. Deselect one or more the previously selected volumes to remove a volume.
   e. Click **OK**.

Enabling and disabling thin pool members

**Procedure**

1. Select the storage system.
2. Select **Storage > Thin Pools** to open the Thin Pools list view.
3. Select the thin pool and click **SRDF Groups** to open the thin pool's details view.
4. Click the number next to **DATA Volumes**.
Managing thin pool allocations

Before you begin

- You can only allocate thin pool capacity to bound thin volumes.
- This procedure explains how to perform this operation from the Volumes view. You can also perform this procedure from storage group views. Depending from where you are performing this procedure, some of the following steps may not apply.

The following describes how to start and stop allocating thin pool capacity from the Volumes view.

Procedure

1. Select the storage system.
2. Select STORAGE > Volumes.
3. Select the volume type by selecting a tab.
4. Do one of the following:
   - To start thin pool allocation:
     - Select one or more volumes, click , and select Allocate/Free/Reclaim > Start.
     - Select Allocate Volumes, Free Volumes, or Reclaim Volumes. If you select Allocate Volumes, you can optionally specify to persist preallocated capacity on the thin volumes by selecting the Persist preallocated capacity through reclaim or copy option. Persistent allocations are unaffected by standard reclaim operations and any TimeFinder/Clone, TimeFinder/Snap, or SRDF copy operations. If you select Reclaim Volumes, you can optionally specify to reclaim persistent capacity by selecting the Reclaim persistent capacity option.
   - To stop thin pool allocation:
     - Select one or more volumes, click more , and select Allocate/Free/Reclaim > Stop.
     - Select Stop Allocate.
5. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.
Viewing thin pools

Procedure
1. Select the storage system.
2. Select STORAGE > Thin Pools to open the Thin Pools list view.
3. The Thin Pools list view allows you to view and manage thin pools on a storage system.

The following properties display:
- **Name** — Name of the thin pool.
- **Technology** — Disk technology on which the pool resides.
- **Configuration** — Configuration of the pool.
- **Emulation** — Emulation of the pool.
- **Allocated Capacity** — Percentage of the pool that is allocated.
- **Enabled Capacity (GB)** — Capacity of the pool in GB.

The following controls are available:
- **Viewing thin pool details** on page 248
- **Create** — Creating thin pools on page 242
- **Modify** — Creating or Expanding or Modifying thin pools on page 257
- **Expand** — Expanding thin pools on page 243
- **Delete** — Deleting thin pools on page 245
- **Start Write Balancing** — Starting and stopping thin pool write balancing on page 245
- **Stop Write Balancing** — Starting and stopping thin pool write balancing on page 245
- **Bind** — Binding/Unbinding/Rebinding thin volumes on page 260

Viewing thin pool details

Procedure
1. Select the storage system.
2. Select STORAGE > Thin Pools to open the Thin Pools list view.
3. Select the pool and click to open its Pool Usage Report or Details panel.

The Pool Usage Report panel provides a graphic representation of the thin pool's allocation as a percentage.

The following properties display in the Details panel:
- **Name** — Name of the pool. To rename a pool, type a new name over the existing and click Apply. Thin pool names can contain up to 12 alpha-numeric characters. The only special character allowed is the underscore ( _ ); however, the name cannot start or end with an underscore.
- **RAID Protection** — RAID protection level for the DATA volumes in the pool.
- **Type** — The pool type.
- **Technology** — Disk technology on which the pool resides.
- **Emulation** — Emulation type for the pool.
- **Total Capacity (GB)** — Total capacity of the pool.
- **Free Capacity (GB)** — Free capacity in the pool.
- **Enabled Capacity (GB)** — Sum of capacity of all enabled DATA volumes in the pool.
- **Allocated Capacity (GB)** — Pool capacity allocated to thin volumes.
- **Allocated %** — Percent of pool used.
- **Maximum Subscription Set** — Enable oversubscription for the pool.
- **Maximum Subscription** — Acceptable oversubscription ratio for the pool.
- **Subscription %** — Current subscription percentage.
- **State** — Pool state (Enabled, Disable, Balancing).
- **Rebalance Variance** — Target volume utilization variance for the rebalancing algorithm. The rebalancing algorithm attempts to level data distribution in a pool so that the percentage utilization of any volume in the pool is within the target variance of the percentage utilization of any other volume in the pool. Possible values range from 1 to 50%, with the default value being 1%. This field is only available when creating a thin pool on a Symmetrix system running Enginuity 5876 or higher.
- **Maximum Volumes per Rebalance Scan** — Maximum number of volumes in the pool on which the rebalancing algorithm will concurrently operate. To change this number, type a new value over the existing and click Apply. Possible values range from 1 to 1024, with the default value being 256. This field only applies to thin pool on a Symmetrix system running Enginuity 5876 or higher.
- **Pool Capacity Reserved** — Whether a percentage of the capacity of the thin pool is reserved.
- **Pool Reserved Capacity** — The percentage of the capacity of the thin pool that will be reserved for non-FAST activities.
- **Pool Egress Counter** — Number of track groups freed from the thin pool as a result of a FAST related data movement.
- **Pool Ingress Counter** — Number of track groups allocated in the thin pool as a result of a FAST related data movement.
- **Number of Bound Volumes** — Number of thin volumes bound to the pool.
- **Number of Data Volumes** — Number of data volumes bound to the pool.
- **Number of Enabled Volumes** — Number of enabled DATA volumes in the pool.
- **Number of Disabled Volumes** — Number of disabled DATA volumes in the pool.
- **Disk Location** — Whether the disk group is internal to the storage system or an external storage system or storage device.

You can view objects contained in and associated with the thin pool. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking the number next to **Number of Data Volumes** opens a view listing the DATA volumes in the pool.
Viewing bound volumes for a thin pool

Procedure

1. Select the storage system.
2. Select STORAGE > Thin Pools to open the Thin Pools list view.
3. Select the thin pool and click to open its Details view.
4. Click the number next to Number of Bound Volumes.

The following properties display:

- **Name**—Assigned volume name.
- **Emulation**—Emulation type for the volume.
- **Configuration**—Volume configuration.
- **Capacity (GB)**—Volume capacity in Gigabytes.
- **Allocated (GB)**—Number of GBs from the pool allocated for exclusive use by the volume.
- **Written (GB)**—Number of allocated GBs in the pool that the thin volume has actually used.
- **Shared Tracks**—Whether the volume shares tracks with other thin volumes.

The following controls display:

- **Create Volumes**—Creating thin volumes on page 186
- **Bind**—Binding/Unbinding/Rebinding thin volumes on page 260
- **Unbind**—Binding/Unbinding/Rebinding thin volumes on page 260
- **Configuration > Change Volume Configuration**—Changing volume configuration on page 192
- **Configuration > Map**—Mapping volume operations on page 99
- **Configuration > Unmap**—Mapping volume operations on page 99
- **Configuration > z/OS Map**—Mapping volume operations on page 99
- **Configuration > z/OS Unmap**—Mapping volume operations on page 99
- **Set Volume > Emulation**—Setting volume emulation on page 98
- **Set Volume > Attributes**—Setting volume attributes on page 197
- **Set Volume > Identifiers**—Setting volume identifiers on page 198
- **Set Volume > Status**—Setting volume status on page 196
- **FAST > Rebind**—Binding/Unbinding/Rebinding thin volumes on page 260
- **FAST > Pin**—Pinning and unpinning volumes on page 175
- **FAST > Unpin**—Pinning and unpinning volumes on page 175
- **Allocate/Free/Reclaim > Start**—Managing thin pool allocations on page 247
- **Allocate/Free/Reclaim > Stop**—Managing thin pool allocations on page 247
- **RecoverPoint > Tag**—Tagging and untagging volumes for RecoverPoint (storage group level) on page 476
5. Select a bound volume and click on its Details view. The following properties display:

- **Name**—Volume name.
- **Physical name**—Physical name.
- **Volume Identifier**—Volume Identifier.
- **Type**—Volume configuration.
- **Encapsulated Volume**—Indication whether the volume is encapsulated.
- **Encapsulated WWN**—Encapsulated World Wide Name.
- **Status**—Volume status.
- **Reserved**—Whether the volume is reserved.
- **Capacity (GB)**—Volume capacity in GBs.
- **Capacity (MB)**—Volume capacity in MBs.
- **Capacity (Cylinder)**—Volume capacity in cylinders.
- **Emulation**—Volume emulation.
- **Symmetrix ID**—Symmetrix system on which the volume resides.
- **Symmetrix Volume ID**—Symmetrix volume name/number.
- **HP Identifier Name**—User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped volumes. This value is mutually exclusive of the VMS ID.
- **VMS Identifier Name**—Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.
- **Nice Name**—Nice name generated by Symmetrix Enginuity.
- **WWN**—World Wide Name of the volume.
- **DG Name**—Name of the device group in which the volume resides, if applicable.
- **CG Name**—Name of the CG in which the volume resides, if applicable.
- **Attached BCV**—Defines the attached BCV to be paired with the standard volume.
- **Attached VDEV TGT Volume**—Volume to which this source volume would be paired.
- **RDF Type**—RDF configuration.
- **Geometry - Type**—Method used to define the volume's geometry.
- **Geometry - Number of Cylinders**—Number of cylinders.
- **Geometry - Sectors per Track**—Number of sectors per track, as defined by the volume's geometry.
• **Geometry - Tracks per Cylinder**—Number of tracks per cylinder, as defined by the volume's geometry.

• **Geometry - 512 Block Bytes**—Number of 512 blocks, as defined by the volume's geometry.

• **Geometry - Capacity (GB)**—Capacity.

• **SSID**—Subsystem ID.

• **Capacity (Tracks)**—Capacity in tracks.

• **SA Status**—Volume SA status.

• **Host Access Mode**—Host access mode.

• **Pinned**—Whether the volume is pinned.

• **RecoverPoint Tagged**—Indication whether the volume is tagged for RecoverPoint.

• **Service State**—Service state.

• **Defined Label Type**—Type of user-defined label.

• **Dynamic RDF Capability**—RDF capability of the volume.

• **Mirror Set Type**—Mirror set for the volume and the volume characteristic of the mirror.

• **Mirror Set DA Status**—Volume status information for each member in the mirror set.

• **Mirror Set Invalid Tracks**—Number of invalid tracks for each mirror in the mirror set.

• **Priority QoS**—Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).

• **Dynamic Cache Partition Name**—Name of the cache partition.

• **Optimized Read Miss**—Optimized Read Miss.

• **Compressed Size (GB)**—Compressed Size.

• **Compressed Percentage**—Compressed percentage.

• **Compressed Size Per Pool**—Compressed size per pool.

**Viewing DATA volumes for a thin pool**

**Procedure**

1. Select the storage system.

2. Select STORAGE > Thin Pools to open the Thin Pools list view.

3. Select the thin pool and click to open its Details view.

4. Click the number next to **Number of Data Volumes**.

   The following properties display:
   - **Name**—Name of the DATA volume.
   - **Emulation**—Volume emulation.
   - **Configuration**—Volume configuration.
   - **Used (%)**—Percent of the volume used.
- **Used (GB)**—Space used.
- **Free**—Free space on the volume.
- **Status**—Volume status.
- **Session Status**—Session status (Active, or Inactive).

The following controls are available:

- [Viewing details on DATA volumes in thin pools](#)
- **Create Volumes**—[Creating DATA volumes](#)
- **Add Volumes to Pool**—[Adding or removing thin pool members](#)
- **Remove**—[Adding or removing thin pool members](#)
- **Enable**—[Enabling and disabling thin pool members](#)
- **Disable**—[Enabling and disabling thin pool members](#)
- **Activate**—[Activating and deactivating DATA volumes](#)
- **Deactivate**—[Activating and deactivating DATA volumes](#)
- **Start Draining**—[Draining thin pools](#)
- **Stop Draining**—[Draining thin pools](#)

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**Viewing details on DATA volumes in thin pools**

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Thin Pools** to open the **Thin Pools** list view.
3. Select the thin pool and click ![Viewing details on DATA volumes in thin pools](#) to open its **Details** view.
4. Click the number next to **Number of Data Volumes**.
5. Select a DATA volume and click ![Viewing details on DATA volumes in thin pools](#) to open its **Details** view.

The following properties display:

- **Name**—Volume name.
- **Type**—Volume configuration.
- **Encapsulated Volume**—Indication whether the volume is encapsulated.
- **Encapsulated WWN**—Encapsulated World Wide Name.
- **Status**—Volume status.
- **Reserved**—Whether the volume is reserved.
- **Capacity (GB)**—Volume capacity in GBs.
- **Capacity (MB)**—Volume capacity in MBs.
- **Capacity (Cylinder)**—Volume capacity in cylinders.
- **Emulation**—Volume emulation.
- **Symmetrix ID**—Symmetrix system on which the volume resides.
- **Symmetrix Volume ID**—Symmetrix volume name/number.
- **HP Identifier Name**—User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped volumes. This value is mutually exclusive of the VMS ID.

- **VMS Identifier Name**—Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.

- **Nice Name**—Nice name generated by Symmetrix Enginuity.

- **WWN**—World Wide Name of the volume.

- **DG Name**—Name of the device group in which the volume resides, if applicable.

- **CG Name**—Name of the CG in which the volume resides, if applicable.

- **Attached BCV**—Defines the attached BCV to be paired with the standard volume.

- **Attached VDEV TGT Volume**—Volume to which this source volume would be paired.

- **RDF Type**—RDF configuration.

- **Geometry - Type**—Method used to define the volume's geometry.

- **Geometry - Number of Cylinders**—Number of cylinders.

- **Geometry - Sectors per Track**—Number of sectors per track, as defined by the volume's geometry.

- **Geometry - Tracks per Cylinder**—Number of tracks per cylinder, as defined by the volume's geometry.

- **Geometry - 512 Block Bytes**—Number of 512 blocks, as defined by the volume's geometry.

- **Geometry - Capacity (GB)**—Capacity.

- **SSID**—Subsystem ID.

- **Capacity (Tracks)**—Capacity in tracks.

- **SA Status**—Volume SA status.

- **Host Access Mode**—Host access mode.

- **Pinned**—Whether the volume is pinned.

- **Service State**—Service state.

- **Defined Label Type**—Type of user-defined label.

- **Dynamic RDF Capability**—RDF capability of the volume.

- **Mirror Set Type**—Mirror set for the volume and the volume characteristic of the mirror.

- **Mirror Set DA Status**—Volume status information for each member in the mirror set.

- **Mirror Set Invalid Tracks**—Number of invalid tracks for each mirror in the mirror set.

- **Priority QoS**—Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).

- **Dynamic Cache Partition Name**—Name of the cache partition.

- **XtremSWCache Attached**—Whether volume is attached to XtremSW cache.
• Compression Delta (GB)—Difference between volume allocation and uncompressed data.

Viewing other volumes for thin pools

Procedure
1. Select the storage system.
2. Select Storage > Thin Pools.
3. Select the pool and click .
4. Click the number next to Other Volumes.
5. Use the Other Volumes for Thin Pool list view to display and manage other volumes bound to a thin pool.

The following properties display:
• Name — Assigned volume name.
• Pool Name — Pool to which the volume is bound.
• % Allocated — Percentage of space allocated in the pool.
• Allocated Capacity — Amount of space allocated in the pool.

The following controls are available:
• — Viewing thin volume details on page 226
• Create — Creating thin volumes on page 186
• Bind — Binding/Unbinding/Rebinding thin volumes on page 260
• Unbind — Binding/Unbinding/Rebinding thin volumes on page 260
• Untag for RecoverPoint — Tagging and untagging volumes for RecoverPoint (volume level) on page 476
• Tag for RecoverPoint — Tagging and untagging volumes for RecoverPoint (volume level) on page 476
• Unpin — Pinning and unpinning volumes on page 175
• Pin — Pinning and unpinning volumes on page 175
• Assign Symmetrix Priority — Assigning array priority to individual volumes on page 191
• Unmap — Unmapping volumes on page 195
• Map — Mapping volumes on page 194
• Assign Dynamic Cache Partition — Assigning dynamic cache partitions on page 837
• Stop Allocate/Free/Reclaim — Managing thin pool allocations on page 247
• Set Volume Status — Setting volume status on page 196
• Set Volume Identifiers — Setting volume identifiers on page 198
• Set Volume Attributes — Setting volume attributes on page 197
• Change Volume Configuration — Changing volume configuration on page 192
Managing thin pool capacity

Before you begin

- You can only reclaim thin pool capacity from bound thin volumes.
- Thin pool reclamation for individual thin volumes requires Enginuity 5876 or HYPERMAX OS 5977 or higher.
- This procedure explains how to perform this operation from the Volumes view. You can also perform this operation from storage group views. Depending from where you are performing this procedure, some of the following steps may not apply.

The following describes how to start and stop the process of freeing allocated thin pool capacity from the Volumes view. In addition, you can also perform this operation from the following views:

- Storage Groups (HYPERMAX OS 5977 or higher): STORAGE > Storage Groups
- Storage Groups (Enginuity 5876): STORAGE > Storage Groups
- Device Groups: DATA PROTECTION > Device Groups
- File Storage Groups: SYSTEM > eNAS > File Dashboard > File Storage Groups

Procedure

1. Select the storage system.
2. Select Storage > Volumes.
3. Select the volume type by selecting a tab.
4. Do one of the following:
   - To start freeing unused capacity:
     - Select one or more volumes, click , and select Start Allocate/Free/Reclaim to open the Start Allocate/Free/Reclaim dialog box.
     - Select Free Volumes.
     - Optional: To free all allocations associated with the volumes, regardless of whether the data is written, select Free all allocations (written and unwritten). This option is only available on storage systems running HYPERMAX OS 5977 or higher.
     - To reserve the volumes, select Reserve. In addition you can also type reserve Comments and select an Expiration Date. The default values for Reserve and Comments are set in Symmetrix Preferences for volumes reservations. If the volumes are not automatically reserved you can optionally reserve them here.
   - To stop freeing unused capacity:
     - Select one or more volumes, click , and select Stop Allocate/Free/Reclaim to open the Stop Allocate/Free/Reclaim dialog box.
     - Select Free Volumes. In addition, on storage systems running Enginuity 5876, you can optionally specify to free tracks that are unwritten or
zero-based, even if they are marked persistent. This option is only available on storage systems running Enginuity 5876.

- To reserve the volumes, select **Reserve**. In addition you can also type reserve **Comments** and select an **Expiration Date**. The default values for **Reserve** and **Comments** are set in Symmetrix Preferences for volumes reservations. If the volumes are not automatically reserved you can optionally reserve them here.

5. Do one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
- Expand **Add to Job List**, and click **Run Now** to perform the operation now.

For more information about thin pools and thin provisioning concepts, refer to the *Solutions Enabler Symmetrix Array Management CLI Product Guide*.

### Allocate/Free/Reclaim dialogs

Use the dialogs to perform the following operations:

- Start allocating thin pool capacity for thin volumes, as described in **Managing thin pool allocations** on page 247.
- Start freeing unused allocated thin pool capacity, as described in **Managing thin pool capacity** on page 256.
- Start reclaiming unwritten tracks from thin volumes, as described in **Managing space reclamation** on page 519.
- Stop allocating thin pool capacity for thin volumes, as described in **Managing thin pool allocations** on page 247.
- Stop freeing unused allocated thin pool capacity, as described in **Managing thin pool capacity** on page 256.
- Stop reclaiming unwritten tracks from thin volumes, as described in **Managing space reclamation** on page 519.

### Creating or Expanding or Modifying thin pools

**Advanced Options** when creating thin pools

- Select the **Disk Group** containing the DATA volumes to use in the pool.
- Type the **Rebalancing Variance (1-50)**. This is the target volume utilization variance for the rebalancing algorithm. The rebalancing algorithm attempts to level data distribution in a pool so that the percentage utilization of any volume in the pool is within the target variance of the percentage utilization of any other volume in the pool. Possible values range from 1 to 50%, with the default value being 1%. This field is only available when creating a thin pool on a Symmetrix system running Enginuity 5876 or higher.
- Type the **Maximum Rebalancing Scan Device Range (2-1024)**. This is the maximum number of volumes in the pool on which the rebalancing algorithm will concurrently operate. Possible values range from 2 to 1024, with the default value being 256. This field is only available when creating a thin pool on a Symmetrix system running Enginuity 5876 or higher.
- To specify the percentage of the pool's capacity to enable, select **Enable Max Subscription (0-65534)** and type a percentage.
To specify the percentage of the capacity of the thin pool that will be reserved for non-FAST activities, select **Enable Pool Reserved Capacity (1-80)** and type a value. If the free space in the pool (as a percentage of pool-enabled capacity) falls below this value, the FAST controller does not move any more chunks into the pool. Specifying a value here will override the system-wide PRC value. Possible values range from 1 to 80.

To enable the DATA volumes in the pool for use, select **Enable DATA Volume for Use**.

To enable FAST VP compression for the volumes in a thin pool, select **Enable VP Compression**. This feature maximizes the storage capacity usage within the pool by compressing its volumes.

Click **APPLY**.

Advanced Options when expanding thin pools

- Select **Start Write Balancing**.
- Click **APPLY**.

Modifying thin pools

- Select **Volume Capacity**, in GB.
- Type the **Rebalancing Variance (1-50)**. This is the target volume utilization variance for the rebalancing algorithm. The rebalancing algorithm attempts to level data distribution in a pool so that the percentage utilization of any volume in the pool is within the target variance of the percentage utilization of any other volume in the pool. Possible values range from 1 to 50%, with the default value being 1%. This field is only available when creating a thin pool on a Symmetrix system running Enginuity 5876 or higher.
- Type the **Maximum Rebalancing Scan Device Range (2-1024)**. This is the maximum number of volumes in the pool on which the rebalancing algorithm will concurrently operate. Possible values range from 2 to 1024, with the default value being 256. This field is only available when creating a thin pool on a Symmetrix system running Enginuity 5876 or higher.
- To specify the percentage of the pool's capacity to enable, select **Enable Max Subscription (0-65534)** and type a percentage.
- To specify the percentage of the capacity of the thin pool that will be reserved for non-FAST activities, select **Enable Pool Reserved Capacity (1-80)** and type a value. If the free space in the pool (as a percentage of pool-enabled capacity) falls below this value, the FAST controller does not move any more chunks into the pool. Specifying a value here will override the system-wide PRC value. Possible values range from 1 to 80.
- To enable the DATA volumes in the pool for use, select **Enable DATA Volume for Use**.
- To enable FAST VP compression for the volumes in a thin pool, select **Enable VP Compression**. This feature maximizes the storage capacity usage within the pool by compressing its volumes.
- Click **OK**.

Creating thin volumes

This procedure explains how to create thin volumes on storage systems running Enginuity version 5876. For instructions on creating thin volumes on storage systems running HYPERMAX OS 5977 or higher, refer to Creating thin volumes on page 187.
Procedure

1. Select the storage system.

2. Select STORAGE > Volumes, click on the Virtual tab and select Create.

3. Select Configuration (TDEV or BCV + TDEV or Virtual Gatekeeper).

4. Select the Emulation type.

5. Specify the capacity by typing the Number of Volumes, and selecting a Volume Capacity. You can also manually enter a volume capacity.

6. To bind the new volumes to a specific thin pool, select one from Bind to Pool. Only thin pools with enabled DATA volumes and matching emulation are available for binding (except AS/400 which will bind to an FBA pool).

7. Click Advanced Options to continue setting the advanced options.

Setting Advanced options:

a. To name the new volumes, select one of the following Volume Identifiers and type a Name:

- **None** — Allows the system to name the volumes (Default).
- **Name Only** — All volumes will have the same name.
- **Name + VolumeID** — All volumes will have the same name with a unique Symmetrix volume ID appended to them. When using this option, the maximum number of characters allowed is 50.
- **Name + Append Number** — All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the Append Number and increment by 1 for each additional volume. Valid Append Numbers must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.

For more information on naming volumes, refer to Setting volume names on page 198.

b. To Allocate Full Volume Capacity, select the option.

c. If you selected to allocate capacity in the previous step, you can mark the allocation as persistent by selecting Persist preallocated capacity through reclaim or copy. Persistent allocations are unaffected by standard reclaim operations and any TimeFinder/Clone, TimeFinder/Snap, or SRDF copy operations.

d. To assign Dynamic Capability to the volumes, select one of the following; otherwise, leave this field set to None.

- **RDF1_Capable** — Creates a dynamic R1 RDF volume.
- **RDF2_Capable** — Creates a dynamic R2 RDF volume.
- **RDF1_OR_RDF2_Capable** — Creates a dynamic R1 or R2 RDF volume.

e. If Auto Meta is enabled on the system, and if you are attempting to create volumes larger than the Minimum Meta Capacity, specify values for the following in the Define Meta panel:

- **Member capacity (Cyl/MB/GB)** — Size of the meta members to use when creating the meta volumes.
- **Configuration (Striped/Concatenated)** — Whether to create striped or concatenated meta volumes.
8. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.
   - Click Advanced Options to continue setting the advanced options, as described next.

**Binding/Unbinding/Rebinding thin volumes**

**Before you begin**
This procedure applies to storage systems running Enginuity OS 5876.

- Only one bind, unbind, or rebinding operation can be performed on the same volume in any one config session.
- As an alternative to unmapping/unmasking a volume prior to unbinding, you can make the volume Not Ready.
- A thin volume cannot be unbound from a pool if any of the following are true:
  - Volume is mapped to a front-end port or is in the Ready state
  - Volume is masked by VCM
  - Volume has active snap sessions
  - Volume is held
  - Volume is a source or target of a clone (src or tgt) session
  - Volume is a metamember
  - Volume is a part of enabled RDF CG group
  - Volume is an RDF volume
- The following apply just to the rebinding operation:
  - The thin volume has to be in the Bound state.
  - The new binding has to comply with the oversubscription ratio of the new pool.
    The entire size of the volume being rebound will be considered when calculating the oversubscription.
  - If volumes in a range, device group, or storage group are bound to different pools, then all the volumes will be rebound to the specified pool.
  - If a thin volume is part of a storage group that is under FAST management, the thin volume can only be bound to a pool in a tier that is part of the FAST policy associated with the storage group. Therefore, the volume can only be rebound to a pool that is within the policy.
  - If all the volumes that are being rebound are already bound to the destination pool, an error returns. If some volumes get bound to a pool different than what they are currently bound to, the operation will return a success status.
- For more information about thin pools and thin provisioning concepts, refer to the Solutions Enabler Array Management CLI Product Guide.

This procedure explains how to bind/unbind/rebind thin volumes to a thin pool of DATA volumes.

You can bind /unbind/rebind thin volumes at the volume, pool, or storage group level.
Procedure

1. Select the storage system.
2. Select STORAGE > Volumes and click on the Virtual tab.
3. Select the volume and do one of the following:
   - Click FAST > Bind
     a. Select the thin pool with which to bind the volume.
     b. Optional: Select Allocate Full Volume Capacity option.
     c. To view additional information on the selected volumes, click Show selected volumes.
     d. If you selected to allocate capacity in the previous step, you can mark the allocation as persistent by selecting Persist preallocated capacity through reclaim or copy option. Persistent allocations are unaffected by standard reclaim operations and any TimeFinder/Clone, TimeFinder/Snap, or SRDF copy operations.
   e. Click OK.
   - Click FAST > Unbind and click OK
   - Click FAST > Rebind, specify the pool name, and click OK.

Understanding Virtual LUN Migration

Virtual LUN Migration (VLUN Migration) enables transparent, nondisruptive data mobility for both disk group provisioned and virtually provisioned storage system volumes between storage tiers and between RAID protection schemes. Virtual LUN can be used to populate newly added drives or move volumes between high performance and high capacity drives, thereby delivering tiered storage capabilities within a single storage system. Migrations are performed while providing constant data availability and protection.

Note

Virtual LUN migration requires Enginuity 5876.

Virtual LUN Migration performs tiered storage migration by moving data from one RAID group to another, or from one thin pool to another. It is also fully interoperable with all other storage system replication technologies such as SRDF, TimeFinder/Clone, TimeFinder/Snap, and Open Replicator.

RAID Virtual Architecture allows, for the purposes of migration, two distinct RAID groups, of different types or on different storage tiers, to be associated with a logical volume. In this way, Virtual LUN allows for the migration of data from one protection scheme to another, for example RAID 1 to RAID 5, without interruption to the host or application accessing data on the Symmetrix system volume.

Virtual LUN Migration can be used to migrate regular storage system volumes and metavolumes of any emulation — FBA, CKD, and IBM i series. Migrations can be performed between all drive types including high-performance enterprise Flash drives, Fibre Channel drives, and large capacity SATA drives.

Migration sessions can be volume migrations to configured and unconfigured space, or migration of thin volumes to another thin pool.
Viewing VLUN migration sessions

Procedure

1. Select the storage system.
2. Select STORAGE > Vlun Migration to open the Virtual LUN Migration list view.

Use this view to display and manage migration sessions. The following properties display:
   - Name — Migration session name.
   - Status — Migration session status.
   - Invalid Tracks — Number of invalid tracks for the volume pair.
   - Percentage — Percentage of the session completed.

The following controls are available:
   - Viewing VLUN migration session details on page 262
   - Terminate — Terminating a VLUN migration session on page 263

Viewing VLUN migration session details

Procedure

1. Select the storage system.
2. Select STORAGE > Vlun Migration to open the Virtual LUN Migration list view.
3. Select a session and click to open its Details view.

Use this view to display details on a migration session. This view contains two panels: Details and Source and Target Info. The following properties display in the Details panel:
   - Name — Migration session name.
   - Status — Migration session status.
   - Invalid Tracks — Number of invalid tracks for the volume pair.
   - Percentage — Percentage of the session completed.
   - Target Type — Type of target volume.
   - Thin Pool — If the target type is thin, this is the name of the pool containing the thin volume.

The following properties display in the Source and Target Info panel:
   - Source — Source volumes in the migration session.
   - Target — Target volumes in the migration session.
   - Target Volumes — Number of target volumes in the session.
   - Invalid Tracks — Number of invalid tracks for the volume pairs in the session.
Terminating a VLUN migration session

Procedure
1. Select the storage system.
2. Select STORAGE > Vlun Migration to open the Virtual LUN Migration list view.
3. Select the migration session and click Terminate.
4. Click OK.

VLUN Migration dialog box
From this dialog box you can perform volume migrations for regular or thin volumes. Thin volumes migrate from a source pool to a target pool, and regular volumes migrate to configured (existing) volumes or unconfigured (new) volumes.

Some of the options in the dialog box display will differ depending on whether you are migrating regular or thin volumes.

For volume-specific migration procedures, refer to the following:
- Migrating regular volumes on page 264
- Migrating thin volumes on page 265
- Migrating regular storage group volumes on page 263
- Migrating thin storage group volumes on page 264

Select VLUN Migration Session Target dialog box
Use this dialog box to select the target disk group (standard migration) or target thin pool (thin migration).

Migrating regular storage group volumes

Before you begin
- Virtual LUN migration requires Enginuity 5876.

This procedure explains how to migrate all the regular volumes in a storage group.

To migrate regular storage group volumes:

Procedure
1. Select the storage system.
2. Select STORAGE> Storage Groups to open the Storage Groups view.
3. Select a storage group, click , and select VLUN Migration.
4. Type a Migration Session Name.
   Migration session names must be less than 32 characters long and are case sensitive.
5. Select the RAID Protection type.
6. Select **Target type**. Choose **Create new volumes** to migrate to unconfigured volumes or **Use existing volumes** to migrate to configured volumes.

7. Select whether to **Pin Volumes** so that they cannot be moved by any FAST automated process.

8. Click **OK** to create the migration session.

**Migrating regular volumes**

**Before you begin**

- Virtual LUN migration requires Enginuity 5876.

This procedure explains how to migrate individual regular volumes.

To migrate regular volumes:

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Volumes** to open the **Volumes** view.
3. Select the volume type by selecting a tab.
4. Select one or more volumes, click , and select **VLUN Migration**.
5. Type a **Migration session name**.
   
   Migration session names must be less than 32 characters and are case sensitive.

6. Select the RAID **Protection type**.
7. Select the **Target type**. Choose **Create new volumes** to migrate to unconfigured volumes or **Use existing volumes** to migrate to configured volumes.
8. Select whether to **Pin Volumes** so that they cannot be moved by any FAST automated process.
9. Click **OK**.

**Migrating thin storage group volumes**

**Before you begin**

- Virtual LUN migration requires Enginuity 5876.

This procedure explains how to migrate all the thin volumes in a storage group.

To migrate thin storage group volumes:

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Storage Groups** to open the **Storage Groups** view.
3. Select a storage group, click , and select **VLUN Migration**.
4. Type a **Migration Session Name**.
   
   The session name must be less than 32 characters long and is case sensitive.
5. Select a Target.
6. From the Migrate allocations from pool menu, select a pool from which to migrate allocations.
7. Select whether to Pin volumes so that they cannot be moved by any FAST automated process.
8. Click OK.

Migrating thin volumes

Before you begin
- Virtual LUN migration requires Enginuity 5876.

This procedure explains how to migrate individual thin volumes.
To migrate selected thin volumes:

Procedure
1. Select the storage system.
2. Select STORAGE> Volumes to open the Volumes view.
3. Select the volume type by selecting a tab.
4. Select one or more thin volumes, click , and select VLUN Migration.
5. Type a Migration Session Name.
   The session name must be less than 32 characters long and is case sensitive.
6. Select a Target.
7. From the Migrate allocations from pool menu, select a pool from which to migrate allocations.
8. Select whether to Pin volumes so that they cannot be moved by any FAST automated process.
9. Click OK.

Understanding Federated Tiered Storage

Federated Tiered Storage (FTS) allows you to attach external storage to a storage system. Attaching external storage allows you to use physical disk space on existing storage systems while gaining access to features such as local replication, remote replication, storage tiering, data management, and data migration.

For additional information on FTS, refer to the following documents:
- Symmetrix Federated Tiered Storage (FTS) Technical Notes
- Solutions Enabler Array Management CLI Product Guide
- Solutions Enabler TimeFinder Family CLI User Guide

Viewing external storage

The External Storage page allows you to view and manage external storage as well as validate paths and zoning. The first time you visit the External Storage page, Unisphere scans all of the volumes that are visible from the DX directors.

At least four paths to external volumes is required, meaning that at least four ports belonging to a single DX dual initiator pair must be configured. The best practice for
maximum redundancy is achieved by using single initiator/multiple target zoning. This is accomplished by creating individual zones that contain each DX port and all external ports that the external volumes are available on.

To view external storage and validate paths and zoning:

**Procedure**

1. Select the storage system.
2. Select **STORAGE > External Storage**.

   Use the tree view lists to filter the list of external LUNs by selecting various combinations of members within a tree list view (control ports, external ports, and external LUNs). You can select a single item, multiple items in consecutive rows, or multiple items in non-consecutive rows. As each selection is made, the filtered results table is updated to reflect the current combination of filter criteria.

**Control Ports** tree view list

The following properties display:

- **Director**—Storage system DX director.
- **Port**—Port number on the director.

**External Ports** tree view list

The following properties display:

- **Port WWN**—World Wide Name of the external port.
- **Array ID**—External storage ID.
- **Dir:Port**—Director: Port ID.
- **Vendor**—External storage system vendor.

**External LUNs** tree view list

The following properties display:

- **LUN WWN**—World Wide Name of the external LUN.
- **Capacity (GB)**—Capacity in GB of the external LUN.

**Filtered LUNs** table

The following properties display:

- **External LUN WWN**—World Wide Name of the external LUN.
- **Vendor**—Vendor name of the external LUN.
- **Capacity (GB)**—Capacity in GB of the external LUN.
- **Volume**—Volume ID on the external storage system.
- **LUN**—Displays 0 for storage systems.
- **Virtualizing Status**—The mode of operation that the eDisk is using. Possible values are External, Encapsulated, and None.
- **Emulation**—Emulation type of the external LUN.
- **Disk Group**—Disk group that contains the virtualized LUN.
- **Spindle**—Spindle ID of the external spindle.
- **Service State**—Availability of the external LUN. Possible values are Normal, Degraded, and Failed. Failed means that there are no network paths available to the external LUN. Degraded means that there are paths from only one of
the supporting DX directors. Normal means that there are network paths available from both supporting DX directors.

The following controls are available:

- **Virtualize**—Virtualizing external LUNs on page 267 (Only displays for Enginuity 5876)
- **Remove**—Removing external LUNs on page 269 (Only displays for HYPERMAX OS 5977 or higher)

## Virtualizing external LUNs

See Virtualizing external LUNs on page 268 for background information.

### Procedure

1. To virtualize external LUNs:
   1. Select the storage system.
   2. Select **STORAGE > External Storage**.
   3. (Optional) Click the **Not Virtualized** check box above the filtered LUNs list view to see a list of external LUNs that have not been virtualized.
   4. Select the external LUNs that you want to virtualize.
   5. Click **Virtualize** to open the **Virtualize External LUNs** dialog.
   6. Select an import method from the **Import Method** drop-down menu. This determines the mode of operation for the eDisk.

   **WARNING**

   Selecting Raw Space - External Provisioning deletes any data that is currently on the external volume.

7. Select an external disk group from the **Disk Group** drop-down menu, or type a disk group name to create a new external disk group. Enginuity adds the virtualized external LUNs to the specified external disk group.

8. If you are using Virtual Provisioning, select an empty pool or an existing pool composed of externally provisioned data volumes from the **Thin Pool** drop-down menu. Type a pool name if you want to create a new pool.

9. Optional: Click **Advanced Options** to continue setting the advanced options, as described next.

   **Setting Advanced options:**

   a. To override the auto meta member capacity configured on the storage system, specify the unit of measurement by selecting **GB**, **MB**, or **CYL** from the drop-down menu, and then select a capacity from the **Meta Member Capacity** drop-down menu.

   The Total Enabled Pool Capacity in GB is displayed.

   b. If you want all of the created storage volumes to be the same capacity, click the **Create Equal Meta Member Capacity** check box. If you do not select this check box, the meta tail is smaller than the other volumes in the meta.

   c. If you want to specify a DX director for the path to the eDisk, select a director from the **DX Director** drop-down menu.
d. Click OK.

10. Do one of the following:

- Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
- Expand Add to Job List, and click Run Now to perform the operation now.

### Virtualizing external LUNs

When you attach external storage to a storage system, FAST.X virtualizes an external storage system’s SCSI logical units as disks called eDisks. eDisks have two modes of operation:

**Encapsulation**

Allows you to preserve existing data on external Symmetrix systems and access it through storage volumes. These volumes are called encapsulated volumes.

**External Provisioning**

Allows you to use external storage as raw capacity for new storage volumes. These volumes are called externally provisioned volumes. Existing data on the external volumes is deleted when they are externally provisioned.

The following restrictions apply to eDisks:

- Can only be unprotected volumes. The RAID protection scheme of eDisks is dependent on the external storage system.
- Cannot be AS400, CKD, or gatekeeper volumes.
- Cannot be used as VAULT, SFS, or ACLX volumes.

**Encapsulation**

Encapsulation has two modes of operation:

**Encapsulation for disk group provisioning (DP encapsulation)**

The eDisk is encapsulated and exported from the storage system as disk group provisioned volumes.

**Encapsulation for virtual provisioning (VP encapsulation)**

The eDisk is encapsulated and exported from the storage system as thin volumes.

In either case, Enginuity automatically creates the necessary volumes. If the eDisk is larger than the maximum volume capacity or the configured minimum auto meta capacity, Enginuity creates multiple volumes to account for the full capacity of the eDisk. These volumes are concatenated into a single concatenated meta volume to allow access to the complete volume of data available from the eDisk.

**External provisioning**

After you virtualize an eDisk for external provisioning, you can create volumes from the external disk group and present the storage to users. You can also use this storage to create a new FAST VP tier.

---

**Note**

If you use external provisioning, any data that is currently on the external volume is deleted.
Geometry of encapsulated volumes
Enginuity builds storage volumes based on the storage system cylinder size (fifteen 64 K tracks), so the capacity of storage volumes does not always match the raw capacity of the eDisk. If the capacity does not match, Enginuity sets a custom geometry on the encapsulated volume. For created meta volumes, Enginuity defines the geometry on the meta head, and only the last member can have a capacity that spans beyond the raw capacity of the eDisk.
Encapsulated volumes that have a cylinder size larger than the reported user-defined geometry are considered geometry limited. For additional details and a list of restrictions that apply to geometry-limited volumes, refer to the Solutions Enabler Array Controls CLI Guide.

Removing external LUNs

Before you begin
- This feature requires HYPERMAX OS 5977 or higher.
- LUNs must be virtualized.

This procedure explains how to remove external LUNs from storage groups protected with ProtectPoint. Encapsulated LUNs whose volumes are in a storage group cannot be removed.

Procedure
1. Select the storage system.
2. Select Storage > External Storage.
   Opens the External Storage page.
3. Optional: Use the tree view lists to filter the list of external LUNs by selecting various combinations of members within a tree list view (control ports, external ports, and external LUNs). Select either a single item, multiple items in consecutive rows, or multiple items in non-consecutive rows. As each selection is made, the filtered results table is updated to reflect the current combination of filter criteria.
4. From the filtered results table, select one or more LUNs and click Remove.
   Opens the Remove External LUNs dialog box.
5. (Optional) To view details on the selected LUNs, click Show selected external LUNs.
6. Do one of the following:
   - Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now.

Understanding storage templates
Storage templates are a reusable set of storage requirements that simplify storage management for virtual data centers by eliminating many of the repetitive tasks required to create and make storage available to hosts/applications. With this feature, Administrators and Storage Administrators create templates for their common provisioning tasks and then invoke them later when performing such things as:
• Creating or provisioning storage groups.

The templates created on a particular Unisphere server can be used across all the arrays on that particular server.

Storage templates require storage system running HYPERMAX OS 5977 or greater and storage groups.

A provisioning template contains configuration information and a performance reservation.

A Workload Plan/Performance Reservation is the I/O profile (IOPS/MBPS, Skew Mixture) for a particular SL-WL type combination. By default, the reservation is used for suitability checks and for comparison to current load running. The reservation expires after 14 days.

Creating storage templates

Before you begin

• Storage templates require HYPERMAX OS 5977 or greater.

• This feature is only available to a user with Admin or StorageAdmin permission.

Using the configuration and performance characteristics of an existing storage group as a starting point, you can create templates that will pre-populate fields in the provisioning wizard and create a more realistic performance reservation in your future provisioning requests.

To create a storage template:

Procedure

1. Select the storage system.

2. Select STORAGE > Templates to open the Provisioning Templates list view

3. For second and subsequent templates, click Provision. Go to step 7.

4. To create the first template, click Select a Storage Group (this is part of the text under Get Started!). and select a storage group that has a service level (SL) assigned (FBA only).

5. Click and click the Compliance icon.

6. Click Save as a Template.

7. Review the default values and update as appropriate.

Configuration information includes the Service Level, Workload Type, Number and Size of Volumes to be saved as part of the template. By default the information will be populated based on the selected storage group, which can be modified as required before saving.

Service Level: The drop-down will be populated with the all the available service levels on the selected storage system and Array Default. By default, the service level of the selected storage group will be selected.

Workload Type: The drop-down will be populated with the workload types available to the selected SL (including None). By default the workload type of the selected storage group will be selected.

Volumes: By default the number of volumes will be the number of volumes in the selected storage group. This field can be left empty. If the Scale Limits switch is on (default state), a change made to volume size will scale the IOPS and MBPS chart and an appropriate host IO limit will be calculated as a recommended value.
Volume Size: By default the size of the volumes will be the size of the volumes in the selected storage group. If there are multiple volume sizes, the size of the first volume size encountered will be used. This field can be left empty. Volume capacity units available will be GB and TB. If the Scale Limits switch is on (default state), a change made to volume size will scale the IOPS and MBPS chart and an appropriate host IO limit will be calculated as a recommended value. Read Interaction Between Charts/Data for more information.

Expected RT: The expected average response time for the selected service level.

The Host I/O Limit section will pull current host I/O limit information from the source storage group (standalone or child limit only, parent limit is ignored). If no host I/O limit is set, a host I/O limit in IOPS is recommended and the value is pre-populated.

Host I/O Limit combobox:
Options: IOPS, MBPS, Both, and None.

Initial Values:

- If the source Storage Group has an IOPS limit set, **IOPS** is selected.
- If the source Storage Group has an MBPS limit set, **MBPS** will be selected.
- If the source Storage Group has an IOPS and an MBPS limit set, **Both** is selected.
- If the source Storage Group has no limit set, **IOPS** is selected.

Host I/O Limit input field(s) and associated recommendation label(s):

- **IOPS Selected in combobox:**
  - Text input initial value:
    - If source storage group has an IOPS limit set, initial value is that limit.
    - If source Storage Group has no IOPS limit set, initial value is the recommended limit.
    - Restrictions:
      - Value must fall between 100-2,000,000.
      - Value must be a multiple of 100.

- **MBPS selected in combobox.**
  - Text input initial value:
    - If source storage group has an MBPS limit set, initial value is that limit.
    - If source Storage Group has no MBPS limit set, initial value is the recommended limit.
    - Restrictions:
      - Value must fall between 1-100,000.

- **Both selected in combobox - the IOPS and MBPS information is displayed.**
- **None selected in combobox - no text field or recommendation is displayed.**

Scale limits switch: The scale limits switch is enabled by default.

If the switch is 'on', provisioning requests using this template with scale the host IO Limit recommendation(s) if the template's default capacity is overridden.
If the switch is 'off', provisioning requests will use the exact Host IO Limit value(s) that were saved with the template.

Dynamic Distribution:
- Options: Never, OnFailure, and Always.
- Initial value:
  - If source Storage Group has a Dynamic Distribution value, initial value is that value.
  - If source Storage Group has no Dynamic Distribution set, initial value is Never.

Performance Reservation
This is a 2 week expiring performance reservation or plan that will be used for comparison on the storage group details page and suitability checks.

IOPS and MBPS: Similar to IOPS and MBPS chart on the storage group details page with just the actual values and no plan (more details Workload Compliance Details spec).

A Host I/O Limit line will be seen on the graph if a corresponding value has been set in the Host IO Limit section.

Workload Skew: Similar to the workload skew chart on the storage group details page with just the actual values and no plan.

I/O Mixture: Similar to the workload mixture chart on the storage group details page with just the actual values and no plan.

Interaction Between Charts and Data

When Capacity is Modified (both Volumes Count and Size are Populated)

Performance Reservation Section:
- IOPS/MBPS: The IOPS and MBPS values are scaled to the new capacity to preserve the IO density. For example, if the source storage group's total capacity was 10 x 50 GB volumes = 500GB, and the Volumes field was changed from 10 to 15, the total capacity would be 750GB. The 42 IOPS values and the 42 MBPS values in the charts would be multiplied by 1.5 to reflect the 50% increase in capacity.
- I/O Mixture: No change.
- Skew: No change.

If the Scale limits switch is 'on', the recommended limit will be recalculated according to the new capacity. So it would be two times the maximum 42 bucket value of IOPS and/or MBPS as calculated for the Performance Reservation section. The textbox will be auto-populated with the recommended limit. This new value will also be drawn in the appropriate IOPS and/or MBPS chart in the Performance Reservation section.

If the Scale limits switch is 'off', the recommended limit will be recalculated the same way. The value in the textbox will NOT be overwritten in this case.

When Capacity is Modified (Volumes Count and/or Size are Empty)

Performance Reservation Section:
- IOPS/MBPS: Total capacity it required to calculate IOPS/MBPS. If we are missing count, size, or both, the IOPS and MBPS values will be calculated according to the current total capacity of the source storage group. So if (for example) the storage group is 5 x 100GB devices, and Volume Count is nulled out, and device size is change to 75GB, IOPS and MBPS will be calculated...
assuming 500GB. The assumed capacity will be displayed in the upper right hand corner of the charts.

I/O Mixture: No change.

Skew: No change.

Host IO Limit:

Total capacity it required to calculate Host IO Limit recommendation. If we are missing count, size, or both, the recommendation will be calculated according to the current total capacity of the source storage group. An information icon will be shown next to the recommendation. Hovering will give more information.

When Host IO Limit Combobox and Textbox Values are Modified

The specified value will be drawn in the appropriate charts. If the value is updated, the chart is updated.

If the combobox value is Both, you should have a red line corresponding to the specified value of IOPS on the IOPS chart and MBPS on the MBPS chart. If None is selected, no host IO limit line should show up on either IOPS or MBPS chart.

If IOPS is selected, there should be a red line on IOPS and none on MBPS. If MBPS is selected, there should be a red line on MBPS and none on IOPS.

8. Click SAVE

If there has not been at least one week of data collected for the selected storage group, a dialog is displayed (see Dialog displayed when there is less than one week’s data collected on page 98).

Viewing storage templates

Before you begin

• Storage templates require HYPERMAX OS 5977 or greater.

The Provisioning Template list view allows you to view and manage provisioning templates.

Procedure

1. Select the storage system.
2. Select STORAGE > Templates to open the Provisioning Template list view.
3. Select a template card.

The following properties are displayed - template service level, workload type, response time, capacity information (number of volumes, size and headroom), as well as workload characteristics (I/O density, I/O size, Writes and Skew.)

4. Hover near the workload writes % to view a popup chart of the I/O mixture that the workload is running. Hovering over the sections of the pie chart reveals the percentages associated with each I/O type. To dismiss the popup charts simply click anywhere off of the charts.

5. Hover near the workload skew % to view a popup chart of the actual workload skew.

The actual workload skew is a load percentage over the percentage of capacity used in the workload. Hovering over the line on the chart will display the percentages for actual capacity and load score. To dismiss the popup charts simply click anywhere off of the charts.
6. Click on the icon on the top-right hand corner of the template card to view the back of the template card.

   The back of the template card displays the name of the template at the very top along with two charts underneath it. The top chart displays the set workload host IO limit in IOPS along with the actual workload IO statistics. The bottom chart displays the set workload host IO limit in MBPS along with the actual workload MBPS IO statistics.

7. Click on the icon on the top-right hand corner of the template card to view front siode of the card again.

   The following controls are available:

   - **Provision**— *Creating storage templates* on page 270
   - **Modify**— *Modifying storage templates* on page 274
   - [ ] —*Deleting storage templates* on page 274

### Modifying storage templates

**Before you begin**

- Storage templates require HYPERMAX OS 5977 or greater.
- The user must have Administrator or StorageAdmin permission.

**Procedure**

1. To modify a storage template:
   1. Select the storage system.
   2. Select **STORAGE > Templates** to open the **Provisioning Templates** list view
   3. Select the template and click **Modify** to open the **Modify Template** wizard.
   4. Modify the template as you step through the wizard.

   All of the fields are exactly like the **Save as a Template** dialog. The only difference is how the scale limits work when volume size or volume count field is left empty.

   If the selected template has both volume size and count when it was created and the user removes one or either of them during the modification operation with scale limits switch on, the original capacity of the template will be used for the display purposes and it will be shown in the tooltip next to the IOPS/MBPS field and top right corner of the chart.

   If the selected template did not have either volume size and count when it was created and the user leaves one or either of the fields empty modification operation with scale limits switch on, the capacity of 200 GB will be used for the display purposes and it will be shown in the tooltip next to the IOPS/MBPS field and top right corner of the chart.

5. Click **Finish**.

### Deleting storage templates

**Before you begin**

- Storage templates require HYPERMAX OS 5977 or greater.
This feature is only available for a user with Administrator or StorageAdmin permission.

To delete a storage template:

**Procedure**

1. Select **STORAGE > Storage Templates** to open the **Storage Template** list view.
2. Select the template and click ![trash](trash).
3. Click **OK**.

## Understanding FAST.X

FAST.X allows the seamless integration of storage systems running HYPERMAX OS 5977 or higher and heterogeneous arrays. It enables LUNs on external storage to be used as raw capacity. Data services such as SRDF, TimeFinder, and Open Replicator are supported on the external device.

FAST.X requires HYPERMAX OS 5977 or higher.

For additional information on FAST.X, refer to the following documents:

- *Solutions Enabler Array Management CLI Guide*
- *Solutions Enabler TimeFinder CLI User Guide*

## Viewing external disks

**Before you begin**

The external disk list is available only for HYPERMAX OS 5977 or higher.

**Note**

You must refresh the external disks list to view the latest status.

**Procedure**

1. Select the storage system.
2. Select **STORAGE > Storage Resource Pools**.
3. Select the SRP and click ![info](info) to view its details.
4. Click the number next to **Disk Groups**.
5. Select an external disk group and click ![info](info) to view its details.
6. Click the number next to **Number of disks**.

The following properties are displayed:

- **Name**
  - World Wide Name of the external disk.

- **Spindle**
  - Spindle ID of the external spindle.

- **Vendor**
  - Vendor name of the external disk.
Capacity (GB)
Capacity in GB of the external disk.

Array ID
ID of the storage system.

Service State
Availability of the external disk. Possible values are Normal, Degraded, and Failed. Failed means that there are no network paths available to the external LUN. Degraded means that there are paths from only one of the supporting DX directors. Normal means that there are network paths available from both supporting DX directors.

Disk State
The state of the disk. Valid values are Active, Drained, Draining, and Disabled.

Drained
Drain information about the disk if it is in Drained or Draining state. Otherwise it displays ".-".

The following controls are available:
- **Add eDisks** — Adding external disks on page 276
- **Remove** — Removing external disks or External LUNs on page 277
- **Start Draining** — Start draining external disks on page 278
- **Stop Draining** — Stop draining external disks on page 278
- **Activate** — Activating external disks on page 279

Adding external disks

**Before you begin**
This action can be performed only for HYPERMAX OS 5977 or higher.

You can add an external disk to the external disk group of a storage resource pool (SRP).

When adding an external disk for storage systems running HYPERMAX OS 5977 or higher, if there is no pre-existing external disk group, it is created automatically when the external disk is added to the selected SRP. If an external disk group exists for the external array’s external LUN WWN, the external LUN WWN is added to it.

**Procedure**
1. To add an external disk:
   1. Select the storage system.
   3. Select the SRP.
   4. Click Add EDisks.

   The Add eDisks dialog box shows the available external LUN WWNs from multiple external arrays.
5. Select the external disk to be added.

6. If you want to preserve the existing data on the external LUN, select Incorporate eDisk data. If you leave the Incorporate eDisk data cleared, the existing data on the external LUN is cleared.

7. (Optional) In the Add Storage Group list, select a storage group to add. You can filter the list by searching for a storage group by name. This option is available only on storage systems running HYPERMAX OS 5977 Q1 2016.

8. Do one of the following:
   • Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   • Expand Add to Job List, and click Run Now to perform the operation now.

Removing external disks or External LUNs

Before you begin
See Removing external LUNs on page 269 for information on removing external LUNs. See below for information on removing external disks.
This action can be performed only for HYPERMAX OS 5977 or higher.
You can remove an external disk from a storage resource pool (SRP) if it is in a Drained state.

Procedure

1. To remove an external disk:
   1. Select the storage system.
   3. Select the SRP and click to view its details.
   4. Click the number next to Disk Groups.
   5. Select an external disk group and click to view its details.
   6. Select the external disk that you want to remove, click , and click Remove eDisks.
      The Remove External LUNs dialog appears and prompts for confirmation that you want to remove the external disk.

7. Do one of the following:
   • Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   • Expand Add to Job List, and click Run Now to perform the operation now.
Working with external disks

You can perform the following operations:

- Start draining an external disk. For more information, refer to Start draining external disks on page 278.
- Stop draining an external disk. For more information, refer to Stop draining external disks on page 278.
- Activate an external disk. For more information, refer to Activating external disks on page 279.

Start draining external disks

Before you begin

The storage resource pool (SRP) containing the external disk you want to drain must have sufficient free space to absorb the allocated tracks from the external disk that is being drained.

You can drain a disk only if it is not currently draining or already drained.

Procedure

1. To start a drain operation on an external disk:
   1. Select the storage system.
   3. Select the SRP and click to view its details.
   4. Click the number next to Disk Groups.
   5. Select an external disk group and click to view its details.
   6. Select the external disk that you want to drain, click , and click Start Draining.
   7. Do one of the following:
      - Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
      - Expand Add to Job List, and click Run Now to perform the operation now.

Stop draining external disks

Before you begin

You can stop the drain operation on an external disk only if it is currently draining.

Procedure

1. To stop a draining operation on an external disk:
   1. Select the storage system.
   3. Select the SRP and click to view its details.
4. Click the number next to Disk Groups.

5. Select an external disk group and click to view its details.

6.

Select the external disk that you want to stop draining, click , and click Stop Draining.

7. Do one of the following:
   - Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

### Activating external disks

#### Before you begin

This action can be performed only for HYPERMAX OS 5977 or higher.

You can activate an external disk if it is in a draining, drained, or disabled state.

#### Procedure

1. To activate an external disk:
   1. Select the storage system.
   3. Select the SRP and click to view its details.
   4. Click the number next to Disk Groups.
   5. Select an external disk group and click to view its details.
   6. Select the external disk that you want to activate, click , and click Activate.

7. Do one of the following:
   - Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

### Viewing reservations

#### Procedure

1. Select the storage system.

2. In the Dashboard, click the System Health tab.

3. In the Actions panel, click View Reservations.

   The following properties display:
   - Reservation—Reservation ID.
   - Owner—User that created the reservation.
- **Application**—Application used to create the reservation.
- **Host**—Host from which the reservation was created.
- **Reserved Volumes**—Number of reserved volumes.
- **Creation**—Date/time the reservation was created.
- **Expiration**—Date/time the reservation will expire. The default value is Never.
- **User Comment**—User-supplied comments.

The following control is available:

**Release**—Releasing reservations on page 280

### Viewing reservation details

**Procedure**

1. Select the storage system.
2. In the dashboard, click the **System Health** tab.
3. In the **Action** panel, click **View Reservations**.
4. Select the reservation and click ![i](i). The **Properties** panel displays the following:
   - **Reservation**—Reservation ID.
   - **Owner**—User that created the reservation.
   - **Application**—Application used to create the reservation.
   - **Host**—Host from which the reservation was created.
   - **Reserved Volumes**—Number of reserved volumes.
   - **Creation**—Date/time the reservation was created.
   - **Expiration**—Date/time the reservation will expire. Never is the default.
   - **User Comment**—User-supplied comments.

There are links to views for objects contained in and associated with the reservation. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking **Reserved Volumes** will open a view listing the volumes held in the reservation.

### Releasing reservations

**Procedure**

1. Select the storage system.
2. In the dashboard, click the **System Health** tab.
3. In the **Action** panel, click **View Reservations**.
4. Select one or more reservations and click **Release**.
5. Click **OK**.
Managing vVol

Before you begin

The storage system must be running HYPERMAX OS 5977 or higher.

The VVol Dashboard provides you with a single place to monitor and manage VVols.

To access the VVol Dashboard:

Procedure

1. Select the storage system.
2. Select Storage > VVol Dashboard.

VVol Dashboard:
The VVol Dashboard is organized into the following panels:

Summary panel
Displays the following VVol summary information:

- **Storage Containers** — The number of storage containers on the selected storage system.
  Click **Storage Containers** to display the Storage Containers list view. For more information about viewing storage containers, refer to Viewing storage containers on page 282.

- **Protocol Endpoints** — The number of protocol endpoints on the selected storage system.
  Click **Protocol Endpoints** to display the Protocol Endpoints list view. For more information about protocol endpoints, refer to Viewing protocol endpoints on page 288.

- **PE Masking Views** — The number of masking views that contain protocol endpoints.
  Click **PE Masking Views** to display the PE Masking Views list view. For more information about PE masking views, refer to Viewing masking views on page 312.

To view additional information on a particular item, click on it to open the corresponding list view.

Actions panel
Displays links to the following common tasks:

- **CREATE STORAGE CONTAINER** — Creating storage containers on page 283

- **PROVISION PROTOCOL ENDPOINT TO HOST** — Provisioning protocol endpoints to hosts on page 289

- **STORAGE CONTAINER ALERTS** — Viewing alerts on page 52

Symmetrix Consumed Capacity - Subscribed panel
Displays a bar graph representing how much subscribed space all storage containers consume on the storage system.

VASA Provider Status panel
Displays one of the following icons representing the status of the VASA provider:

- ✔ — The VASA provider is online.
The VASA provider is offline.

A connection to the VASA provider has not been configured.

There was an error connecting to the VASA provider.

To refresh the status of the VASA provider, click ⌁. To create a connection to the VASA provider, click Create Connection. To edit an existing connection, click Edit Connection. For more information about configuring a connection to the VASA provider, see Configuring the VASA provider connection on page 290.

Storage Resources panel
Displays a list of storage resources within all containers on the storage system, showing the current usage of each storage resource, ascending by usage.

- Name — The name of the capability profile.
- Subscribed Used (%) — The current percent of subscribed tracks within the storage resource in relation to the limit imposed on the capability profile.
- Limit (GB) — The subscribed limit imposed on the storage resource.
- Container — The name of the storage container with which the storage resource is associated.
- Compression — If compression is enabled on this storage resource a tick will appear. If it's disabled a horizontal dash will appear.

Click VIEW ALL STORAGE RESOURCE to view the Storage Resources list view.

Viewing storage containers
To view the storage container list:

Procedure
1. Select the storage system.
2. Select Storage > VVol Dashboard.
3. Click Storage Containers to display the Storage Containers list view.

The following properties display:

- Name — The name of the storage container.
- Storage Resources — The number of associated storage resources.
- Subscribed Used (%) — The current percentage of subscribed tracks within the storage container, in relation to the limit imposed on all of the storage resources within the storage container.
- Subscribed Limit (GB) — The current total limit of all storage resources in GB.

The following controls are available:

- Viewing storage container details on page 283
- Create — Creating storage containers on page 283
- Modify — Modifying storage containers on page 284
Viewing storage container details

To view storage container details:

Procedure

1. Select the storage system.
2. Select Storage > VVol Dashboard.
3. Click Storage Containers to display the Storage Containers list view.
4. Select the storage container and click ⌁. The following properties display:
   - Name — The name of the storage container.
   - Description — The description of the storage container. This field is editable.
   - Subscribed Limit (GB) — The total combined limit of all storage resources within the storage container.
   - Subscribed Used (GB) — The current subscribed usage on the storage container of all of the storage resources within the storage container.
   - Subscribed Free (GB) — The total free subscribed capacity, based on the capacity used and the limit of all of the storage resources in the storage container.
   - Number of Storage Resources — The total number of storage resources within the storage container.

Creating storage containers

This procedure allows you to create a storage container. To add a storage resource to a storage container, refer to Adding storage resources to storage containers on page 286.

To create a storage container:

Procedure

1. Select the storage system.
2. Select Storage > VVol Dashboard.
3. Click Storage Containers to display the Storage Containers list view.
4. Click Create. The Create Storage Container wizard displays.
5. Complete the following steps:
   a. Type a name for the storage container.
   b. Optional: Type a description of a storage container.
6. Click NEXT.
7. On the Storage Resources page, specify at least one storage resource. Default values for a new storage resource are populated.
To remove a storage resource from the list of associated storage resources, hover the mouse over the storage resource and click.

To add a storage resource, click and complete the following steps (same steps when modifying an existing resource):

a. In the Name field, type a name for the storage resource, or accept the default name.
b. From the SRP menu, select the SRP to apply to the storage resource.
c. From the Service Level menu, select the service level to apply to the storage resource.
   For all-flash storage systems, the only service level available is Diamond and it is selected by default.
d. From the Workload menu, select the workload to apply to the storage resource.
e. In the Limit (GB) field, type the imposed subscribed limit on the storage resource. 0.1 GB is the minimum value allowed.

8. Compression is enabled by default on All Flash systems running the HYPERMAX OS 5977 Q3 2016 Service Release or higher. To disable the feature on this storage container, uncheck the Compression check box. For more information, refer to Understanding compression.

9. Click NEXT.

10. On the Summary page, review the details and do one of the following:
    - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
    - Expand Add to Job List, and click Run Now to perform the operation now.

Modifying storage containers

To modify a storage container:

Procedure

1. Select the storage system.
2. Select Storage > VVol Dashboard.
3. Click Storage Containers to display the Storage Containers list view.
4. Select the storage container and click Modify.
5. Modify the description.
6. Click OK.

Deleting storage containers

Before you begin

- The storage system must be running HYPERMAX OS 5977 or higher.
- You cannot delete containers with used capacity.

To delete a storage container:
Procedure
1. Select the storage system.
2. Select **Storage > VVol Dashboard**.
3. Click **Storage Containers** to display the **Storage Containers** list view.
4. Select the storage container you want to delete, click ..., and click **Delete**.
5. Click **OK**.

**Viewing storage resources**

To view the storage resource list:

**Procedure**
1. Select the storage system.
2. Select **Storage > VVol Dashboard**.
3. Click **Storage Containers** to display the **Storage Containers** list view.
4. Select the storage container and click ![i](i)
5. Click the number next to **Storage Resources** to display the Storage Resources list view.

The following properties display:

- **Name** — The name of the capability profile.
- **SRP** — The number of the SRP.
- **Service Level** — The name of the service level.
- **Workload** — The name of the workload.
- **Subscribed Used (%)** — The current percent of subscribed tracks within the storage resource in relation to the limit imposed on the storage resource.
- **Subscribed Limit (GB)** — The subscribed capacity limit within the storage resource.

The following controls are available:

- ![i](i) — Viewing storage resource details on page 285
- **Add** — Adding storage resources to storage containers on page 286
- **Modify** — Modifying storage resources on page 287
- **Remove** — Removing storage resources from storage containers on page 288

**Viewing storage resource details**

To view storage resource details:

**Procedure**
1. Select the storage system.
2. Select **STORAGE > VVol Dashboard**.
3. Click **Storage Containers**.

4. Select the storage container and click 🔄.

5. Click the number next to **Storage Resources** to display the Storage Resources list view.

6. Select the storage resource and click 🔄.

   The following properties display:

   - **Name** — The name of the storage resource.
   - **Storage Container** — The name of the associated storage container.
   - **SRP** — The name of the associated SRP.
   - **Service Level** — The name of the associated service level.
   - **Workload** — The name of the associated workload.
   - **Compression** — Indication if compression is enabled or disabled.
   - **Compression Ratio** — The current compression ratio on this storage resource.
   - **Subscribed Capacity Limit (GB)** — The subscribed capacity limit imposed. This field is editable.
   - **Subscribed Capacity Used (GB)** — The current subscribed usage on the storage resource.
   - **Subscribed Capacity Free (GB)** — The subscribed free space on the storage resource.

**Viewing storage resource related SRPs**

To view the related SRPs of a storage resource:

**Procedure**

1. Select the storage system.
2. Select **Storage > VVol Dashboard**.
3. Click **Storage Containers** to display the Storage Containers list view.
4. Select the storage container and click 🔄.
5. Click the number next to **Number of Storage Resources** to display the Storage Resources list view.
6. Select the storage resource and click 🔄.
7. Click the entry next to SRP to display the Storage Resource Pools list view.

   For more information about the Storage Resource Pools list view, refer to **Viewing Storage Resource Pools** on page 156.

**Adding storage resources to storage containers**

To add a storage resource to a storage container:
Procedure

1. Select the storage system.
2. Select STORAGE > VVol Dashboard.
3. Click Storage Containers to display the Storage Containers list view.
4. Select the storage container and click 🔄.
5. Click the number next to Number of Storage Resources.
6. Click Add.

The Add Storage Resource To Storage Container dialog box displays. The details of any existing storage resource are populated automatically.

7. To add an additional resource, click 🔄 and specify the following details:
   - **Name** — The name of the storage resource.
   - **SRP** — The name of the SRP.
   - **Service Level** — The name of the service level.
   - **Workload** — The name of the workload.
     For more information about current workload, click 🔄.
   - **Limit (GB)** — The subscribed capacity limit imposed.
   - **Compression** — The Compression check box will be checked if you enabled compression when creating the storage group. Uncheck to disable compression on this particular storage resource. For more information, refer to Understanding compression.

8. (Optional) If required, edit the details of the new storage resource, click 🔄 to remove it completely, or click 🔄 to add another new storage resource.
9. After you have added all of the required storage resources, do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Modifying storage resources

To modify a storage container:

Procedure

1. Select the storage system.
2. Select STORAGE > VVol Dashboard.
3. Click Storage Containers to display the Storage Containers list view.
4. Select the storage container and click 🔄.
5. Click the number next to Number of Storage Resources.
6. Select the storage resource and click Modify.
Removing storage resources from storage containers

To remove a storage resource from a storage container:

Procedure
1. Select the storage system.
2. Select STORAGE > VVol Dashboard.
3. Click Storage Containers to display the Storage Containers list view.
4. Select the storage container and click .
5. Click the number next to Number of Storage Resources.
6. Select the storage resource you want to remove, click , and click Remove.
7. Click OK.

Viewing protocol endpoints

To view the protocol endpoints list:

Procedure
1. Select the storage system.
2. Select Storage > VVol Dashboard.
3. Click Protocol Endpoints to display the Protocol Endpoints list view.

The following properties display:

- Name — The volume ID of the protocol endpoint.
- Masking view — Indicates, using a or symbol, if the protocol endpoint is in a masking view or not.
- Storage Groups — The number of associated storage groups.
- Reserved — Indicates if the protocol endpoint is reserved or not.

The following controls are available:

- [ ] Viewing protocol endpoint details on page 288
- [ ] Deleting protocol endpoints on page 290
- Set Volume Identifier — Setting volume identifiers on page 198

Viewing protocol endpoint details

To view protocol endpoint details:

Procedure
1. Select the storage system.
2. Select Storage > VVol Dashboard.
3. Click Protocol Endpoints.
4. Select the protocol endpoint and click 
   ![icon]

The following properties display:

- **Name** — The name of the protocol endpoint.
- **Volume Identifier** — The volume identifier of the protocol endpoint.
- **Status** — The status of the protocol endpoint.
- **Reserved** — The reserved status of the protocol endpoint. Valid values are Yes and No.
- **Number of Storage Groups** — The total number of storage groups associated with the protocol endpoint.
- **Number of Masking Views** — The total number of masking views associated with the protocol endpoint.

**Provisioning protocol endpoints to hosts**

To provision a protocol endpoint to a host:

**Procedure**

1. Select the storage system.
2. Select Storage > VVol Dashboard.
3. In the Actions panel, click Provision Protocol Endpoint to Host.
4. Specify a host or host group. Do one of the following:
   - Select an existing host or host group from the list.
   - To create a new host, click Create Host. The Create Host dialog displays. For more information, refer to Creating hosts on page 296.
   - To create a host group, click Create Host Group. The Create Host Group dialog displays. For more information, refer to Creating host groups on page 306.
5. Click NEXT.
6. On the Select Port Group pane, specify a port group. Do one of the following:
   - To create a new port group, select New. For more information about creating port groups, refer to Creating port groups on page 321.
   - To use an existing port group, select Existing, and select a port group from the Port Group list.
7. Click NEXT.
8. On the Summary page, review the details and do one of the following:
   - Optional: Modify the auto-generated Masking View name.
   - Optional: Modify the auto-generated Storage Group name.
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.
Deleting protocol endpoints

Before you begin
The storage system must be running HYPERMAX OS 5977 or higher.

To delete a protocol endpoint:

Procedure
1. Select the storage system.
2. Select Storage > VVol Dashboard.
3. Click Protocol Endpoints to display the Protocol Endpoints list view.
4. Select the protocol endpoint you want to delete and click .
5. Click OK.

Configuring the VASA provider connection

To configure the VASA provider connection:

Procedure
1. Select the storage system.
2. Select Storage > VVols Dashboard.
3. In the VASA Provider Status panel, do one of the following:
   - To create a new connection, click Create Connection.
   - To edit an existing connection, click Edit Connection.
4. Specify the IP address of the VASA provider.
5. Click OK.

Understanding compression

Compression allows users to compress user data on storage groups and storage resources. The feature is enabled by default and can be turned on and off at storage group and storage resource level.

If a storage group is cascaded, enabling compression at this level enables compression for each of the child storage groups. The user has the option to disable compression on one or more of the child storage groups if desired.

To turn the feature off on a particular storage group or storage resource, uncheck the Compression check box in the in the Create Storage Group, Modify Storage Group or Add Storage Resource To Storage Container dialogs or when using the Provision Storage or Create Storage Container wizards.

The following are the prerequisites for using compression:

- Compression is only allowed on All Flash systems running the HYPERMAX OS 5977 Q3 2016 Service Release or higher.
- Compression is allowed for FBA devices only.
- The user must have at least StorageAdmin rights.
- The storage group needs to be FAST managed.
• The associated SRP cannot be comprised, either fully or partially, of external storage.

**Reporting**

Users are able to see the current compression ratio on the device, the storage group and the SRP. Efficiency ratios are reported in units of 1/10th:1.

**Note**

External storage is not included in efficiency reports. For mixed SRPs with internal and external storage only the internal storage is used in the efficiency ratio calculations.

### Viewing the SRP efficiency details

**Before you begin**

Users need to have at least Monitor rights.

This procedure explains how one way to view the overall efficiency details of an SRP. The **Overall Efficiency Ratio** field can also be viewed from the Storage Resource Pools Details view.

**Procedure**

1. Select the storage system.
2. Select CAPACITY to open the CAPACITY dashboard.

The following fields are displayed in the Efficiency panel:

- Overall Efficiency Ratio - The ratio of the sum of all TDEVs and Snapshot sizes and the Physical Used Storage (calculated based on the compressed pool track size).
- Virtual provisioning Savings - The ratio of the sum of all TDEVs and Snapshot sizes and the sum of all TDEVs allocated plus RDP allocated space.
- Snapshot Savings - The ratio of the RDP Logical Backend Storage (calculated based on the 128K track size) and the RDP Physical Used Storage of the RDP space (calculated based on the compressed pool track size).

### Viewing compressibility reports

This procedure shows how to view maximum data compressibility of storage groups on an All Flash storage system. Compression must be enabled on the storage system.

**Before you begin:**

- This feature requires HYPERMAX OS 5977.1125.1125 running on an All Flash storage system
- The account you use on Unisphere must have Monitor privilege at least.

**Procedure**

1. Select the storage system.
2. Select CAPACITY to open the CAPACITY dashboard.
3. Select a SRP instance from the drop down menu and in the Actions panel, click COMPRESSIBILITY.

The report lists the following details for each storage group:
• **Storage Group**—The name of the storage group.
• **# of Volumes**—The number of volumes in the group.
• **Allocated (GB)**—The amount of space allocated to the storage group.
• **Used (GB)**—The amount of allocated space that the group is using.
• **Target Ratio**—The expected compression ratio based on the last 24 hours of samples. If all storage groups are compressed, the compressibility report will be empty except for an entry named **NOT_IN_SG** (assuming that not all of the configured volumes are in storage groups).

**Viewing a storage group's compression ratio**

**Before you begin**

Users need to have at least Monitor rights to view the compression ratio.

**Procedure**

1. Select a storage system.
2. Select **STORAGE > Storage Groups**
3. Select a storage group and click 🔄.

The **Compression**,** Compression Ratio** and **VP Saved** fields for the selected storage group are displayed.

If compression is enabled on the storage group a tick will appear in the **Compression** field. If compression is disabled a horizontal dash will be shown.

**Viewing a volume's compression details**

**Before you begin**

Users need to have at least Monitor rights to view the compression ratio.

This procedure explains how to view a storage group volume's compression ratio.

**Procedure**

1. Select a storage system.
2. Select **STORAGE > Storage Groups**.
3. Click 🔄 and click the number next to **Volumes**.
4. Select a volume and click 🔄.

The **Compression Ratio** field for the selected volume is displayed. If compression ratio is not applicable on the volume the field will read "N/A."

5. Alternatively, select a storage system and then select **Storage > Volumes**.
6. Select a volume and click 🔄.

The **Compression Ratio** field for the selected volume is displayed.

**Viewing compression status using the VVol Dashboard**

**Before you begin**

Users need to have at least Monitor rights.
This procedure explains how to view the compression status and compression ratio of storage resources using the VVol Dashboard.

Procedure
1. Select a storage system.
2. Select Storage > VVol Dashboard.
   The compression state column for each storage resource is displayed in the Symmetrix Consumed Capacity - Subscribed panel. If compression is enabled for that resource a tick will appear in the column. If compression is disabled a horizontal dash will be shown.
3. To view the compression ratio on a storage resource, click on Storage Containers.
4. Select a storage container and click .
5. Click the number next to Storage Resources.
6. Select a storage resource and click .
   The Compression Ratio field is displayed.

Viewing the compression efficiency dashboard

This procedure explains how to view the compression efficiency of a storage system running HYPERMAX OS 5977.

Procedure
1. Select a storage system.
2. Select PERFORMANCE > Dashboards.
3. Choose Array as the category.
4. Click on the Array Efficiency tab.


Understanding Host Management

Host Management covers the following areas:

- **Hosts** - Management of host and host groups.
- **Masking Views** - Management of masking views. A masking view is a container of a storage group, a port group, and an initiator group, and makes the storage group visible to the host. Devices are masked and mapped automatically. The groups must contain some devices entries.
- **Port Groups** - Management of port groups. Port groups contain director and port identification and belong to a masking view. Ports can be added to and removed from the port group. Port groups no longer associated with a masking view can be deleted.
- **Initiators** - Management of initiators and initiator groups. An initiator group is a container of one or more host initiators (Fibre or iSCSI). Each initiator group can contain up to 64 initiator addresses or 64 child IG names. Initiator groups cannot contain a mixture of host initiators and child IG names.
- **Xtrem SW Cache Adapters** - Monitor of host cache adapters.
- **PowerPath Hosts** - Management of PowerPath hosts.
- **Mainframe** - Management of configured splits, CU images, and CKD volumes.
- **CU Images** - Management of CU images.

Creating hosts

**Before you begin**

- To perform this operation, you must be a StorageAdmin.
- The storage system must be running Enginuity version 5876, or HYPERMAX OS 5977 or higher.
- The maximum number of initiators allowed in a host depends on the storage operating environment:
  - For Enginuity 5876, the maximum allowed is 32.
  - For HYPERMAX OS 5977 or higher, the maximum allowed is 64.

To create hosts:

**Procedure**

1. Select the storage system.
2. Select **Hosts > Hosts**.
3. Click **Create > Create Host**.
   - The Create Host dialog displays.
4. Type a Host Name.
   - Host names must be unique from other hosts/host groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and (-) are allowed. Host names are case-insensitive.
5. Select the Fibre radio button to filter the available initiators table to display Fibre Channel initiators only or select the iSCSI radio button to filter the table to display iSCSI initiators only. The Fibre radio button is selected by default.
6. Select a host, click \( 
\) and then click Set Flags to open the Set Host/Host Group Flags dialog.

7. Optional: To set the host port attributes:
   a. Click Set Host Flags .
   b. Optional: Select a host whose flag settings you want to copy.
   c. Modify any of the attributes, by selecting the corresponding Override option (thereby activating the Enable option) and enable (select) or disable (clear) the flag.
   d. Optional: Select Consistent LUNs to specify that LUN values for the host must be kept consistent for all volumes within each masking view of which this host is part. When set, any masking operation involving this host that would result in inconsistent LUN values, will be rejected. When not set, the storage system will attempt to keep LUN values consistent, but will deviate from consistency if LUN conflicts occur during masking operations.
   e. Click OK .

8. Do either of the following:
   - Click Run Now to start the task now.
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.

**Adding initiators to hosts**

**Before you begin**
To perform this operation, you must be a StorageAdmin.
The storage system must be running Enginuity version 5876 or higher.
On storage systems running HYPERMAX OS 5977 or higher, iSCSI and fibre initiators cannot be mixed in the same host.

To add initiators to hosts:

**Procedure**
1. Select the storage system.
2. Select Hosts > Hosts.
3. Select the host and click Modify to open the Modify Host dialog.
4. Select an initiator from the Available Initiators list and click .
5. To add a user defined initiator to the host, click , fill in the name and click OK.
6. Specify the initiator by typing its name or by selecting it from the list. The Initiators table is a filtered list based on whether the initiator is Fibre Channel or iSCSI. To filter the list, type part of the initiator name. Click Add. Repeat this step for each additional host.
7. Click Run Now or Add To Job List.

**Adding initiator to host**

To add an initiator to a host:

**Procedure**
1. Select HOSTS > Hosts
2. Click Create and then click Create Host.
3. Click the + button to the right of Initiators in Host.
4. Type the Initiator name.
5. Click OK.

**Removing initiators from hosts**

**Before you begin**
To perform this operation, you must be a StorageAdmin.
The storage system must be running Enginuity version 5876 or higher.

To remove initiators from hosts:

**Procedure**
1. Select the storage system.
2. Select Hosts > Hosts.
3. Select the host and click Modify to open the Modify Host dialog.
4. Select an initiator from the Available Initiators list and click .
5. Select the initiator and click Replace Initiator.
6. Click Run Now or Add To Job List.

**Modifying hosts**

**Before you begin**
To perform this operation, you must be a StorageAdmin.
The storage system must be running Enginuity version 5876 or higher.

**Procedure**
1. Select the storage system.
2. Select Hosts > Hosts to open the Hosts list view.
3. Do one of the following:
   - Modifying hosts:
     - Select the host and click Modify to open the Modify Host dialog box.
     - To change the Host Name, highlight it and type a new name over it. Host names must be unique from other hosts on the Symmetrix system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and (-) are allowed. Host names are case-insensitive.
• Adding initiators:
  • In the Select Initiators list box, type the initiator name or select it from
    the list. To filter the list, type part of a initiator name.

  **Note**
  Initiators can only belong to one host at a time; therefore, any initiators
  that do not appear in the list already belong to another host.

  • The Add Initiators table is a filtered list based on whether the host is
    Fibre Channel or iSCSI.

  • Select an initiator from the Available Initiators list and click .
  • Repeat these steps for each additional initiator.
  • To add a user defined initiator to the host, click , fill in the name and
    click OK.

• Removing initiators:

  • In the Initiators in Host list, select the initiator and click .
  • Repeat these steps for each additional initiator.

4. Do either of the following:
  • Click Run Now to start the task now.
  • Click Add to Job List to add this task to the job list, from which you can
    schedule or run the task at your convenience. For more information, refer to
    Scheduling jobs on page 812 and Previewing jobs on page 812.

**Renaming hosts/host groups**

**Before you begin**
To perform this operation, you must be a StorageAdmin.
The storage system must be running Enginuity version 5876 or higher.

To rename host/host groups:

**Procedure**
1. Select the storage system.
2. Select Hosts > Hosts.
3. Select the host/host group and click Modify.
4. In the Properties panel, type a new name for the host/host group and click Apply.

  Host/host group names must be unique from other hosts/host groups on the
  storage system and cannot exceed 64 characters. Only alphanumeric
  characters, underscores (_), and (-) are allowed. Host/host group names are
  case-insensitive.
Setting host or host group port flags

To set host or host group port flags:

**Procedure**

1. Select the storage system.
2. Select **Hosts** > **Hosts**.
3. Select a host, click and then click **Set Flags** to open the **Set Host/Host Group Flags** dialog.
4. Optional: Select a host/host group whose flag settings you want to copy from the **Copy Flags from Other Host/Host Group** drop-down menu.
5. Modify any of the flags, by selecting the corresponding Override option (thereby activating the Enable option) and enable (select) or disable (clear) the flag.
6. Optional: Select **Consistent LUNs** to specify that LUN values for the host must be kept consistent for all volumes within each masking view of which this host is part. When set, any masking operation involving this host that would result in inconsistent LUN values, will be rejected. When not set, the storage system will attempt to keep LUN values consistent, but will deviate from consistency if LUN conflicts occur during masking operations.
7. Click **OK**.

Deleting hosts/host groups

**Before you begin**
To perform this operation, you must be a StorageAdmin.
The storage system must be running Enginuity version 5876 or higher.

To delete hosts/host groups:

**Procedure**

1. Select the storage system.
2. Select **Hosts** > **Hosts**.
3. Select the host/host group from the list and click **Delete**.
4. Click **Delete**, then click **OK** to confirm.

Viewing hosts/host groups

**Procedure**

1. Select the storage system.
2. Select **Hosts** > **Hosts** to open the Hosts list view.
3. Use the Hosts list view to view and manage hosts.

The following properties display:

**Name**—Host/host group name. An arrow icon at the beginning of the name indicates that the host is a host group. Click the icon to view hosts contained in the group.
Masking Views—Number of masking view associated with the host.

Initiators—Number of initiators in the host.

Consistent LUNs—Flag indicating if the Consistent LUNs flag is set. When set, any masking operation involving this host/host group that would result in inconsistent LUN values, will be rejected. When not set, the storage system will attempt to keep LUN values consistent, but will deviate from consistency if LUN conflicts occur during masking operations. ✔️ indicates that the feature is set.

Port Flag Overrides—Flag indicating if any port flags are overridden for the host. ✔️ indicates that there are overridden port flags.

Last Update—Timestamp of the most recent changes to the host.

Click 🔄 to view the host/host group details.

The following controls are available:

Create Host—Creating hosts on page 296

Create Host Group—Creating host groups on page 306

Provision Storage to Host—Using the Provision Storage wizard on page 102 or Using the Provision Storage wizard on page 110

Modify—Modifying hosts on page 298 or Modifying host groups on page 308

Set Flags—Setting host or host group port flags on page 300

Delete—Deleting hosts/host groups on page 300

---

**Viewing host/host group details**

**Procedure**

1. Select the storage system.
2. Select **Hosts** > **Hosts**.
3. Select the host/host group.
4. Click 🔄 to view the host/host group details.

---

**Note**

The properties and controls available in this panel depend on whether you are viewing details of an individual host or of host group, and on the storage operating environment.

The following properties display:

**Name**—Host/host group name. To rename the host/host group, type a new name over the existing and click Apply. Host/host group names must be unique from other hosts/host groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores ( _ ), and (-) are allowed. Host names are case-insensitive.

**Hosts**—Number of hosts in the group. This field only displays for host groups.

**Masking Views**—Number of masking views with which the host/host group is associated.
Initiators—Number of initiators in the host/host group. For host groups, the value includes initiators in any child host groups.

Host Groups—Number of host groups in which this host is a member. This field only displays for individual hosts.

Consistent LUNs—Flag indicating if the Consistent LUNs flag is set. When set, any masking operation involving this host/host group that would result in inconsistent LUN values, will be rejected. When not set, the storage system will attempt to keep LUN values consistent, but will deviate from consistency if LUN conflicts occur during masking operations. ✓ indicates that the feature is set.

Port Flag Overrides—Flag indicating if any port flags are overridden for the host. ✓ indicates that there are overridden port flags.

Enabled Port Flags—List of any enabled port flags overridden by the host/host group.

Disabled Port Flags—List of any disabled port flags overridden by the host/host group.

Last Update—Timestamp of the most recent changes to the host/host group.

PowerPath Hosts—Number of PowerPath hosts.

Viewing host initiators

Procedure

1. Select the storage system.
2. Select Hosts > Hosts.
3. Select the host and click ✓ to open the host details view, then click on the link in the Initiators field to open the initiators list view.

The following properties display:

Initiator—WWN or iQN (iSCSI Qualified Name) ID of the initiator.

Dir:Port—Storage system director and port associated with the initiator, for example: FA-7E:1.

Alias—User-defined initiator name.

Logged In—Flag indicating if the initiator is logged into the fabric: Yes/No.

On Fabric—Flag indicating if the initiator is on the fabric: Yes/No.

Port Flag Overrides—Flag indicating if any port flags are overridden by the initiator: Yes/No.

Hosts—Number of hosts the initiator is associated with.

Masking Views—Number of associated masking views.

The following controls are available:

Set Attributes—Setting initiator attributes on page 316

Set Host Flags—Setting initiator port flags on page 315

Rename Alias—Renaming initiator aliases on page 316

Replace Initiator—Replacing initiators on page 317
Remove Masking Entry—Removing masking entries on page 317

Host/Host group flags

Table 4 Host/Host group flags

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Serial Number</td>
<td>Enables a unique serial number. This attribute is only available on storage systems running Enginuity 5876.</td>
</tr>
<tr>
<td>Volume Set Addressing**</td>
<td>Enables the volume set addressing mode. When using volume set addressing, you must specify a 4-digit address in the following range: (0)000-(0)007, (0)010-(0)017,... to a maximum of (0)FF0-(0)FF7. Where the first digit must always be set to 0 (storage system does not currently support the upper range of volume set addressing), the second digit is the VBus number, the third digit is the target, and the fourth digit is the LUN.</td>
</tr>
<tr>
<td>Avoid Reset Broadcast*</td>
<td>Enables a SCSI bus reset to only occur to the port that received the reset (not broadcast to all channels).</td>
</tr>
<tr>
<td>Environ Set*</td>
<td>Enables the environmental error reporting by the Symmetrix to the host on the specific port.</td>
</tr>
<tr>
<td>Disable Q Reset on UA</td>
<td>When enabled, a Unit Attention (UA) that is propagated from another director does not flush the queue for this volume on this director. Used for hosts that do not expect the queue to be flushed on a 0629 sense (only on a hard reset).</td>
</tr>
<tr>
<td>SCSI 3*</td>
<td>Alters the inquiry data (when returned by any volume on the port) to report that the Symmetrix supports the SCSI-3 protocol. When disabled, the SCSI 2 protocol is supported.</td>
</tr>
<tr>
<td>SCSI Support1 (OS2007)*</td>
<td>Provides a stricter compliance with SCSI standards for managing volume identifiers, multi-port targets, unit attention reports, and the absence of a volume at LUN 0. To enable the SCSI Support1 attribute, you must also enable the SPC2 Protocol Version attribute.</td>
</tr>
<tr>
<td>SPC2 Protocol Version*</td>
<td>This flag should be enabled (default) in a Windows 2003 environment running Microsoft HCT test version 12.1. When setting this flag, the port must be offline.</td>
</tr>
<tr>
<td>AS400</td>
<td>Indicates whether AS/400 is enabled. This attribute is only available on storage systems running Enginuity 5876.</td>
</tr>
<tr>
<td>Open VMS*,**</td>
<td>Enables an Open VMS fiber connection.</td>
</tr>
</tbody>
</table>

* To enable/disable this flag when it is already overridden (i.e., the Override option is already selected), you must:
  
  Clear the Override option and click OK to close the dialog.
  
  Open the dialog again, select Override, and then the desired state (Enable/Disable). Click OK.
** For storage systems running HYPERMAX OS 5977 or higher, if Volume Set Addressing is overridden and enabled, the Open VMS flag must be disabled. However, if you do not actually select the Open VMS override option, Solutions Enabler will override and disable it.

If the Open VMS flag is overridden and enabled, the Volume Set Addressing flag must be disabled. However, if you do not actually select the Volume Set Addressing override option, Solutions Enabler will automatically override and disable it.

**Host I/O limits dialog box**

Use this dialog box to set the host I/O limits for the storage group you are provisioning:

**Procedure**

1. Type values for one or both of the following:
   - **MB/Sec**—Maximum bandwidth (in MB per second). Valid values range from 1 MB/sec to 100,000 MB/sec.
   - **IO/Sec**—Maximum IOPs (in I/Os per second). Valid values range from 100 IO/Sec to 2,000,000 IO/sec, in 100 increments.

2. To configure a dynamic distribution of host I/O limits, set Dynamic Distribution to one of the following; otherwise, leave this field set to Never (default). This feature requires Enginuity 5876.163.105 or higher.
   - **Always**—Enables full dynamic distribution mode. When enabled, the configured host I/O limits will be dynamically distributed across the configured ports, thereby allowing the limits on each individual port to adjust to fluctuating demand.
   - **Failure**—Enables port failure capability. When enabled, the fraction of configured host I/O limits available to a configured port will adjust based on the number of ports currently online.

3. Click OK.

---

**Note**

For more information on host I/O limits, refer to Setting host I/O limits on page 134.

---

**Host Group filtering rules**

The host and host group list follows these guidelines for display:

- Initiators with the same name, but seen from different storage system login history tables will be filtered to only show once. New host groups can be set on both storage systems.
- Initiators logged into one storage system but not another displays in the list, but
will show up as logged out in the other storage system if they are added to the host.

If an Initiator is already in an host group on ALL of the storage systems where that initiator is logged in, then this initiator is filtered out of the Available list. Host groups with the same name and the same contents will be filtered to only show once.

If an initiator is not in an host group on one storage system, but it is in a host group on another storage system, both the initiator and the host group will be shown in the list.

Host groups with the same name but different contents will be shown individually with “Sym” and the last three digits of the storage appended to the name.

Host groups with different names but same contents across different storage systems display individually.

If an initiator that is not in a host group has the same name as a host group on a different storage system, then the host group is appended with (Group).

Cascaded host groups are filtered out.

Select Storage Resource Pool

Use this dialog box to select a storage resource pool for the operation. Selecting None will remove the storage group from FAST control.
Provisioning storage

This section describes how to make storage available to hosts:

Creating host groups

Before you begin

To perform this operation, you must be a StorageAdmin.
The storage system must be running Enginuity version 5876, or HYPERMAX OS 5977 or higher.
The maximum number of hosts allowed in a host group depends on the HYPERMAX OS:
For Enginuity 5876, the maximum allowed is 32.
For HYPERMAX OS 5977 or higher, the maximum allowed is 64.

This procedure explains how to create a host group (collection of hosts). For instructions on creating a host, refer to Creating hosts on page 296.

To create host groups:

Procedure

1. Select the storage system.
2. Select Hosts > Hosts.
3. Click Create > Create Host Group.
4. Type a Host Group Name.
   Host group names must be unique from other hosts/host groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and (-) are allowed. Host group names are case-insensitive.
5. Select the Fibre radio button to filter the available hosts table to display Fibre Channel hosts only or select the iSCSI radio button to filter the table to display iSCSI hosts only. The Fibre radio button is selected by default.
6. Optional: Do one of the following:
   - To create new hosts to add to the group, click Create New Host. For instructions on creating hosts, refer to Creating hosts on page 296.
   - To add existing hosts to the group:
     - Specify the host by typing its name or by selecting it from the list.
     - To filter the list, type part of the host name.
     - Repeat this step for each additional host.
     - Click Add.
     Repeat these steps for each additional host.
   - To set the host port attributes:
     - Click Set Host Group Flags to open the Set Host/Host Group Flags dialog box.
     - Optional: Select a host whose flag settings you want to copy.
- Modify any of the **attributes**, by selecting the corresponding Override option (thereby activating the Enable option) and enable (select) or disable (clear) the flag.

- Optional: Select **Consistent LUNs** to specify that LUN values for the host must be kept consistent for all volumes within each masking view of which this host is part. When set, any masking operation involving this host that would result in inconsistent LUN values, will be rejected. When not set, the storage system will attempt to keep LUN values consistent, but will deviate from consistency if LUN conflicts occur during masking operations.

7. Click **OK**.

8. Do either of the following:
   - Click **Run Now** to start the task now.
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.

---

**Adding hosts to host groups**

**Before you begin**

To perform this operation, you must be a StorageAdmin.

To add hosts to host groups:

**Procedure**

1. Select the storage system.
2. Select **Hosts > Hosts**.
3. Select the host group (or empty host) and click 🔄.
4. Click on the link in the **Hosts** field.
5. Click **Add Hosts**.
6. Specify the host by typing its name or by selecting it from the list. The hosts table is a filtered list based on whether the host selected is Fibre Channel or iSCSI. To filter the list, type part of the host name. Click Add. Repeat this step for each additional host.
7. Click **Run Now** or **Add To Job List**.

---

**Removing hosts from host groups**

**Before you begin**

To perform this operation, you must be a StorageAdmin.

The storage system must be running Enginuity version 5876 or higher.

To add hosts to host groups:

**Procedure**

1. Select the storage system.
2. Select **Hosts > Hosts**.
3. Select the host group (or empty host) and click 🔄.
4. Click on the link in the **Hosts** field.
5. Select the host and click Remove.
6. Click OK.

Modifying host groups

Before you begin
To perform this operation, you must be a StorageAdmin.
The storage system must be running Enginuity version 5876 or higher.

Modifying host groups:

Procedure
1. Select the storage system.
2. Select Hosts > Hosts.
3. Do one of the following:
   - To modify a host group:
     - Select the host group and click Modify.
     - To change the host group Name, highlight it and type a new name over it. Host names must be unique from other hosts on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores ( _ ), and (-) are allowed. Host names are case-insensitive.
   - To add a Host:
     - Optional: To create a new host to add to the group, click Create. For help, refer to Creating hosts on page 296.
     - Select the host and click Add. To filter the list, type part of the host name. Repeat this step for each additional host.
   - To remove a Host:
     - In the list of hosts, select the host, click and then click Delete.
     - Click OK.
4. Repeat these steps for each additional host.
5. Do either of the following:
   - Click Run Now to start the task now.
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.

Renaming hosts/host groups

Before you begin
To perform this operation, you must be a StorageAdmin.
The storage system must be running Enginuity version 5876 or higher.

To rename host/host groups:

Procedure
1. Select the storage system.
2. Select Hosts > Hosts.
3. Select the host/host group and click Modify.
4. In the Properties panel, type a new name for the host/host group and click Apply.

Host/host group names must be unique from other hosts/host groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and (-) are allowed. Host/host group names are case-insensitive.

## Setting host or host group port flags

To set host or host group port flags:

**Procedure**

1. Select the storage system.
2. Select Hosts > Hosts.
3. Select a host, click and then click Set Flags to open the Set Host/Host Group Flags dialog.
4. Optional: Select a host/host group whose flag settings you want to copy from the Copy Flags from Other Host/Host Group drop-down menu.
5. Modify any of the flags, by selecting the corresponding Override option (thereby activating the Enable option) and enable (select) or disable (clear) the flag.
6. Optional: Select Consistent LUNs to specify that LUN values for the host must be kept consistent for all volumes within each masking view of which this host is part. When set, any masking operation involving this host that would result in inconsistent LUN values, will be rejected. When not set, the storage system will attempt to keep LUN values consistent, but will deviate from consistency if LUN conflicts occur during masking operations.
7. Click OK.

## Deleting hosts/host groups

**Before you begin**

To perform this operation, you must be a StorageAdmin.

The storage system must be running Enginuity version 5876 or higher.

To delete hosts/host groups:

**Procedure**

1. Select the storage system.
2. Select Hosts > Hosts.
3. Select the host/host group from the list and click
4. Click Delete, then click OK to confirm.
Viewing hosts/host groups

**Procedure**

1. Select the storage system.
2. Select **Hosts > Hosts** to open the Hosts list view.
3. Use the Hosts list view to view and manage hosts.

The following properties display:

- **Name**—Host/host group name. An arrow icon at the beginning of the name indicates that the host is a host group. Click the icon to view hosts contained in the group.
- **Masking Views**—Number of masking view associated with the host.
- **Initiators**—Number of initiators in the host.
- **Consistent LUNs**—Flag indicating if the Consistent LUNs flag is set. When set, any masking operation involving this host/host group that would result in inconsistent LUN values, will be rejected. When not set, the storage system will attempt to keep LUN values consistent, but will deviate from consistency if LUN conflicts occur during masking operations. ✓ indicates that the feature is set.
- **Port Flag Overrides**—Flag indicating if any port flags are overridden for the host. ✓ indicates that there are overridden port flags.
- **Last Update**—Timestamp of the most recent changes to the host.

Click ![icon] to view the host/host group details.

The following controls are available:

- **Create Host**—Creating hosts on page 296
- **Create Host Group**—Creating host groups on page 306
- **Provision Storage to Host**—Using the Provision Storage wizard on page 102 or Using the Provision Storage wizard on page 110
- **Modify**—Modifying hosts on page 298 or Modifying host groups on page 308
- **Set Flags**—Setting host or host group port flags on page 300
- **Delete**—Deleting hosts/host groups on page 300

Viewing host/host group details

**Procedure**

1. Select the storage system.
2. Select **Hosts > Hosts**.
3. Select the host/host group.
4. Click ![icon] to view the host/host group details.
The properties and controls available in this panel depend on whether you are viewing details of an individual host or of host group, and on the storage operating environment.

The following properties display:

**Name**—Host/host group name. To rename the host/host group, type a new name over the existing and click Apply. Host/host group names must be unique from other hosts/host groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores ( _ ), and (-) are allowed. Host names are case-insensitive.

**Hosts**—Number of hosts in the group. This field only displays for host groups.

**Masking Views**—Number of masking views with which the host/host group is associated.

**Initiators**—Number of initiators in the host/host group. For host groups, the value includes initiators in any child host groups.

**Host Groups**—Number of host groups in which this host is a member. This field only displays for individual hosts.

**Consistent LUNs**—Flag indicating if the Consistent LUNs flag is set. When set, any masking operation involving this host/host group that would result in inconsistent LUN values, will be rejected. When not set, the storage system will attempt to keep LUN values consistent, but will deviate from consistency if LUN conflicts occur during masking operations. ✓ indicates that the feature is set.

**Port Flag Overrides**—Flag indicating if any port flags are overridden for the host. ✓ indicates that there are overridden port flags.

**Enabled Port Flags**—List of any enabled port flags overridden by the host/host group.

**Disabled Port Flags**—List of any disabled port flags overridden by the host/host group.

**Last Update**—Timestamp of the most recent changes to the host/host group.

**PowerPath Hosts**—Number of PowerPath hosts.

---

**Creating masking views**

**Before you begin**

The following explains how to mask volumes on storage systems running Enginuity 5876 or higher.

To create a masking view, you need to have created initiator groups, port groups, and storage groups. For instructions, refer to **Creating port groups** on page 321.

**Procedure**

1. Select the storage system.
2. Select **Hosts > Masking view** to open the **Masking view** list view.
3. Click **Create** to open the **Create Masking View** dialog box.
4. Type the **Masking View Name**.
   Masking view names must be unique from other masking views on the array and cannot exceed 64 characters. Only alphanumeric characters, underscores ( _ ), and (-) are allowed. Masking view names are case-insensitive.

5. Select the **Host**.

6. Select the **Port Group**.

7. Select the **Storage Group**.

8. Optional: Manually set the host LUN addresses:
   a. Click **Set Dynamic LUNs** to open the **Set Dynamic LUNs** dialog box.
   b. Select a volume, and notice the address displayed in the **Starting LUN** field.
      To accept this automatically generated address, click **Apply Starting LUN**.
      To move to the next available, click **Next Available LUN**.
   c. Click **OK** to close the **Set Dynamic LUNs** dialog box.

9. Click **OK**.

**Renaming masking views**

**Procedure**

1. Select the storage system.

2. Select **Hosts > Masking view** to open the **Masking Views** list view.

3. Select the masking view from the list and click **Rename**.

4. Type the new **Name**, and click **OK**.
   Masking view names must be unique from other masking views on the array and cannot exceed 64 characters. Only alphanumeric characters, underscores ( _ ), and (-) are allowed. Masking view names are case-insensitive.

**Deleting masking views**

This procedure explains how to delete masking views from the **Masking Views** list view. In eNAS operating environments, you can also perform this operation from the **File Masking Views** page (**System > System Dashboard > File Dashboard > File Masking Views**).

**Procedure**

1. Select the storage system.

2. Select **Hosts > Masking view** to open the **Masking View** list view.

3. Select the masking view from the list, click and then click **Delete** to open the **Delete Masking View** confirmation dialog box.

4. To unmap volumes in the masking view from their mapped ports, select **Delete Storage Group(s)**.

5. Click **OK**.

**Viewing masking views**
Procedure

1. Select the storage system.

2. Do one of the following:
   - Select Hosts > Masking view to open the Masking Views list view.
   - Select Storage > VVols Dashboard > PE Masking Views to open the PE Masking Views list view.

Use the Masking view list view to view and manage masking views.

The following properties display:
   - Name — User-defined masking view name.
   - Host — Name of the associated host.
   - Port Group — Name of the associated port group.
   - Storage Group — Name of the associated storage group.

To view a masking group's details, select it and click 🔄. The following properties are displayed:
   - Name — User-defined masking view name.
   - Capacity (GB) — Total capacity, in GB, of all volumes in the masking view.
   - Host — Name of the associated host.
   - Port Group — Name of the associated port group.
   - Storage Group — Name of the associated storage group.
   - Initiators — Number of initiators in the masking view. This is the number of primary initiators contained in the masking view and does not include any initiators included in cascaded initiator groups that may be part of the masking view.
   - Ports — Number of ports contained in the masking view.
   - Volumes — Number of volumes in the storage group contained in the masking view.

Depending on the options chosen, some of the following controls are available:
   - Create — Creating masking views on page 311
   - Rename — Renaming masking views on page 312
   - View Path Details — Viewing masking view connections on page 313
   - Delete — Deleting masking views on page 312

Viewing masking view connections

This procedure explains how to perform the operation from the Masking Views list view. In eNAS operating environments, you can also perform this operation from the File Masking Views page (System > System Dashboard > File Dashboard > File Masking Views).

Procedure

1. Select the storage system.

2. Select Hosts > Masking Views to open the Masking Views list view.
3. Select the masking view from the list and click **View Path Details** to open the masking view connections view.

4. Use the **Masking View** view to filter a masking view by selecting various combinations of members within a group (initiators, ports, volumes) and display the masking view details from the group level to the object level.

**Filtering a masking view**

The **Masking view** view contains three tree view lists for each of the component groups in the masking view, initiator groups, ports groups, and storage groups.

The parent group is the default top-level group in each expandable tree view and contains a list of all components in the masking group including child entries which are also expandable.

To filter the masking view, single or multi-select (hold shift key and select) the items in the list view.

As each selection is made, the filtered results table is updated to reflect the current combination of filter criteria.

**Filtered results table**

The following properties display:

- **LUN Address**
  - LUN address number.

- **Volume**
  - Symmetrix system volume number.

- **Capacity (GB)**
  - Capacity, in GB, of the volume.

- **Initiator**
  - WWN or IQN (iSCSI Qualified Name) ID of the initiator.

- **Alias**
  - Alias of the initiator.

- **Director:Port**
  - Symmetrix system director and port in the port group.

- **Logged In**
  - Indicates if the initiator is logged into the host/target.

- **On Fabric**
  - Indicates if the initiator is zoned in and on the fabric.

The following additional filters are available to filter the results table:

- **Show Logged In**
  - Shows only the entries for LUNs where the associated initiator is logged in.

- **Show On Fabric**
  - Shows only the entries for LUNs where the associated initiator is zoned in and on the fabric.
Viewing masking view details

Procedure

1. Select the storage system.
2. Select **Hosts > Masking view** to open the **Masking Views** list view.
3. Select the masking view from the list and click the link.

   The following properties display:
   - **Name**—Name of the masking view.
   - **Host**—Name of the host.
   - **Port group**—Name of the port group.
   - **Storage group**—Name of the storage group.
   - **Initiators**—Number of initiators in the masking view. This is the number of primary initiators contained in the masking view and does not include any initiators included in cascaded initiator groups that may be part of the masking view.
   - **Ports**—Number of ports contained in the masking view.
   - **Volumes**—Number of volumes in the storage group contained in the masking view.
   - **Capacity (GB)**—Total capacity, in GB, of all volumes in the masking view.

Set Dynamic LUN Addresses

Use this dialog box to manually assign host LUN addresses for a masking operation.

Procedure

1. Select the storage system.
2. Select **Hosts > Masking Views**.
3. Select a masking view and click **Create** to open the **Create Masking View** dialog box.
4. Click **Set Dynamic LUNs** to open the **Set Dynamic LUNs** dialog box.

   This dialog box contains the following elements:
   - **Starting LUN**—LUN address assigned to the first volume.
   - **Apply Starting LUN**—Sets the address for the volume and keeps the dialog box open for additional operations.
   - **Next Available LUN**—Increments the Starting LUN address to the next available.
   - **Volumes to be masked**—Select the volumes you want to mask from the volumes list.

   Enter the necessary values and click **OK**.

Setting initiator port flags
Procedure
1. Select the storage system.
2. Select Hosts > Initiators.
3. Select an initiator and click Set Host Flags to open the Set Initiator Flags dialog.
4. Optional: Copy the attributes of an existing flag by selecting a flag under the Copy Flags drop-down menu.
5. Modify the attributes, by selecting the corresponding Override option (thereby activating the Enable option), and enable (select) or disable (clear) the flag.
6. Click OK.

Setting initiator attributes

Before you begin
Any changes made to an initiator's attributes affect the initiator and all its ports.

To set initiator attributes:

Procedure
1. Select the storage system.
2. Select Hosts > Initiators.
3. Select an initiator and click Set Attributes.
   The initiator director: port, initiator, and optional alias names display.
4. Type the FCID (Fibre Channel ID) Value.
5. Click OK.

Renaming initiator aliases

When the system discovers the attached HBAs, a two-part record is created for the name. The format is NodeName/PortName. For fiber adapters, the HBA name is the WWN or iSCSI name. For native iSCSI adapters, the HBA name is the IP address.

You can rename the HBA identifier by creating a shorter, and easier to remember, ASCII alias name.

To rename an initiator alias:

Procedure
1. Select the storage system.
2. Select Hosts > Initiators.
3.
   Select an initiator, click and then click Rename Alias.
4. Type a Node Name and Port Name.
   On storage systems running Enginuity 5876, node and port names cannot exceed 16 characters.
On storage systems running HYPERMAX OS 5977 or higher, node and port names cannot exceed 32 characters.

5. Click OK.

This overwrites any existing alias name.

**Replacing initiators**

If a host adapter fails, or needs replacement for any reason, you can replace the adapter and assign its set of volumes to a new adapter.

To replace an initiator:

**Procedure**

1. Select the storage system.
2. Select **Hosts > Initiators**.
3. Select the initiator, click ![button](image) and then click **Replace Initiator**.

   The existing initiator and optional alias names display.
4. Type the full WWN or iSCSI identifier of the New Initiator. For native iSCSI, type the IP address.
5. Click OK.

   This substitutes all occurrences of the old WWN/iSCSI/IP address with the new one.

**Removing masking entries**

**Procedure**

1. Select the storage system.
2. Select **Hosts > Initiators**.
3. Select the initiator, click ![button](image) and select **Remove Masking Entry** to open the **Remove Masking Entry** dialog box.
4. Select the director and port.
5. Click OK.

**Viewing initiators**

**Procedure**

1. Select the storage system.
2. Select **Hosts > Initiators**.
3. Use the **Initiators** list view to view and manage initiators.

   The properties and controls displayed in the view vary depending on the Enginuity version running on the storage system and on how you arrived at this view.
Initiator — WWN or IQN (iSCSI Qualified Name) ID of the initiator.

Dir:Port — Storage system director and port associated with the initiator, for example: FA-7E:1.

Alias — User-defined initiator name.

Logged In — Flag indicating if the initiator is logged into the fabric: Yes/No.

On Fabric — Flag indicating if the initiator is on the fabric: Yes/No.

Port Flag Overrides — Flag indicating if any port flags are overridden by the initiator: Yes/No.

Hosts — Number of hosts the initiator is associated with

Masking Views — Number of masking views the initiator is associated with, including the masking views that are associated with any cascaded relationships. This field only applies/appears for storage systems running Enginuity 5876 or higher.

To view the initiator's details, click

The following controls are available:

Set Host Flags—Setting initiator port flags on page 315

Set Attributes—Setting initiator attributes on page 316

Rename Alias—Renaming initiator aliases on page 316

Replace Initiator—Replacing initiators on page 317

Removing Masking Entry—Removing masking entries on page 317

Viewing initiator details

Procedure

1. Select the storage system.
2. Select Hosts > Initiators.
3. Select the initiator from the list and click
4. The following properties are displayed:

Note

The properties and controls displayed in the view vary depending on the Enginuity version running on the storage system and on how you arrived at this view.

Initiator—WWN or IQN (iSCSI Qualified Name) ID of the initiator.

Dir:Port—Storage system director and port associated with the initiator, for example: FA-7E:1

Alias—The user-defined initiator name.

Hosts—Number of hosts.

Initiator Groups—Number of associated initiator groups, including the immediate initiator group and any parent initiator groups that include this initiator group. This field only applies/appears for Symmetrix systems running Enginuity 5876 or higher.
**Masking Views**—Number of associated masking views, including the masking views that are associated with any cascaded relationships. This field only applies/appears for storage systems running Enginuity 5876 or higher.

**Volumes**—Number of volumes.

**Logged In**—Flag indicating if the initiator is logged into the fabric: Yes/No.

**On Fabric**—Flag indicating if the initiator is on the fabric: Yes/No.

**Port Flag Overrides**—Flag indicating if any port flags are overridden by the initiator: Yes/No.

**Enabled Flags**—List of any enabled port flags overridden by the initiator.

**Disabled Flags**—List of any disabled port flags overridden by the initiator.

**Flags in Effect**—Flags that are in effect for the initiator.

**Last Login**—Timestamp for the last time this initiator was logged into the system.

**FCID**—Fibre Channel ID for the initiator.

**FCID Value**—Value that is enabled for FCID lockdown.

**FCID Lockdown**—Flag indicating if port lockdown is in effect: Yes/No.

**IP Address**—IP address for the initiator.

The following controls are available:

**Set Attributes**—Setting initiator attributes on page 316

**Set Host Flags**—Setting initiator port flags on page 315

**Rename Alias**—Renaming initiator aliases on page 316

**Replace Initiator**—Replacing initiators on page 317

**Removing Masking Entry**—Removing masking entries on page 317

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**Viewing volumes associated with host initiator**

**Procedure**

1. Select the storage system.

2. Select **Hosts > Initiators**.

3. Select the initiator from the list and click.

4. Click on the number in the **Volumes** field.

5. Use this view to view and manage volumes associated with the initiator.

   The following properties display:

   **Name**—Volume name.

   **Type**—Type of volume.

   **Allocated %**—% of space allocated.

   **Capacity (GB)**—Volume capacity in GBs.

   **Status**—Volume status.

   **Emulation**—Volume emulation.

   **SRDF Group**—SRDF group the volume belongs to.
Host Paths—Host paths for the volume.

To see more volume properties, select the volume and click.

The following controls are available, depending on the Enginuity version running on the storage system:

*Create*—Creating volumes on page 180

*Expand*—Expanding existing volumes on page 193

*Delete*—Deleting volumes on page 190

*Create SG*—HYPERMAX OS 5977 or later: Creating storage groups on page 114

*Set Volume Attributes*—Setting volume attributes on page 197

*Set Volume Identifiers*—Setting volume identifiers on page 198

*Set Volume Status*—Setting volume status on page 196

*Change Volume Configuration*—Changing volume configuration on page 192

*Replication QoS*—QOS for replication on page 200

*Duplicate Volume*—Duplicating volumes on page 190

*Expand Volume*—Expanding existing volumes on page 193

*Start Allocate/Free/Reclaim*—Managing thin pool allocations on page 247

*Stop Allocate/Free/Reclaim*—Managing thin pool allocations on page 247

*Map*—Mapping volumes on page 194

*Unmap*—Unmapping volumes on page 195

*Set SRDF GCM*—Setting the SRDF GCM flag on page 438

*Reset SRDF/Metro Identity*—Resetting original device identity on page 436

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**Viewing details of a volume associated with initiator**

**Procedure**

1. Select the storage system.
2. Select Hosts > Initiators.
3. Select the initiator from the list and click.
4. Click on the number in the Volumes field.
5. Select the volume from the list and click to see its details.

The following controls are available:

*Create*—To select the type of volume to create refer to Creating volumes on page 180.
Creating port groups

Before you begin

Note the following recommendations:

Port groups should contain four or more ports.
Each port in a port group should be on a different director.

A port can belong to more than one port group. However, for storage systems running HYPERMAX OS 5977 or higher, you cannot mix different types of ports (physical FC ports, virtual ports, and iSCSI virtual ports) within a single port group.

Creating port groups:

Procedure

1. Select the storage system.
2. Select Hosts > Port Groups.
3. Click Create.
4. Type a Port group name.
   Port group names must be unique from other port groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and (-) are allowed. Port group names are case-insensitive.
5. Select the appropriate filter to filter the port list by iSCSI or FC.
6. Select the available ports from the Ports list, and click Add to add them to the Ports to add list.
   The following properties display:
   - Dir:Port—Storage system director and port in the port group.
   - Identifier—Port identifier
   - Port Groups—Number of port groups where the port is a member.
   - Masking Views—Number of masking views where the port is associated.
   - Volumes—Number of volumes in the port group.
   - VSA Flag — An indicator to show if Volume Set Addressing flag is set for the port.
7. Select Run Now or Add To Job List.

Deleting port groups

Procedure

1. Select the storage system.
2. Select Hosts > Port Groups.
3. Select the port group, click and then click Delete to open the Delete Port Group confirmation message.
4. For mapped ports only: Select Unmap.
5. Click OK.
Adding ports to port groups

Before you begin

Note the following recommendations:

Port groups should contain four or more ports.

Each port in a port group should be on a different director.

A port can belong to more than one port group. However, for storage systems running HYPERMAX OS 5977 or higher, you cannot mix different types of ports (physical FC ports, virtual ports, and iSCSI virtual ports) within a single port group.

Adding ports to port groups:

Procedure

1. Select the storage system.
2. Select Hosts > Port Groups.
3. Select the port group and click ΄.
4. Click on the number in the Ports field.
5. Click Add Ports.

If the port group already contain FC ports, the dialog is populated with all available FC ports. If the port group already contain iSCSI ports, this dialog is populated with all available iSCSI ports. If there are no ports in the port group, select the appropriate filter to filter the port list by iSCSI or FC.

6. Select the available ports from the Ports to add list, and click Add Ports to add them to the Ports to Add list.

The following properties display:

Dir:Port—Storage system director and port in the port group.
Identifier—IQN of an iSCSI target or WWN of an FC port.
Ports Groups—Number of port groups where the port is a member.
Masking Views—Number of associated masking views.
Mapped Volumes—Number of associated mapped volumes.

7. Click OK.

Removing ports from port groups

Before you begin

Note the following recommendations:

Port groups should contain four or more ports.

Each port in a port group should be on a different director.

To remove ports from port groups:

Procedure

1. Select the storage system.
2. Select Hosts > Port Groups.
3. Select the port group and click ΄.
4. Click on the number in the **Ports** field.

5. Select the port to remove or hold down the shift key to multi-select the ports to be removed from the port group.

6. Click to open the Remove Ports confirmation message.

7. For mapped ports only: You can optionally select to Unmap any affected volumes from their respective ports.

8. Click **OK**.

**Renaming port groups**

To rename port groups:

**Procedure**

1. Select the storage system.
2. Select **Hosts > Port Groups**.
3. Select the port group and click **Modify**.
4. Type the new port group Name and click **Apply**.

**Viewing port groups**

**Procedure**

1. Select the storage system.
2. Select **Hosts > Port Groups** to open the **Port Groups** list view.

   The **Port Groups** list view allows you to view and manage port groups on a storage system.

   There are multiple ways to open this view. Depending on the one you used, some of the following properties and controls may not appear.

   The following properties display (Click a column heading to sort the list by that value):

   - **Name**—User-defined port group name.
   - **Ports**—Number of ports in the group.
   - **Masking Views**—Number of masking views where the port group is associated.
   - **Last Update**—Timestamp of the most recent changes to the port group.

   To view more details of a port group, select it and click 📰

   The following controls are available:

   - **Create**—Creating port groups on page 321
   - **Modify**—Renaming port groups on page 323
   - **Delete**—Deleting port groups on page 321

**Viewing port groups details**

**Procedure**

1. Select the storage system.
2. Select **Hosts > Port Groups**.

3. Select the port group and click 🗑️.

4. Use the port groups Details view to view and manage a port group.

   The following properties display:

   - **Name**—User-defined port group name.
   - **Ports**—Number of ports in the group. Click on the number for more details
   - **Masking Views**—Number of masking views where the port group is associated. Click on the number for more details.
   - **Last Update**—Timestamp of the most recent changes to the port group.
   - **Host I/O (IO/Sec)**—Total host I/O limit on the specified port group in IO/Sec. Zero indicates that there is no limit set.
   - **Host I/O (MB/Sec)**—Total host I/O limit on the specified port group in MB/Sec. Zero indicates that there is no limit set.
   - **Port Speed (MB/Sec)**—Bandwidth in MB/sec for that port group (that is, the aggregated port negotiated speed for the ports in the group).
   - **Percent Capacity (%)**—Percentage of the bandwidth demand over the port group negotiated speed.
   - **Excess (MB/Sec)**—Amount of bandwidth in MB/sec that is left available on the port group after the host I/O limits have been accounted for.

   The following controls are available:

   - **Create**—Creating port groups on page 321
   - **Modify**—Renaming port groups on page 323
   - **Delete** —Deleting port groups on page 321

### Viewing ports in port group

**Procedure**

1. Select the storage system.

2. Select **Hosts > Port Groups**.

3. Select the port group and click 🗑️.

4. Click on the number in the **Number of Ports** field.

5. Use the **Ports** list view to view and manage ports.

   The following properties are displayed:

   - **Dir:Port**—Storage system director and port in the port group.
   - **Identifier**—IQN of an iSCSI target or WWN of an FC port.
   - **Port Groups**—Number of port groups where the port is a member.
   - **Masking Views**—Number of masking views where the port is associated.
   - **Mapped Volumes**—Number of volumes mapped to the port.

   The following controls are available:

   - **Add Ports**—Adding ports to port groups on page 322
Viewing port details

Procedure
1. Select the storage system.
2. Select Hosts > Port Groups.
3. Select the port group and click .
4. Click on the number in the Ports field.
5. Select a port and click .
6. Use the port Details view to view and manage a port.

The following properties display:
- Dir:Port—Storage system director and port in the port group.
- Identifier—IQN of an iSCSI target or WWN of an FC port.
- Number of Port Groups—Number of port groups where the port is a member.
- Number of Masking Views—Number of masking views where the port is associated.
- Number of Masked Volumes—Number of volumes visible through the port.
- Number of Mapped Volumes—Number of volumes mapped to the port, including meta members.
- Volume Set Addressing—Whether volume set addressing is on or off.
- Ports Status—Whether the port is online or offline.
- Number of IP Interfaces—Number of IP interfaces associated with the iSCSI target.
- Number of iSCSI Ports—Number of physical iSCSI ports associated with IP interfaces which are in turn attached to the iSCSI target.

Volume Set Addressing

An addressing scheme that uses virtual busses, targets, and LUNs to increase greatly the number of LUNs that can be addressed on a target port. Volume Set Addressing is supported for HP-UX.

Viewing host IO limits

Procedure
1. Select the storage system.
2. Select Hosts > Port Groups.
3. Select the port group and click .
4. Click on the link in the **Host I/O (IO/Sec)** or **Host I/O (MB/Sec)** fields.

The following properties display:

- **Storage Group**—Storage group on which the limit is set.
- **Quota State**—Whether the limit is set directly on the storage group (Defined) or through a cascaded relationship (Shared).
- **Dir:Port**—Storage system director and port in the port group.
- **Host I/O Limit (MB/Sec)**—Total host I/O limit on the listed port in MB/Sec. This value is the associated port group’s I/O limit divided across its ports.
- **Host I/O Limit (IO/Sec)**—Total host I/O limit on the listed port in IO/Sec. This value is the associated port group’s I/O limit divided across its ports.
- **Child Host I/O Limit (MB/Sec)**—Total child host I/O limit on the listed port in MB/Sec. This value is the associated port group’s I/O limit divided across its ports.
- **Child Host I/O Limit (IO/Sec)**—Total child host I/O limit on the listed port in IO/Sec. This value is the associated port group’s I/O limit divided across its ports.

## Managing storage for Mainframe

The Mainframe Dashboard provides you with a single place to monitor and manage configured splits, CU images, and CKD volumes. To access the Mainframe Dashboard:

**Procedure**

1. Select the storage system.
2. Select **Hosts > Mainframe** to open the Mainframe Dashboard.

The Mainframe Dashboard is organized into the following panels:

- CKD Compliance
- CKD Storage Groups
- Actions
- Summary

**CKD Compliance panel**

Displays how well CKD storage groups are complying with their respective service level policies, if applicable. All of the storage groups on the Mainframe Dashboard are organized into the following categories:

- **Total**
  All Mainframe storage groups on the array.

- **Stable**
  Number of storage groups performing within the service level targets.

  indicates that there are no storage groups performing within the service level targets.
Marginal
Number of storage groups performing below service level targets.
indicates that there are no storage groups performing below service level targets.

Critical
Number of storage groups performing well below service level targets.
indicates that there are no storage groups performing well below service level targets.

No Service Level
No service level compliance information.

CKD Storage Groups panel
Displays all of the Mainframe storage groups on the array. Double-click on a storage group to see more details as well as information on its compliance and volumes.

Actions panel
Displays the following links:
Provision Storage
Opens the Mainframe Provision wizard, which guides you through the process of provisioning storage for a mainframe. For more information, see Using the Provision Storage wizard for mainframe on page 106.

Create CKD Volumes
Opens the Create Volume dialog, from where you can create a CKD volume. For more information, see Creating CKD volumes on page 334.

Summary panel
Displays the following mainframe summary information:
Splits
The number of splits on the selected array. To view the list of splits, click Splits. For more information about viewing splits, see Viewing splits on page 331.

CU Images
The number of CU images on the selected array. To view the list of CU images, click CU Images. For more information about viewing CU images, see Viewing CU images on page 332.
**CKD Volumes**

The number of CKD volumes on the selected array. To view the list of CKD volumes, click **CKD Volumes**. For more information about viewing CKD volumes, see Managing volumes on page 179.

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**Provisioning storage for mainframe**

With the release of HYPERMAX OS 5977 Q1 2016, Unisphere introduces support for service level provisioning for mainframe. Service level provisioning simplifies storage system management by automating many of the tasks associated with provisioning storage.

Service level provisioning eliminates the need for storage administrators to manually assign physical resources to their applications. Instead, storage administrators specify the service level and capacity required for the application and the system provisions the storage group appropriately.

You can provision CKD storage to a mainframe host using the Provision Storage wizard. For specific instructions about how to provision storage for mainframe, refer to Using the Provision Storage wizard for mainframe on page 106.

The storage system must be running HYPERMAX OS 5977 Q1 2016, or higher, and have at least one FICON director configured.

To provision storage for Open Systems, refer to Using the Provision Storage wizard on page 102.

**Mapping CKD devices to CU images**

You can map CKD devices to front-end EA/EF directors. Addressing on EA and EF directors is divided into Logical Control Unit images, referred to as CU images. Each CU image has its own unique SSID and contains a maximum of 256 devices (numbered 0x00 through 0xFF). When mapped to an EA or EF port, a group of devices becomes part of a CU image.

For more information about how to map CKD devices to CU images, see the following tasks:

- z/OS map from the CU image list view on page 336
- z/OS map from the volume list view on page 337

---

**Using the Provision Storage wizard for mainframe**

**Before you begin**

- The storage system must be running HYPERMAX OS 5977 Q1 2016, or higher, and have at least one FICON director configured.
- Depending on the type of configuration selected, not all of the steps listed below might be required.

To provision storage to mainframe:

**Procedure**

1. Select the storage system.
2. Select **Hosts > Mainframe** to open the Mainframe Dashboard.
3. In the Actions panel, click **Provision Storage**. The Provision Storage wizard for mainframe is displayed.
4. In the **Create Storage Group** page, type a **Storage Group Name**.
Storage group names must be unique from other storage groups on the storage system and cannot exceed 64 characters. Only alphanumeric characters, underscores (_), and dashes (-) are allowed. Storage group names are case-insensitive.

If you want to create an empty storage group, proceed to the final step after typing the storage group name.

5. Select a **Storage Resource Pool**.

   To create the storage group outside of FAST control, select **None**. External storage resource pools are listed below the **External** heading.

6. Select an **Emulation** type. Available values are **CKD-3390** and **CKD-3380**.

7. Select the **Service Level** to set on the storage group.

   Service levels specify the characteristics of the provisioned storage, including average response time, workload type, and priority. This field defaults to None if you set the **Storage Resource Pool** to None.

   Available values are:

<table>
<thead>
<tr>
<th>Service level</th>
<th>Performance level</th>
<th>Use case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamond</td>
<td>Ultra high</td>
<td>HPC, latency sensitive</td>
</tr>
<tr>
<td>Bronze</td>
<td>Cost optimized</td>
<td>Backup, archive, file</td>
</tr>
<tr>
<td>Optimized</td>
<td></td>
<td>Places the most active data on the highest performing storage and the least active on the most cost-effective storage.</td>
</tr>
<tr>
<td>(Default)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   For all-flash storage systems, the only service level available is Diamond and it is selected by default.

8. Type the number of **Volumes** and select either a **Model** or **Volume Capacity**.

   Selecting a **Model** type automatically updates the **Volume Capacity** value. Alternatively, you can type the **Volume Capacity**.

   **Note**

   The maximum CKD volume size supported is 1182006 cylinders or 935.66 GB. It is possible to create an empty Storage Group with no volumes.

9. (Optional) Configure volume options:

   **Note**

   When using this option, Unisphere uses only new volumes when creating the storage group; it will not use any existing volumes in the group.

   a. Hover the cursor on the service level and click 🕒.

   b. Edit the **Volume Identifier**.

      The following options are available:

      **None**

      Do not set a volume identifier.
Name Only
All volumes will have the same name. Type the name in the Name field.

Name and VolumeID
All volumes will have the same name with a unique volume ID appended to them. When using this option, the maximum number of characters allowed is 50. Type the name in the Name field.

Name and Append Number
All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the Append Number and increment by 1 for each additional volume. Valid Append Numbers must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50. Type the name in the Name field.

c. To Allocate capacity for each volume you are adding to the storage group, select this option. You can use this option only for newly created volumes, not existing volumes.

d. If you selected to allocate capacity in the previous step, you can mark the allocation as persistent by selecting Persist preallocated capacity through reclaim or copy. Persistent allocations are unaffected by standard reclaim operations and any TimeFinder/Clone, TimeFinder/Snap, or SRDF copy operations.

e. Click OK.

10. (Optional) To add a child storage group, do one of the following:

- On all-flash storage systems, click Add Storage Group.
- On all other storage systems click Add Service Level.

Specify a Name, Service Level, Volumes, and Model/Volume Capacity. Repeat this step for each additional child storage group. The maximum number of child storage groups allowed is 64.

11. To create a storage group, without actually provisioning it, click one of the following; otherwise, click Next and continue with the remaining steps in this procedure:

- Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812
- Expand Add to Job List, and click Run Now to perform the operation now.

12. On the CU Image page, select whether to use a New or an Existing CU image, and then do the following depending on your selection:

- New:
  a. Specify the following information for the new CU image:
     - CU Image Number
     - SSID
     - Base Address
  b. Select a Split with which to associate the CU image.
- Existing:
a. Select a CU image.

b. To specify a new value for the base address, click **Set Base Address**. For more information about setting the base address, refer to **Setting the base address** on page 341.

13. Click **Next**.

14. On the **Review** page, review the summary information displayed.

If the storage system is registered for performance, you can subscribe for compliance alerts for the storage group and run a suitability check to ensure that the load being created is appropriate for the storage system. To enable compliance alerts, select **Enable Compliance Alerts**.

To run a suitability check, click **Run Suitability Check**.

15. Do one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.

- Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Viewing splits

**Before you begin**

- The storage system must be running HYPERMAX OS 5977 Q1 2016, or higher, and have at least one FICON director configured.

To view the splits list view:

**Procedure**

1. Select the storage system.

2. Select **HOSTS > Mainframe**.

3. Click **Splits** to display the Splits list view.

   The following properties are displayed:

   **Split Name**
   
   The user-defined name for the split.

   **Alpha Serial #**

   The alpha serial number of the split.

   **PAV State**

   Indicates what type of PAV is enabled on the split. The types are: HyperPAV, DynamicPAV, or SuperPAV (5978 only).

   **CU Images**

   The number of CU images associated with the split.

   **Ports**

   The number of FICON ports assigned to the split.

4. Select the split and click ![image](image.png).

   The following properties display:
Split Name
The user-defined name for the split.

Alpha Serial #
The alpha serial number of the split.

PAV State
Indicates if PAV is enabled on the split.

Number of CU Images
The number of CU images associated with the split.

Number of Ports
The number of FICON ports assigned to the split.

Viewing CU images

To view the CU images list view:

Procedure
1. Select the storage system.
2. Click **Hosts > CU Images** to display the **CU Images** list view.
3. The following properties display:

   - **CU Image Number**
     The CU image number.
   - **SSID**
     The netmask prefix value of the IP interface.
   - **Split**
     The name of the split containing the CU image.
   - **Number of Volumes**
     The number of volumes mapped to the CU image.
   - **Storage Groups**
     The number of storage groups containing volumes mapped to the CU image.
   - **Total Number of Base Addresses**
     The total number of the base addresses configured on the CU image. The total includes used plus unused base addresses.
   - **Number of Aliases**
     The number of aliases in use on the CU image.
   - **Status**
     The status of volumes in the CU image.

To view more details, click 📌

The following controls are available:
- **z/OS Map** — [z/OS map from the CU image list view](#) on page 336
Viewing CU image details

To view the CU images detailed view:

Procedure

1. Select the storage system.
2. Select **Hosts > Mainframe** to open the Mainframe Dashboard.
3. Click **CU Images** to display the **CU Images** list view.
4. Select the CU image and click 📊.

The following properties display:

**CU Image Number**

The CU image number.

**SSID**

The CU SSID.

**Split**

The name of the containing split.

**Number of Volumes**

The number of volumes.

**Storage Groups**

The number of storage groups.

**Status**

The current status of the CU image.

**Total Number of Base Addresses**

The total number of base addresses configured on the CU image. The total includes used plus unused base addresses.

**Number of Available Base Addresses**

The number of available base addresses, in hexadecimal.

**Available Base Addresses**

The available base address ranges on the CU image.

**Next Available Base Address**

The next available base address, in hexadecimal.

**Number of Aliases**

The number of alias addresses.

**Alias Address Range**

The assigned alias address range, if applicable.
PAV Aliasing

The type of PAV aliasing: HyperPAV, DynamicPAV, or SuperPAV (5978 only).

Creating CKD volumes

Before you begin

- The storage system must be running HYPERMAX OS 5977.810.784, or later, and have at least one FICON director configured.
- Depending on the type of configuration selected, not all of the steps listed below might be required.

Procedure

1. Select the storage system.
2. Do one of the following:
   - Select Storage > Volumes. In the Volumes list view, click Create.
   - Select Hosts > Mainframe. In the Actions panel, click Create CKD volumes.
3. Select the Configuration type.
4. From the Emulation list, select one of the following values:
   - CKD-3390
   - CKD-3380
5. Specify the capacity by typing the Number of Volumes, and selecting a Volume Capacity.
   - If the Model menu is available, selecting a model automatically updates the volume capacity to the correct capacity. Alternatively, you can manually enter a volume capacity by clicking .
6. (Optional) To add the volumes to a CKD storage group, click in the Add to Storage Group field to reveal a drop-down menu of available CKD storage groups. Click Clear to clear the selection.
7. Click Advanced Options
   - The advanced options that are presented depend on the configuration details. Complete any of the following steps that are appropriate:
     a. If required, type an SSID or click Select to choose one.
     b. To name the new volumes, select one of the following Volume Identifiers:
        - None
          Allows the system to name the volumes (Default).
        - Name Only
          All volumes will have the same name.
        - Name + VolumeID
          All volumes will have the same name with a unique volume ID appended to them. When using this option, the maximum number of characters allowed is 50.
**Name + Append Number**

All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the Append Number and increment by 1 for each additional volume. Valid Append Numbers must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.

For more information on naming volumes, refer to Setting volume names on page 198.

c. Depending on the value selected for Volume Identifier, type a Name, or a Name and Append Number.

d. If creating thin volumes or a thin BCVs, you can specify to Allocate Full Volume Capacity.

In addition, you can mark the preallocation on the thin volume as persistent by selecting Persist preallocated capacity through reclaim or copy. Persistent allocations are unaffected by standard reclaim operations.

e. Click OK.

8. Do one of the following:

   a. Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.

   b. Expand Add to Job List and click Run Now to perform the operation now.

---

**Editing CKD volume capacities**

**Procedure**

1. Select the storage system.

2. Select Hosts > Mainframe > Create.

3. Click ✍️ to open the Edit Volume Capacities dialog.

4. Use the drop-down menus to choose the number of volumes, the model, the capacity and the unit to be used to measure capacity (TB, GB, MB or cylinders).

   Click ➡️ to add another volume size.

5. Click Apply to apply your changes or Cancel to reject them.

---

**Expanding CKD volumes**

**Before you begin**

To expand CKD volumes requires HYPERMAX OS 5977.1125.1125 or later. In addition, you must be logged in as an Administrator.

You can expand a volume up to 1,182,006 cylinders (1 TB). When expanding a device above 565,250 cylinders, the new size must be a multiple of 1113 cylinders. If you specify a size that isn't that multiple, the system rounds the size up to the next multiple of 1113.

You cannot expand a volume when it is:

- A CKD 3380 device
- A TDAT
The procedure below shows one way to expand a CKD volume. You can also carry out this task via Storage > Storage Groups > Volumes or Storage > Volumes.

Procedure

1. Select the storage system.
2. Click Hosts > Mainframe, click CKD Volumes, select a volume and click Expand to open the Expand Volume dialog.
3. In the Volume Capacity field of the Expand Volume dialog box, type or select the new capacity of the volume. The Total Capacity and Additional Capacity figures update automatically.
4. To reserve the volume, select Reserve Volumes.
5. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

z/OS map from the CU image list view

Before you begin

The storage system must be running HYPERMAX OS 5977 Q1 2016.

Note

Before making any mapping changes to an existing CU image, please ensure that all of the devices in the CU are offline (the status of the CU should be offline).

To map to a CU image from the CU image list view:

Procedure

1. Select the storage system.
2. Select Hosts > Mainframe to open the Mainframe Dashboard.
3. Click CU Images.
4. Select a CU image, which has not already been mapped, and click z/OS Map. The CU Image Map wizard displays.
5. In the Find Volumes page, search for a volume to which you can map the CU image:
   a. (Optional) Specify one or more criteria by which you can filter volumes. An Additional Criteria filter for volumes with emulation CKD-3390 is applied by default.
   b. (Optional) Click Add Another to configure further additional criteria.
   c. Click Find Volumes.
6. In the Select Volumes page, select one or more volumes to map to the CU image.
7. Click **Summary**.
8. Review the summary information.
9. (Optional) To reset the base address, click **Set Base Address** and specify the new base address.
10. Do one of the following:
    a. Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
    b. Expand **Add to Job List** and click **Run Now** to perform the operation now.

### z/OS unmap from the CU image list view

**Before you begin**
The storage system must be running HYPERMAX OS 5977 Q1 2016.

---

**Note**
Before making any mapping changes to an existing CU image, please ensure that all of the devices in the CU are offline (the status of the CU should be offline).

To unmap a CU image from the CU image list view:

**Procedure**
1. Select the storage system.
2. Select **Hosts > Mainframe** to open the Mainframe Dashboard.
3. Click **CU Images**.
4. Select the CU image you want to unmap. Click **z/OS Unmap**.
   The **CU Image Unmap** dialog box displays.
5. Select one or more volumes to unmap from the CU image.
6. Do one of the following:
   a. Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
   b. Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### z/OS map from the volume list view

**Before you begin**
The storage system must be running HYPERMAX OS 5977 Q1 2016 or higher.

---

**Note**
Before making any mapping changes to an existing CU image, please ensure that all of the devices in the CU are offline (the status of the CU should be offline).

To map to a CU image from the volume list view:

**Procedure**
1. Select the storage system.
2. Select **Hosts** > **Mainframe** to open the Mainframe Dashboard.

3. Click **CKD Volumes**.

4. Select one or more volumes to map, click and then click **z/OS Map**.

   The **Mainframe Volumes Mapping** dialog box displays.

5. Select whether to want to map the volume(s) to a **New** or an **Existing** CU image.
   - **New**
     a. Specify values for **CU Image Number**, **SSID**, and **Base Address**.
     b. (Optional) Select a **Split**.
   - **Existing**
     a. Select the CU image to which you want to map the selected volume(s).
     b. (Optional) Click **Set Base Address** to reset the next available base address.

6. Do one of the following:
   a. Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
   b. Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### z/OS unmap from the volume list view

**Before you begin**

The storage system must be running HYPERMAX OS 5977 Q1 2016 or higher.

---

**Note**

Before making any mapping changes to an existing CU image, please ensure that all of the devices in the CU are offline (the status of the CU should be offline).

---

To unmap a CU image (from the volume list view):

**Procedure**

1. Select the storage system.
2. Select **Hosts** > **Mainframe** to open the Mainframe Dashboard.
3. Click **CKD Volumes**.
4. Select one or more volumes to unmap, click and then click **z/OS Unmap**.

   The **Mainframe Volumes Unmapping** dialog box displays a summary of the unmap operation.

5. Do one of the following:
   a. Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
   b. Expand **Add to Job List** and click **Run Now** to perform the operation now.
z/OS map from the Volumes (Storage Groups) list view

Before you begin
The storage system must be running HYPERMAX OS 5977 Q1 2016 or higher.

Note
Before making any mapping changes to an existing CU image, please ensure that all of the devices in the CU are offline (the status of the CU should be offline).

To map to a CU image from the Volumes (Storage Groups) list view:

Procedure

1. Select the storage system.
2. Select Hosts > Mainframe.
3. In the CKD Storage Groups panel, click View All Storage Groups to open the Storage Groups list view.
4. Select the storage group and click \(\text{ }\) to see its details. Click on the number in the Number of Volumes field to open the Volumes (Storage Groups) list view.
5. Select one or more volumes to map, click \(\text{ }\) and then click z/OS Map.
   The Mainframe Volumes Mapping dialog box displays.
6. Select whether to want to map the volume(s) to a New or an Existing CU image.
   - New
     a. Specify values for CU Image Number, SSID, and Base Address.
     b. (Optional) Select a Split.
   - Existing
     a. Select the CU image to which you want to map the selected volume(s).
     b. (Optional) Click Set Base Address to reset the next available base address.
7. Do one of the following:
   a. Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   b. Expand Add to Job List, and click Run Now to perform the operation now.

z/OS unmap from the Volumes (Storage Groups) list view

Before you begin
The storage system must be running HYPERMAX OS 5977 Q1 2016 or higher.
To unmap a CU image (from the Volumes (Storage Groups) list view):

**Procedure**

1. Select the storage system.
2. Select **Hosts > Mainframe**.
3. In the **CKD Storage Groups** panel, click **View All Storage Groups** to open the **Storage Groups** list view.
4. Select the storage group and click to see its details. Click on the number in the **Number of Volumes** field to open the **Volumes (Storage Groups)** list view.
5. Select one or more volumes to unmap, click and then click **z/OS Unmap**. The **Mainframe Volumes Unmapping** dialog box displays a summary of the unmap operation.
6. Click **Yes** to the warning dialog box. The **Mainframe Volumes Unmapping** dialog box displays a summary of the unmap operation.
7. Do one of the following:
   a. Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
   b. Expand **Add to Job List** and click **Run Now** to perform the operation now.

**Adding an alias range to a CU image**

**Before you begin**

The storage system must be running HYPERMAX OS 5977 Q1 2016.

To add an alias range to a CU image:

**Procedure**

1. Select the storage system.
2. Select **Hosts > Mainframe** to open the Mainframe Dashboard.
3. Click **CU Images**, select the CU image to which you want to add an alias range and click **Assign Alias Range**.
4. Type the **Start Alias** (Next available address). The minimum value allowed is 00.
5. Type the **End Alias**. The maximum value allowed is FF.
6. If required, select **Reserve Volumes**.
7. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can
     schedule or run the task at your convenience. For more information, refer to
     Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand **Add to Job List** and click **Run Now** to perform the operation now.

Removing an alias range from a CU image

**Before you begin**
- The storage system must be running HYPERMAX OS 5977 Q1 2016.
- This operation removes all of the aliases for the selected CU image.

To remove an alias range from a CU image:

**Procedure**
1. Select the storage system.
2. Select **Hosts > Mainframe** to open the Mainframe Dashboard.
3. Click **CU Images**, select the CU image from which you want to remove an alias
   range and click **Remove Alias Range**.
4. Review the information displayed in the **Remove Alias Range** dialog box and do
   one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can
     schedule or run the task at your convenience. For more information, refer to
     Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand **Add to Job List** and click **Run Now** to perform the operation now.

Setting the base address

The **Set Base Address** dialog box is launched from the following locations:
- Provision Storage wizard — Using the Provision Storage wizard on page 102
- CU Image Map wizard — z/OS map from the CU image list view on page 336
- Mainframe Volumes Mapping dialog — z/OS map from the volume list view on
  page 337

To set the base address:

**Procedure**
1. In the **Base Address** field, specify a new value for base address.
   Addresses in the range 00-FF are allowed.
2. Click **OK**.

Understanding All Flash Mixed FBA/CKD support

With the release of HYPERMAX OS 5977 Q2 2017, Unisphere introduces support for
All Flash Mixed FBA/CKD arrays.
This feature is only available for All Flash 450F/850F/950F arrays that are:

- Purchased as a mixed All Flash system
- Installed at HYPERMAX OS 5977 Q2 2017 or later

You can provision FBA/CKD storage to a mainframe host using the Provision Storage wizard.

For specific instructions about how to provision storage for mainframe, refer to Using the Provision Storage wizard for mainframe on page 106, by default only the CKD SRP is available in the Storage Resource Pool drop down list.

To provision storage for Open Systems, refer to Using the Provision Storage wizard on page 102, by default only the FBA SRP is available in the Storage Resource Pool drop down list.

For specific instructions about how to modify a storage group, refer to Modifying storage groups on page 121, depending on the storage group selection the Storage Resource Pool drop down list is filtered to display the CKD or FBA SRP.

Note

1. A CKD SG can only provision from a CKD SRP
2. A FBA SG can only provision from a FBA SRP
3. FBA volumes cannot reside in a CKD SRP
4. CKD volumes cannot reside in a FBA SRP
5. Compression is only for FBA volumes

Mapping FBA devices to CU images

You can map FBA devices to front-end EA/EF directors. Addressing on EA and EF directors is divided into Logical Control Unit images, referred to as CU images. Each CU image has its own unique SSID and contains a maximum of 256 devices (numbered 0x000 through 0xFF). When mapped to an EA or EF port, a group of devices becomes part of a CU image.

For more information about how to map FBA devices to CU images, see the following tasks:

- z/OS map FBA volumes from the Volumes (Storage Groups) list view (HYPERMAX OS 5977 or higher) on page 342
- z/OS unmap FBA volumes from the Volumes (Storage Groups) list view on page 343

z/OS map FBA volumes from the Volumes (Storage Groups) list view (HYPERMAX OS 5977 or higher)

Before you begin

This feature is only available for All Flash 450F/850F/950F arrays that are:

- Purchased as a mixed all flash system
To map to a CU image from the Volumes (Storage Groups) list view:

Procedure

1. Select the storage system.
2. Select Storage > Storage Groups.
3. Select a storage group and click to see its details.
4. Click on the number in the Volumes field to open the Volumes (Storage Groups) list view.
5. Select one or more volumes to map, click and then click z/OS Map.
   The Mainframe Volumes Mapping dialog box displays.
6. Select whether to want to map the volume(s) to a New or an Existing CU image.
   - New
     a. Specify values for CU Image Number, SSID, and Base Address.
     b. (Optional) Select a Split.
   - Existing
     a. Select the CU image to which you want to map the selected volume(s).
     b. (Optional) Click Set Base Address to reset the next available base address.
7. Do one of the following:
   a. Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   b. Expand Add to Job List, and click Run Now to perform the operation now.

z/OS unmap FBA volumes from the Volumes (Storage Groups) list view

Before you begin
This feature is only available for All Flash 450F/850F/950F arrays that are:

- Purchased as a mixed all flash system
- Installed at HYPERMAX OS 5977 Q2 2017 or later
See Understanding All Flash Mixed FBA/CKD support on page 341 for additional information.

**Note**
Before making any mapping changes to an existing CU image, please ensure that all of the devices in the CU are offline (the status of the CU should be offline).

To unmap a CU image (from the Volumes (Storage Groups) list view):

**Procedure**
1. Select the storage system.
2. Select Storage > Storage Groups.
3. Select a storage group and click ![icon] to see its details.
4. Click on the number in the Volumes field to open the Volumes (Storage Groups) list view.
5. Select one or more volumes to unmap, click ![icon] and then click z/OS Unmap. The Mainframe Volumes Unmapping dialog box displays a summary of the unmap operation.
6. Do one of the following:
   a. Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   b. Expand Add to Job List and click Run Now to perform the operation now.

**Mapping CKD volumes**

The following explains how to map CKD volumes to ESCON/FICON ports.

You can perform this operation at the volume level or the CU image level.

**Procedure**
1. Select the storage system.
2. To map at the volume level:
   a. Select Storage > Volumes.
   b. To display only CKD volumes, click in the Emulation field and select CKD from the drop-down menu.
   c. Select a CKD volume, click ![icon] and then click z/OS Map to open the z/OS Map Volumes dialog box.
Note
To create a new CU Image - Enter a base address with a 4 hexadecimal format e.g. "3210"
- "32" = the CU Image Id
- "10" = base address (First base address must end with 0)
To create a new SSID - Enter a SSID with a 4 hexadecimal format e.g. "1234" (must be unique)

- To map at the CU image level:
  a. Select Hosts > CU Images.
  b. Select an image and click z/OS Map to open the z/OS Map dialog box.
3. Type or Select a Volume Range.
4. Type the Base Address to be assigned to the first volume in the mapping request.
   Base addresses increases incrementally by one for each volume in the range of volumes being mapped. To view base addresses already in use, click Show.
5. Type or Select an SSID.
   Valid SSIDs must only have unmapped volumes using them and the number of volumes cannot exceed 256.
6. Select the Port to which you want to map the volumes.
7. Click one of the following:
   - Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Unmapping CKD volumes

The following explains how to unmap CKD volumes from ESCON/FICON ports.
You can perform this operation at the volume level or the CU image level.

Procedure
1. Select the storage system.
2. To unmap at the volume level:
   a. Select Storage > Volumes.
   b. To display only CKD volumes, click in the Emulation field and select CKD from the drop-down menu.
   c. Select a CKD volume, click and then click z/OS Unmap to open the z/OS Unmap Volumes dialog box.
   - To unmap at the CU image level:
     a. Select Hosts > CU Images to open the CU Images list view.
     b. Select an image and click z/OS Unmap to open the Unmap CU Image dialog box.
3. Type or Select the Volume Range to be unmapped.

4. Type or Select the Base Address.

5. Type or Select an SSID.
   Valid SSIDs must only have unmapped volumes using them, and the number of
   volumes cannot exceed 256.

6. Select the Port to which you want to map the volumes.

7. Click one of the following:
   • Add to Job List to add this task to the job list, from which you can schedule
     or run the task at your convenience. For more information, refer to
     Scheduling jobs on page 812 and Previewing jobs on page 812.
   • Expand Add to Job List, and click Run Now to perform the operation now.

Copying CU image mapping

Before you begin

Before you begin:

All volumes in a specified range must be mapped to the same CU image, or not
mapped at all. Volumes within the specified range that are not mapped will be ignored
as long as they are not mappable (SAVE devices, DRVs, and so on). If a volume in the
specified range is mappable, the request will be rejected.

The following explains how to copy the front-end mapping addresses of a set of
volumes from one port to another, providing multi-path access from the storage
system to the mainframe.

To copy CU image mapping:

Procedure

1. Select Hosts > CU Images to open the CU Images list view.
2. Select an image, and click Copy Mapping to open the z/OS Map dialog box.

Available Volume for EA/EF Mapping dialog box

Use this dialog box to select one or more volumes for the mapping operation.

To select a range of volumes, select the first volume in the range, press and hold the
Shift key, and then click the last volume in the range.

Base Addresses in Use dialog box

Use this dialog box to view base addresses already in use.

Select SSID dialog box

Use this dialog box to select an SSID for the operation.

Viewing CKD volumes in CU image

Viewing CKD volumes in CU image

Procedure

1. Select the storage system.
2. Select **Hosts > CU Images**

3. Select the CU image and click 🔍.

4. In the details panel, click on the number in the **Number of Volumes** field to open the **CKD Volumes** list view.

5. Use the **CKD Volumes** list view to display and manage CKD volumes in a CU image.

### Results

- **Name** — Symmetrix volume name.
- **Type** — Volume configuration.
- **Status** — Volume status.
- **Capacity (GB)** — Volume capacity in GBs.
- **Emulation** — Emulation type.
- **UCB Address** — Unit control block (address used by z/OS to access this volume.
- **Volser** — Volume serial number (disk label (VOL1) used when the volume was initialized).

The following controls are available:

1. — Viewing CU image details on page 333
2. **z/OS Map**— z/OS map from the volume list view on page 337
3. **z/OS Unmap**— z/OS unmap from the volume list view on page 338

### Creating PowerPath hosts

#### Before you begin

The following are the minimum requirements to perform this task:

- A storage system running PowerMax 5978 or higher.
- Unisphere for PowerMax 9.0.
- Solutions Enabler 9.0.
- PowerPath 6.3.

#### Procedure

1. Select the storage system.

2. Select **Hosts > PowerPath Hosts** to open the **PowerPath Hosts** list view.

3. Click **Create Host** to open the **Create Host for PowerPath Host** dialog.

4. You can use the host name that appears in the dialog or else type in a new one.

   Host names must be unique from other host/host group names on the storage system.

5. Select either **Add To Job List** or **Run Now**.

   All initiators associated with the selected PowerPath Host will be added to the new host.
**Viewing PowerPath hosts**

**Before you begin**

The following are the minimum requirements to perform this task:

- A storage system running PowerMaxOS 5978 or higher.
- Unisphere for PowerMax 9.0.
- Solutions Enabler 9.0.
- PowerPath 6.3.

**Procedure**

1. Select the storage system.
2. Select **Hosts > PowerPath Hosts** to open the **PowerPath Hosts** list view.
   
   The following properties display:

   - **Name** — The PowerPath host name.
   - **Version** — The PowerPath host version.
   - **OS Version** — The PowerPath host OS version.
   - **Vendor** — The PowerPath host hardware vendor.
   - **Initiators** — The number of PowerPath host initiators.
   - **Hosts** — The number of PowerPath hosts.
   - **VMs** — The number of PowerPath host virtual machines.

   The following control is available: **Create Host**: [Creating PowerPath hosts](#) on page 347

**Viewing PowerPath hosts details**

**Before you begin**

The following are the minimum requirements to perform this task:

- A storage system running PowerMaxOS 5978 or higher.
- Unisphere for PowerMax 9.0.
- Solutions Enabler 9.0.
- PowerPath 6.3.

**Procedure**

1. Select the storage system.
2. Select **Hosts > PowerPath Hosts** to open the **PowerPath Hosts** list view.
3. To view the details of a PowerPath host, select it and click

   The following properties display:

   - **Name** — The PowerPath host name.
   - **Version** — The PowerPath host version.
• **Patch Level** — The PowerPath host patch level.
• **License Info** — The PowerPath host license info.
• **Vendor** — The PowerPath host hardware vendor.
• **OS Version** — The PowerPath host OS version.
• **OS Revision** — The PowerPath host OS revision.
• **Host Registration Time** — The time the host registered with the POWERMAX array.
• **Connectivity Type** — Indicates whether the PowerPath Host is connected to the POWERMAX array by iSCSI or Fibre.
• **Cluster Name** — The PowerPath host cluster name.
• **Cluster Node Name** — The PowerPath host node name in the cluster.
• **Initiators** — The number of PowerPath host initiators. Click on the number to see the initiators list view.
• **Hosts** — The number of PowerPath hosts.
• **Masking Views** — The number of PowerPath host masking views. Click on the number to see the masking views list view.
• **VMs** — The number of PowerPath host virtual machines. Click on the number to see the VMs list view.
• **Storage Groups** — The number of PowerPath host storage groups. Click on the number to see the storage groups list view.
• **Volumes** — The number of PowerPath host volumes. Click on the number to see the volumes list view.

### Viewing PowerPath Host Virtual Machines

**Procedure**

1. Select the storage system.
2. Select **Hosts** > **PowerPath Hosts** to open the **PowerPath Hosts** list view.
3. Select a PowerPath Host and click the information icon.
4. In the details panel, click on the number in the **VMs** field to open the **VMs** list view.

The following properties display:

• **Name** — The VM name.
• **OS Name** — The VM operating system.

A link allows you to add ESX or vCenter viClient credentials so as to retrieve more information on the Virtual Machine. In that case, the following additional properties are displayed:

• **Power State** — The VM power status.
• **CPU Count** — The number of CPUs assigned to the VM.
• **Total Memory** — The total RAM assigned to the VM.
• **State** — The current state of the VM.
• **Address** — The IP address of the VM.
Viewing host cache adapters

**Procedure**

1. Select the storage system.
2. Select **Hosts > Xtrem SW Cache Adapters** to open the **XtremSW Cache Adapters** list view.

   The following properties display:
   - **Card S/N**—Adapter serial number.
   - **Card Version**—Adapter version.
   - **Vendor**—Adapter vendor.
   - **Card Size (GB)**—Adapter size.
   - **Card Used (GB)**—Amount of card used.
   - **Volumes**—Number of accessible volumes.
   - **Host**—Host name.
   - **IP Address**—Host IP address.
   - **Host OS**—Host operating system.
CHAPTER 6

Data Protection

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Understanding Data Protection Management

Data Protection Management covers the following areas:

- **Storage Groups** - Management of SRDF protected storage groups.
- **Device Groups** - Management of device groups. A device group is a user-defined group comprised of devices that belong to a locally attached array. Control operations can be performed on the group as a whole, or on the individual device pairs in the group. By default, a device can belong to more than one device group.
- **SRDF Groups** - Management of SRDF groups. SRDF groups provide a collective data transfer path linking volumes of two separate storage systems. These communication and transfer paths are used to synchronize data between the R1 and R2 volume pairs associated with the RDF group. At least one physical connection must exist between the two storage systems within the fabric topology.
- **Migrations** - Non-disruptive migration (NDM) management. NDM allows you to migrate storage group (application) data in a non-disruptive manner with no downtime from NDM capable source arrays to NDM capable target arrays.
- **SRDF/A DSE Pools** - Management of SRDF/A DSE Pools.
- **TimeFinder Snap pools** - Management of TimeFinder Snap pools.
- **Open Replicator** - Management of Open Replicator. Open Replicator (ORS) provides a method for copying data to or from various types of arrays within a storage area network (SAN) infrastructure.
- **Virtual Witness** - Management of Virtual Witness. The Witness feature supports a third party that the two storage systems consult if they lose connectivity with each other, that is, their SRDF links go out of service. When this happens, the Witness helps to determine, for each SRDF/Metro Session, which of the storage systems should remain active (volumes continue to be read and write to hosts) and which goes inactive (volumes not accessible).

Creating device groups

**Before you begin**

Target volumes are automatically created by the wizard when the source Storage Group contains CKD volumes.

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > Device Groups**.
3. Click the **Device Groups** tab to open the **Device Group** list view.
4. Click **Create** to open the **Create Device Group** wizard.
5. Type a **Device Group Name**.
6. Select a **Device Group Type**.

   Possible values are:

   - **REGULAR** — Group can only contain REGULAR volumes.
• RDF1 — Group can only contain R1 volumes.
• RDF2 — Group can only contain R2 volumes.
• RDF21 — Group can only contain R21 volumes.
• ANY — Group can contain any volume type.

7. Click Next.
8. Select the Source of the volumes to use when creating the group; either manual selection, or all the volumes in a storage group.
9. Do the following, depending on the source of the volumes:
   • Manual selection:
     a. Select the Source Volume Type.
     b. Select one or more volumes and click Add.
   • Storage group:
     Type or select the name of the Storage Group.
10. Click NEXT.
11. Select how to specify the Target Volumes, either manually or automatically.
12. Do the following, depending on how you are specifying the target volumes:
   • Automatically:
     a. Optional: Select to replicate the source volumes using TimeFinder/Snap, TimeFinder Mirror, or TimeFinder/Clone. The required devices (if they are not found to be already existing and unused) will be created. The BCV devices will be automatically created for the TimeFinder Mirror device group. The VDEV devices will be automatically created for the TimeFinder/Snap device group. The required devices will be automatically created for the TimeFinder/Clone device group.
     b. If you are replicating the source volumes with TimeFinder/Clone, select whether to add BCV or STD volumes to the device group. The volumes will be added with the TGT flag.
   • Manually:
     a. Click NEXT.
     b. Select the Target Volume Type.
     c. Select one or more volumes and click Add.
13. Click NEXT.
14. Verify your selections in the Summary page. To change any of your selections, click Back. Note that some changes may require you to make additional changes to your configuration.
15. Click FINISH.

Results
A window appears that displays the progress of the wizard's tasks.

Adding volumes to device groups

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > Device Groups.
3. Click the Device Groups tab to open the Device Group list view.
4. Select the device group and click Add Volumes.
5. From the list of available volumes, select the volume(s) and click Add to Group.
6. Optional: Remove a previously added volume by selecting it and clicking Remove.
7. Click OK.

Removing volumes from device groups

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > Device Groups.
3. Click the Device Groups tab to open the Device Group list view.
4. Select the device group and click to open the Details view.
5. Click the number next to Number of Volumes to view all volumes in device group.
6. Select one or more volumes and click Remove Volumes.
7. Click OK.

Setting consistency protection

Before you begin
To set consistency protection:

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups > SRDF or DATA PROTECTION > Device Groups > SRDF.
3. Select a group, click more , and select Asynchronous > Set Consistency.
4. select Enable or Disable.
5. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (only applicable for device groups).
6. Click Advanced Options to set the advanced options. Select the advanced options and click OK.
7. Do one of the following:
   a. Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   b. Expand Add to Job List, and click Run Now to perform the operation now.
Renaming device groups

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > Device Groups.
3. Click the Device Groups tab to open the Device Group list view.
4. Select the device group from the list and click Rename.
5. In the Name field, enter the new device group name.
6. Do one of the following:
   - Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Deleting device groups

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > Device Groups.
3. Click the Device Groups tab to open the Device Group list view.
4. Select the device group and click .
5. Do one of the following:
   - Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Viewing device groups

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > Device Groups.
3. Click the Device Groups tab to open the Device Group list view.

Use the Device Group list view to view and manage device groups. The following properties display, depending on the operating environment:
- **Name**—User-defined device group name.
- **Group Type**—Device configuration of the devices in the group. Possible values are: Regular, R1, R2, R21, or Any.
- **Standards**—Number of standard devices in the device group.
- **BCVs**—Number of BCV devices in the device group.
- **VDEVs**—Number of virtual devices in the device group.
• **Targets**—Number of target devices in the device group.

• **Gatekeepers**—Number of gatekeeper devices in the device group (Does not apply/display with HYPERMAX OS 5977).

• **Group Valid**—Indicates whether the device group is valid.

The following controls are available, depending on the operating environment:

• ![Viewing device group details](image)

• **Create**—Creating device groups on page 352

• **Rename**—Adding volumes to device groups on page 353

• ![Deleting disk groups](image)

• **Add Volumes**—Adding volumes to device groups on page 353

• **Replication QOS**—QOS for replication on page 200

• **Assign Dynamic Cache Partition**—Assigning dynamic cache partitions on page 837 (Does not apply/display with HYPERMAX OS 5977 or higher.)

• **Assign Symmetrix Priority**—Assigning array priority to groups of volumes on page 191 (Does not apply/display with HYPERMAX OS 5977 or higher.)

• **Set Optimized Read Miss**—Setting optimized read miss on page 195 (Does not apply/display with HYPERMAX OS 5977 or higher.)

**Viewing device group details**

**Procedure**

1. Select the storage system.

2. Select **DATA PROTECTION > Device Groups**.

3. Click the **Device Groups** tab to open the **Device Group** list view.

4. Select the device group and click ![ ] to open the **Details** view.

The following properties display, depending on the operating environment:

• **Name**—User-defined device group name.

• **Application ID**—Indicates which application created the device group.

• **Group Valid**—Indicates whether the device group is valid.

• **Device Group Create Time**—Time the device group was created.

• **Device Group Modify Time**—Time the device group was modified.

• **Symmetrix ID**—Storage system serial number ID.

• **Number of Volumes**—Number of volumes.

• **Number of Associate Gatekeepers**—Number of gatekeeper devices in the device group.

• **Number of STD Volumes in Group**—Number of standard devices in the device group.

• **Number of Locally-Associated BCVs**—Number of local BCV devices associated with the device group.

• **Number of Locally-Associated VDEVs**—Number of virtual devices associated with the device group.
• **Number of Locally-Associated TGTs**—Number of local target volumes associated with the device group.

• **Number of Remotely-Associated BCVs (STD SRDF)**—Number of remote BCV devices associated with the device group.

• **Number of Remotely-Associated BCVs (BCV SRDF)**—Number of BCV devices, associated with the device group, to be paired with remotely-attached BCV devices.

• **Number of Remotely-Associated RBCVs (RBCV SRDF)**—Number of remote BCV devices associated with the device group.

• **Number of Remotely-Associated VDEVs**—Number of remote VDEV devices associated with the device group.

• **Number of Remotely-Associated TGTs**—Number of remote target devices associated with the device group.

• **Number of Hop2 BCVs (Remotely-associated Hop2 BCV)**—Number of BCVs on the second hop of the Cascaded SRDF configuration associated with the device group.

• **Number of Hop2 VDEVs (Remotely-associated Hop2 VDEV)**—Number of virtual devices on the second hop of the Cascaded SRDF configuration associated with the device group.

• **Number of Hop2 TGTs (Remotely-associated Hop2 TGT)**—Number of target devices on the second hop of the Cascaded SRDF configuration associated with the device group.

• **Number of Composite Groups**—Number of composite groups.

• **Pacing Capable**—Indicates if the device group allows write pacing capability.

• **Group-level Pacing State**—Indicates if the device group is write pacing enabled or disabled.

• **Volume-level Pacing State**—Indicates if the volumes in the device group are write pacing enabled or disabled.

• **Configured Group-level Exempt State**—Indicates if group-level write pacing exemption capability is enabled or disabled.

• **Effective Group-level Exempt State**—Indicates if effective group-level write pacing exemption capability is enabled or disabled.

• **Group Write Pacing Exempt Volumes**—Indicates if the volumes in the device group have write pacing exemption capability enabled or disabled.

Links are provided to views for objects contained in or associated with the device group. Each group link is followed the name of the group, or by a number, indicating the number of objects in the corresponding view. For example, clicking the number next to **Number of Volumes** opens the view listing the volumes contained in the device group.

**Viewing volumes in device group**

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > Device Groups**.
3. Click the **Device Groups** tab to open the **Device Group** list view.
4. Select the device group and click to open the Details view.

5. Click the number next to Number of Volumes to view all volumes in device group.

The following properties display:
- **Name**—Volume name
- **LDev**—Logical device name
- **Volume Config**—Device Configuration
- **Capacity (GB)**—Device capacity in GB
- **Status**—Device status

The following controls are available:
- **Add Volumes**—Adding volumes to device groups on page 353
- **Remove Volumes**—Removing volumes from device groups on page 354

### Understanding TimeFinder.Clone operations

Clone copy sessions allow you to create clone copies of a source volume on multiple target volumes. The source and target volumes can be either standard volumes or BCVs, as long as they are the same size and emulation type (FBA/CKD). Once you have activated the session, the target host can instantly access the copy, even before the data is fully copied to the target volume.

**Note**

TimeFinder operations are not supported directly on storage systems running HYPERMAX OS 5977 or higher. Instead, they are mapped to their TimeFinder/SnapVX equivalents.

An overview of a typical clone session is:
1. Create a device group, or add volumes to an existing device group.
2. Create the session; restore the session.
3. Activate the session.
4. View the session's progress.
5. Terminate the session

For more information on TimeFinder.Clone concepts, refer to the *Solutions Enabler TimeFinder Family CLI Product Guide* and the *TimeFinder Family Product Guide*.

### Managing TimeFinder.Clone sessions

**Before you begin**

TimeFinder.Clone requires Enginuity version 5876, or HYPERMAX OS 5977 or higher. On HYPERMAX OS 5977 or higher, TimeFinder.Clone operations are mapped to their TimeFinder/SnapVX equivalents using Clone emulation.

The TimeFinder.Clone dashboard provides you with a single place to monitor and manage TimeFinder.Clone sessions on a storage system.

To manage TimeFinder.Clone sessions:
Procedure

1. Select the storage system.
2. Select DATA PROTECTION > Device Groups.
3. Click the TimeFinder Clone tab to open the TimeFinder Clone list view.

The following properties display:

- **Device Group** Lists the groups containing volumes using TimeFinder/Clone. Information in this column is organized in a tree format, with groups organized into folders according to their type. To view information on a specific group, expand the appropriate folder.
- **Standard**—The number of standard volumes in the group.
- **BCV**—The number of BCVs in the group.
- **Target**—The number of target volumes in the group.
- **State**—The combined state of the sessions in the group. If all the sessions are in the same state, then that state appears; otherwise, Mixed appears.
- **Group Type**—The type of group. Property values: RDF1, RDF2, RDF21, and Regular.
- **Group Valid**—Indicates whether the group is valid. Property values: Yes or No.

Click **1** and click the number next to **Clone Pairs** to view the associated clone pairs (see Viewing clone pairs on page 368).

Click **1** to click the number next **Storage Groups** to view the associated storage groups.

The following controls are available:

- **Create Pairs**—Creating clone copy sessions on page 359
- **Activate**—Activating clone copy sessions on page 361
- **Recreate**—Recreating clone copy sessions on page 362
- **Split**—Splitting clone volume pairs on page 366
- **Restore**—Restoring data from target volumes on page 365
- **Establish**—Creating Snapshots on page 383
- **Terminate**—Terminating clone copy sessions on page 367
- **Set Mode**—Modifying clone copy sessions on page 364

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Creating clone copy sessions

This procedure explains how to create clone copy sessions.
Note

Note the following:

- TimeFinder/Clone requires Enginuity version 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Clone operations are mapped to their TimeFinder/SnapVX equivalents.
- You can only perform this operation on a group containing source and target volumes.
- You can use the target volume of a clone session as the source volume for other clone sessions. To use this feature, you must first enable the SYMAPI_ALLOW_DEV_IN_MULT_GRPS option in the SYMAPI options file. For more information on enabling SYMAPI options, refer to the Solutions Enabler CLI Command Reference.
- Data Domain volumes are not supported.
- The clone copy does not become available to the host until the session is activated.

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > Device Groups.
3. Click the TimeFinder Clone tab to open the TimeFinder Clone list view.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - **Group level:**
     a. Select a group and click **Create Pairs**.
     b. Select a source type and a target type.
   - **Pair level:**
     a. Select a group and click to open its Details view.
     b. Click on the number next to **Clone Pairs**.
     c. Select one or more pairs and click **Create Pairs**.
     d. Click **Set Pairs** to open the **Set Pairs** dialog box.
     e. Select a source volume and a target volume, and click **Add** to make them a pair. Repeat this step as required.
     f. Click **OK** to return to the **Create Sessions** dialog box.
5. Click **Advanced Options** to set the advanced options as described next.

Setting Advanced Options:

- If performing this operation at the group level, you can optionally select a **Pairing Type** and select one of the following. If you are not using the **Pairing Type** option, leave this field set to **None**.
  - **Use Exact Pairs**—Allows the system to pair up the volumes in the exact order that they were added to the group.
Use Optimized Pairs—Optimizes volume pairings across the local Symmetrix system without regard for whether the volumes belong to different RDF (RA) groups.

For Copy Mode, select one of the following:

- **Use Background Copy**—Specifies to start copying tracks in the background at the same time as target I/Os are occurring.
- **Use No Copy**—Specifies to change the session to CopyOnAccess once the session is activated and no full-volume copy will initiate.
- **Use PreCopy**—Specifies to start copying tracks in the background before you activate the clone session.

By default, when creating a clone session, the system creates an SDDF session for maintaining changed track information. To change this default behavior, expand the Differential Mode menu, and select Use No Differential. Otherwise, leave this field set to Use Differential.

To attach Session Options to the operation, select any number of options. Click OK.

6. Do one of the following:

- Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
- Expand Add to Job List, and click Run Now to perform the operation now.

### Activating clone copy sessions

This procedure explains how to activate the copy operation from the source volume to the target volume. Activating a copy session places the target volume in the Read/Write state. The target host can access the cloned data and has access to data on the source host until you terminate the copy session.

**Note**

- TimeFinder/Clone requires Enginuity version 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Clone operations are mapped to their TimeFinder/SnapVX equivalents.
- You can only activate clone sessions that are in the Created or Recreated state.
- This procedure explains how to perform this operation from the TimeFinder/Clone dashboard. You can also perform this operation from other locations in the interface. Depending on the location, some of the steps may not apply.

To activate the copy operation from the source volume to the target volume:

**Procedure**

1. Select the storage system.
2. Select DATA PROTECTION > Device Groups.
3. Click the TimeFinder Clone tab to open the TimeFinder Clone list view.
4. Do one of the following, depending on whether you want to perform the operation at the group level or pair level:
Group level:
- Select a group and click **Activate**.
- Select a source type and a target type.

Pair level:
- Select a group and click **Open Details** to open its Details view.
- Click on the number next to **Clone Pairs**.
- Select one or more pairs, and click **Activate**.

5. Optional: To attach session options to the operation, click **Advanced Options** and select any number of options.

6. Do one of the following:
- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
- Expand **Add to Job List**, and click **Run Now** to perform the operation now.

Recreating clone copy sessions

**Before you begin**
- TimeFinder/Clone requires Enginuity version 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Clone operations are mapped to their TimeFinder/SnapVX equivalents.
- The copy session must not have been created with the No Copy or No Differential option.
- The session must have been activated to establish the new point-in-time copy.
- With Enginuity 5876.159.102 or higher, you can recreate a clone copy without terminating TimeFinder/Snap or VP Snap sessions that are cascading off of the clone target.

This procedure explains how to incrementally copy all subsequent changes made to the source volume (made after the point-in-time copy initiated) to the target volume. While in the Recreated state, the target volume remains Not Ready to the host.

**Procedure**

1. To recreate clone copy sessions:
   1. Select the storage system.
   2. Select **DATA PROTECTION > Device Groups**.
   3. Click the **TimeFinder Clone** tab to open the **TimeFinder Clone** list view.
   4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
      - **Group level:**
        - Select a group and click **Recreate**.
        - Select a source type and a target type.
      - **Pair level:**
a. Select a group, and click to open its Details view.
b. Click on the number next to Clone Pairs.
c. Select one or more pairs and click Recreate.

5. Optional: To attach session options to the operation, click Advanced Options, and select any number of options.

6. Do one of the following:
   • Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   • Expand Add to Job List, and click Run Now to perform the operation now.

Creating clone snapshots

Before you begin
- TimeFinder/Clone requires Enginuity OS 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Clone operations are mapped to their TimeFinder/SnapVX equivalents.
- The create operation sets the target volume to Not Ready for a short time. If you are using a file system, unmount the target host before performing the create operation.

This procedure explains how to create and immediately activate clone snapshots

Procedure
1. To create clone snapshots:
   1. Select the storage system.
   2. Select DATA PROTECTION > Device Groups.
   3. Click the TimeFinder Clone tab to open the TimeFinder Clone list view.
   4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
      Group level:
      a. Select a group, click to open its Details view, and select Create Snapshot.
      b. Select the source type and the target type.
      Pair level:
      a. Select a group and click to open its Details view.
      b. Click on the number next to Clone Pairs.
      c. Select one or more pairs, click to open its Details view, and select Create Snapshot.
      d. Select the source type and the target type.
   5. Specify whether to perform an Incremental or Full create.
6. Optional: To attach session options to the operation, click **Advanced Options**, and select any number of **options**.

7. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

---

**Modifying clone copy sessions**

**Before you begin**
- TimeFinder/Clone requires Enginuity version 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Clone operations are mapped to their TimeFinder/SnapVX equivalents.
- You can modify the mode between Copy, NoCopy, and Precopy on clone pairs that are in a Created, Recreated, or Activated state.
- Do not change a session created with the Differential option to the No Copy mode, as the session will fail.

This procedure explains how to modify the mode in which a clone copy session is operating.

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > Device Groups**.
3. Click the **TimeFinder Clone** tab to open the **TimeFinder Clone** list view.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - **Group level:**
     - Select a group, click ⚙, and select **Set Mode**.
   - **Pair level:**
     a. Select a group, and click ⚙ to open its **Details** view.
     b. Click on the number next to **Clone Pairs**.
     c. Select one or more pairs, click ⚙, and select **Set Mode**
5. Select a **Copy Mode**:
   - **Use Copy**—If the session was created without the Copy option, it can be changed now to Copy mode. A copy initiates once the session is activated.
   - **Use No Copy**—If the session was created with Copy mode, you can change the session to NoCopy mode. The session becomes CopyOnAccess once the session is activated and no full-volume copy will initiate.
   - **Use Precopy**—If the session was created without Precopy, you can change the session to Precopy mode, which implies a copy. You cannot change to
NoCopy mode. Once the session is activated, the session changes to Copy mode.

6. If performing the operation at the group level, select the type of source volumes (Source Type) and the type of target volumes Target Type.

7. Optional: To set session options, click Advanced Options, and select any number of options.

8. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

## Restoring data from target volumes

### Before you begin
- TimeFinder/Clone requires Enginuity version 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Clone operations are mapped to their TimeFinder/SnapVX equivalents.
- With Enginuity 5876 or higher, you can:
  - Use ORS control volumes as clone restore targets when the volumes are in PUSH sessions and in the ORS Copied state.
  - Perform an incremental restore to a cascaded clone target. For example, in the relationship A->B->C, you can copy data from volume C to volume A.
- With Enginuity 5876, you can perform an incremental restore on volume pairs in a NoCopy/NoDiff clone session.
- With Enginuity 5876.159.102 or higher, you can perform an incremental restore of clone targets to source volumes with active snap and VP snap sessions.
- For a clone session in the Created state, the target volume must be in a fully copied state.

This procedure explains how to copy target data to another volume (full restore), or back to the original source volume (incremental restore).

In the case of a full restore, the original session terminates and a copy session to the target of the restore starts.

In the case of an incremental restore, the original session copy direction is reversed and changed data is copied from the target volume to the source volume. To support this operation, the session must have been created with the Differential option and the volume must be in a fully Copied state.

To restore data from a target volume:

### Procedure
1. Select the storage system.
2. Select DATA PROTECTION > Device Groups.
3. Click the TimeFinder Clone tab to open the TimeFinder Clone list view.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - **Group level:**
Select a group, click , and select Restore.

**Pair level:**

a. Select a group, and click to open its Details view.
b. Click on the number next to Clone Pairs.
c. Select one or more pairs, click , and select Restore.

5. Select a Restore Type:
   - **Incremental** — Terminates the original session and starts an incremental copy session back to the original source volume. The session must have been created with the Differential option.
   - **Full** — Terminates the original session and starts a copy session to the target of the restore.

6. If performing the operation at the group level, select the type of source volumes (Source Type) and the type of target volumes Target Type.

7. To attach Session Options to the operation, click Advanced Options, and select any number of Clone copy session options on page 369.

8. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

---

**Splitting clone volume pairs**

**Before you begin**

- TimeFinder/Clone requires Enginuity version 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Clone operations are mapped to their TimeFinder/SnapVX equivalents.
- The clone session must be in the Restored state.

This procedure explains how to split clone volume pairs. Splitting volume pairs changes the direction of the clone relationship (that is, the original source volume becomes the source volume for a future copy), which enables you to use either the establish or recreate command.

**Procedure**

1. To split clone volume pairs:
2. Select the storage system.
3. Select DATA PROTECTION > Device Groups.
4. Click the TimeFinder Clone tab to open the TimeFinder Clone list view.
5. Do one of the following, depending on whether you want to perform the operation at the group level or pair level:
   - **Group level:**
Select a group, click 📊, and select Split.

**Pair level:**

a. Select a group and click 📊 to open its Details view.
b. Click on the number next to Clone Pairs.
c. Select one or more pairs, click 📊, and select Split.

5. If performing the operation at the group level, select the type of source volumes (Source Type) and the type of target volumes Target Type.

6. Optional: To attach session options to the operation, click Advanced Options, and select any number of options.

7. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

---

**Terminating clone copy sessions**

**Before you begin**

- TimeFinder/Clone requires Enginuity version 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Clone operations are mapped to their TimeFinder/SnapVX equivalents.
- You need a clone copy session in any pair state.
- Terminating a session while the pairs are in the CopyOnAccess, CopyOnWrite, or CopyInProg state causes the session to end. If the application has not finished accessing all of the data, the target copy is not a full copy.

This procedure explains how to terminate a clone copy session, thereby deleting the pairing information from the storage system, and removing any hold on the target volume.

**Procedure**

1. To split clone volume pairs:
   1. Select the storage system.
   2. Select DATA PROTECTION > Device Groups.
   3. Click the TimeFinder Clone tab to open the TimeFinder Clone list view.
   4. Do one of the following, depending on whether you want to perform the operation at the group level or pair level:
      
      **Group level:**
      
      Select a group, click 📊, and select Terminate.

      **Pair level:**
      

a. Select a group and click to open its Details view.
b. Click on the number next to Clone Pairs.
c. Select one or more pairs, click , and select Terminate.

5. If performing the operation at the group level, select the type of source volumes (Source Type) and the type of target volumes Target Type.

6. To attach Session Options to the operation, click Advanced Options, and select any number of Clone copy session options on page 369.

7. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

**Viewing clone pairs**

**Procedure**

1. Select the storage system.
2. Select DATA PROTECTION > Device Groups.
3. Click the TimeFinder Clone tab to open the TimeFinder Clone list view.
4. Select a group and click to open its Details view.
5. Click on the number next to Clone Pairs.

The following properties display:

- **Source Volume**—The name of the source volume.
- **Source LDev**—The logical name of the source volume.
- **Target Volume**—The name of the target volume.
- **Target LDev**—The logical name of the target volume.
- **State**—The session state of the pair.

The following controls are available:

- Viewing clone pair details on page 369
- Create Pairs—Creating clone copy sessions on page 359
- Activate—Activating clone copy sessions on page 361
- Recreate—Recreating clone copy sessions on page 362
- Split—Splitting clone volume pairs on page 366
- Restore—Restoring data from target volumes on page 365
- Set Mode—Modifying clone copy sessions on page 364
- Create Snapshot—Creating clone snapshots on page 363
- Terminate—Terminating clone copy sessions on page 367
Viewing clone pair details

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > Device Groups.
3. Click the TimeFinder Clone tab to open the TimeFinder Clone list view.
4. Select a group, and click to open its Details view.
5. Click on the number next to Clone Pairs.
6. Select a pair and click to open its Details view.

The following properties display:

- **Source Volume** — The name of the source volume.
- **Source LDev** — The logical name of the source volume.
- **Target Volume** — The name of the target volume.
- **Target LDev** — The logical name of the target volume.
- **State** — The session state of the pair.
- **CDGP** — (this property is displayed by clicking). Flags specific to the pair session in the form:
  (C): X = The background copy setting is active for this pair.
  . = The background copy setting is not active for this pair.
  (G): X = The Target volume is associated with a group.
  . = The Target volume is not associated with a group.
  (D): X = The Clone session is a differential copy session.
  . = The Clone session is not a differential copy session.
  (P): X = The precopy operation has completed one cycle.
  . = The precopy operation has not completed one cycle.
- **Percent Copied** — The percentage of copying that is complete. (this property is displayed by clicking).
- **Timestamp** — Date and time the pair was created. (this property is displayed by clicking).

Clone copy session options

The following table describes the TimeFinder/Clone session options:
<table>
<thead>
<tr>
<th>Session option</th>
<th>Description</th>
<th>Available with action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both Sides</td>
<td>Activates all locally and remotely associated clone pairs in an SRDF group.</td>
<td>Activate, Establish</td>
</tr>
<tr>
<td>Concurrent</td>
<td>Performs the action for an additional clone pair in a group.</td>
<td>Create, Recreate, Establish, Activate, Verify</td>
</tr>
<tr>
<td>Consistent</td>
<td>Creates clone copies that are consistent with the database up to the point in time that the activation occurs. It suspends writes to the source volumes during the activation.</td>
<td>Activate</td>
</tr>
<tr>
<td>Copy</td>
<td>Creates a full data copy. By omitting this option (default), the volume pair state will be in the CopyOnAccess state when activated. Actual copying of the data is deferred until either tracks on the source volume are written to, or tracks on the target volume are read or written. This option is only applicable when the target volume is a regular volume (not a virtual volume).</td>
<td>Create, Establish</td>
</tr>
<tr>
<td>Differential</td>
<td>Used with either the Copy or Precopy option to create an SDDF session for maintaining changed track information. It must be used when creating copy sessions on which you plan on issuing a Restore action.</td>
<td>Create, Establish</td>
</tr>
<tr>
<td>Force</td>
<td>Overrides any restrictions and forces the operation, even though one or more paired volumes may not be in the expected state. Use caution when checking this option because improper use may result in data loss.</td>
<td>Create, Establish, Activate, Restore, Split, Terminate</td>
</tr>
<tr>
<td>Not Ready</td>
<td>Sets the target volumes as Not Ready.</td>
<td>Establish, Activate, Restore</td>
</tr>
<tr>
<td>Optimize</td>
<td>Optimizes volume pairings across the local storage system without regard for whether the volumes belong to different RDF (RA) groups. For remote volumes, use the Optimize Rag option.</td>
<td>Create, Establish</td>
</tr>
<tr>
<td>Optimize Rag</td>
<td>Uses optimization rules to create remote BCV pairs from volumes within the same RDF (RA) group on a storage system.</td>
<td>Create, Establish</td>
</tr>
<tr>
<td>Precopy</td>
<td>Copies tracks in the background before the clone session is activated. Used with the create and recreate actions.</td>
<td>Create</td>
</tr>
</tbody>
</table>
Table 5 TimeFinder/Clone session options (continued)

<table>
<thead>
<tr>
<th>Session option</th>
<th>Description</th>
<th>Available with action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Recreate</td>
</tr>
<tr>
<td>Restored</td>
<td>With the verify command, verifies that the copy sessions are in the Restored state. With the terminate command, terminates a restored VP Snap session.</td>
<td>Verify Terminate</td>
</tr>
<tr>
<td>Star</td>
<td>Targets the action at volumes in SRDF/Star mode.</td>
<td>Create Recreate Establish Activate Restore Split Terminate</td>
</tr>
<tr>
<td>Symforce</td>
<td>Forces an operation on the volume pair including pairs that would be rejected. Use caution when checking this option because improper use may result in data loss.</td>
<td>Terminate</td>
</tr>
</tbody>
</table>

Understanding TimeFinder/Snap operations

TimeFinder/Snap operations enable you to create and manage copy sessions between a source volume and multiple virtual target volumes. When you activate a virtual copy session, a point-in-time copy of the source volume is immediately available to its host through the corresponding virtual volume. Virtual volumes consume minimal physical disk storage because they contain only the address pointers to the data that is stored on the source volume or in a pool of SAVE volumes. SAVE volumes are storage volumes that are not host-accessible and can only be accessed through the virtual volumes that point to them. SAVE volumes provide pooled physical storage for virtual volumes.

Snapping data to a virtual volume uses a copy-on-first-write technique. Upon a first write to the source volume during the copy session, Enginuity copies the preupdated image of the changed track to a SAVE volume and updates the track pointer on the virtual volume to point to the data on the SAVE volume.

The attached host views the point-in-time copy through virtual volume pointers to both the source volume and SAVE volume, for as long as the session remains active. If you terminate the copy session, the copy is lost, and the space associated with the session is freed and returned to the SAVE volume pool for future use.

**Note**

TimeFinder operations are not supported directly on storage systems running HYPERMAX OS 5977 or higher. Instead, they are mapped to their TimeFinder/SnapVX equivalents.

The following are the basic actions performed in a TimeFinder/Snap operation:

- Create—Creates the relationship between the source volume and the virtual target volume.
• Activate—Makes the virtual target volume available for read/write access and starts the copy-on-first-write mechanism.
• Recreate—Creates a new point-in-time copy.
• Restore—Copies tracks from the virtual volume to the source volume or another volume.
• Terminate—Causes the target host to lose access to data pointed to by the virtual volume.

For more information about TimeFinder concepts, refer to the Solutions Enabler TimeFinder Family CLI Product Guide and the TimeFinder Family Product Guide.

Managing TimeFinder/Snap sessions

Before you begin

TimeFinder/Snap requires Enginuity version 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Snap operations are mapped to their TimeFinder/SnapVX equivalents.

The TimeFinder/Snap dashboard provides you with a single place to monitor and manage TimeFinder/Snap sessions on a storage system.

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > Device Groups.
3. Click the TimeFinder Snap tab to open the TimeFinder Snap list view.
   The following properties display:
   • Device Group—Groups containing volumes using TimeFinder/Snap.
   • Standard—The number of standard volumes in the group.
   • BCV—The number of BCVs in the group.
   • VDEV—The number of virtual volumes in the group.
   • Target—The number of target volumes in the group.
   • State—The session state of the pair.
   • Group Type—The type of group. Property values: Regular, R1, R2, or R21.
   • Group Valid—Whether the group is valid or invalid.

Click and click the number next to Snap Pairs to view the associated snap pairs (see Viewing snap pairs on page 380).

Click to click the number next Storage Groups to view the associated storage groups.

The following controls are available:
• Create Pairs—Creating virtual copy sessions on page 373
• Activate—Activating virtual copy sessions on page 374
• Terminate—Terminating virtual copy sessions on page 379
• Restore—Restoring virtual copy sessions on page 378
• Recreate—Recreating virtual copy sessions on page 377
Creating virtual copy sessions

Virtual copy sessions define and set up the volumes for snap operations.

The Create action defines the copy session requirements and sets the track protection bitmap on the source volume to protect all tracks and detect which tracks are being accessed by the target host or written to by the source host. The target virtual volume remains Not Ready to its host and placed on hold status for copy session usage. This prevents other control operations from using the volume. The volume pair state transitions from CreateInProg to Created when complete. The virtual data becomes accessible to its host when the copy session is activated.

**Note**

- TimeFinder/Snap requires Enginuity version 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Snap operations are mapped to their TimeFinder/SnapVX equivalents.
- You can create up to 128 copies of a source volume to various virtual target volumes. To do this, enable the following SYMCLI environment variable: SYMCLI_MULTI_VIRTUAL_SNAP = ENABLED.
- A source volume can concurrently copy data to as many as 15 target volumes at one time. Each target requires a separate copy session.
- For storage systems running Enginuity 5876, you can:
  - Use this feature to create multivirtual snap sessions from thin volumes.
  - Use RDF2 async volumes as source volumes.
  - Create a snap pair from a clone target in the Split state.
- To create a snap session of an R2 volume that is in an SRDF/A session, volume level pacing must be enabled on the R1 side.
- Data Domain volumes are not supported.

To create virtual copy sessions:

**Procedure**

1. Select the storage system.
2. Select DATA PROTECTION > Device Groups.
3. Click the TimeFinder Snap tab to open the TimeFinder Snap list view.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level.

   **Group level:**
   - Select a group, and click Create Pairs.
   - Select a source type and a target type.

**Pair level:**
a. Select a group, and click  to open its Details view.

b. Click on the number next to SnapPairs.

c. Select one or more pairs and click Create Pairs.

d. Click Set Pairs to open the Set Pairs dialog box.

e. Select a source volume and a target volume, and click Add to make them a pair. Repeat this step as required.

f. Click OK to return to the Create Sessions dialog box.

5. Click Advanced Options to set the advanced options as described next.

   - Select a Pairing Type. If you are not using the Pairing Type option, leave this field set to None.
   - To attach Session Options to the operation, select any number of options.

6. Do one of the following:

   - Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

**Activating virtual copy sessions**

Activating the copy session starts the copy-on-first-write mechanism and places the target volume in the Read/Write state. The target host can access the copy and has access to data on the source host until the copy session is terminated.

---

**Note**

TimeFinder/Snap requires Enginuity version 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Snap operations are mapped to their TimeFinder/SnapVX equivalents.

To activate virtual copy sessions:

**Procedure**

1. Select the storage system.

2. Select DATA PROTECTION > Device Groups.

3. Click the TimeFinder Snap tab to open the TimeFinder Snap list view.

4. Do the following, depending on whether you want to perform the operation at the group level or pair level:

   Group level:
   
   - Select a group, and click Activate.
   - Select a source type and a target type.

   Pair level:
   
   a. Select a group, and click  to open its Details view.
   
   b. Click on the number next to Clone Pairs.
Creating snapshots

Before you begin

TimeFinder/Snap requires Enginuity OS 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Snap operations are mapped to their TimeFinder/SnapVX equivalents.

This procedure explains how to create and immediately activate virtual copy sessions.

To create a snapshot:

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > Device Groups.
3. Click the TimeFinder Snap tab to open the TimeFinder Snap list view.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level:

   Group level:
   
   Select a group, click , and select Create Snapshot.
   Select a source type and a target type.

   Pair level:
   
   a. Select a group, and click to open its Details view.

   b. Select one or more pairs, click , and select Create Snapshot.

5. Click Advanced Options to set the advanced options.

Setting Advanced options:

a. Select one of the following for Pairing Type. If you are not using the Pairing Type option, leave this field set to None.

   • Use Exact Pairs—Allows the system to pair up the volumes in the exact order that they were added to the group.

   • Use Optimized Pairs—Optimizes volume pairings across the local storage system without regard for whether the volumes belong to different RDF (RA) groups.

b. To attach Session Options to the operation, select Advanced Options and select any number of options.
6. Do one of the following:
   - Expand **Add to Job List** and click **Add to Job List Now** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**Duplicating virtual copy sessions**

The duplicate TimeFinder/Snap feature allows you to duplicate a point-in-time copy of a virtual volume that is paired in a previously activated snap session to another virtual volume. This second point-in-time copy session actually resides with the source volume of the original snap session and is charged as part of the maximum number of sessions for that source volume. The duplicate snap is an actual copy of the virtual volume to another virtual volume.

**Before you begin:**
- TimeFinder/Snap requires Enginuity version 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Snap operations are mapped to their TimeFinder/SnapVX equivalents.
- Snap create and activate operations cannot be mixed between normal snap sessions and duplicate snap sessions within the same operation.
- The maximum number of duplicated sessions in the Created state is two
- When a duplicate session is in the Created state, the original session cannot be terminated or recreated until the duplicate session is activated.

**To duplicate virtual copy session:**

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > Device Groups**.
3. Click the **TimeFinder Snap** tab to open the **TimeFinder Snap** list view.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - **Group level:**
     - Select a group, click , and select **Duplicate**.
     - Select a source type and a target type.
   - **Pair level:**
     - Select a group, and click  to open its **Details** view.
     - Select one or more pairs, click , and select **Duplicate**.
5. To attach Session Options to the operation, select **Advanced Options** and select any number of options.
6. Do one of the following:

- Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
- Expand Add to Job List, and click Run Now to perform the operation now.

**Recreating virtual copy sessions**

**Before you begin**

- TimeFinder/Snap requires Enginuity version 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Snap operations are mapped to their TimeFinder/SnapVX equivalents.

- For storage systems running Enginuity 5876 or higher, you can use this feature to recreate multivirtual snap sessions from thin and standard volumes.

- This feature can only be used on sessions that have been previously activated.

The snap recreate action allows you to recreate a snap session on an existing VDEV in order to prepare to activate a new point-in-time image.

**Procedure**

1. To recreate virtual copy sessions:
   1. Select the storage system.
   2. Select DATA PROTECTION > Device Groups.
   3. Click the TimeFinder Snap tab to open the TimeFinder Snap list view.
   4. Do the following, depending on whether you want to perform the operation at the group level or pair level:

      **Group level:**

      Select a group, click ..., and select Recreate.
      Select a source type and a target type.

      **Pair level:**

      a. Select a group, and click 1 to open its Details view.
      b. Select one or more pairs, click ..., select Recreate to open the Recreate dialog box.

5. To attach Session Options to the operation, select Advanced Options and select any number of options.

6. Do one of the following:

- Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
- Expand Add to Job List, and click Run Now to perform the operation now.
Restoring virtual copy sessions

Before you begin

- TimeFinder/Snap requires Enginuity version 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Snap operations are mapped to their TimeFinder/SnapVX equivalents.
- With Enginuity 5876 or higher, you can use ORS control volumes as snap restore volumes when the volumes are in Push sessions and in the ORS Copied state.
- With Enginuity 5876.159.102 and higher, you can perform a TimeFinder/Snap restore to a TimeFinder/Clone target. For example, volumes in an A > B > C cascaded session (where A > B is TimeFinder/Clone and B > C is TimeFinder/Snap) can copy data from volume C to volume A (via volume B). You can complete this operation without terminating the TimeFinder/Clone session, or any existing TimeFinder/Snap sessions off of the TimeFinder/Clone target. This feature is known as Persistent Restore to Target (PTT).

The following types of restore operations can be performed for virtual copy sessions:

- Incremental restore back to the original source volume.
- Incremental restore to a BCV, which has been split from its original standard source volume but maintains the incremental relationship with the source.
- Full restore to any standard or split BCV outside of the existing copy session. The target volume of the restore must be of the same size and emulation type as the source volume.

Procedure

1. To restore virtual copy sessions:

   1. Select the storage system.
   2. Select DATA PROTECTION > Device Groups.
   3. Click the TimeFinder Snap tab to open the TimeFinder Snap list view.
   4. Do the following, depending on whether you want to perform the operation at the group level or pair level:

      **Group level:**
      
      Select a group, click , and select Restore.
      Select a source type and a target type.

      **Pair level:**

      a. Select a group, and click to open its Details view.
      b. Select one or more pairs, click , and select Restore to open the Restore dialog.

5. Select the Restore Type.

   Restore operations can be used to copy target data to another device (full restore), or back to the original source device (incremental restore). In the case of a full restore, the original session terminates and a copy session to the target of the restore starts. In the case of an incremental restore, the original session
copy direction is reversed and changed data is copied from the target device to the source device. Restore operations require that the original session is differential and the source device is fully copied.

6. If performing a Full restore, click Set Pairs to open the Set TimeFinder Snap Pairs dialog from which you can select the volumes to use in the operation.

7. To attach Session Options to the operation, select Advanced Options and select any number of options.

8. Do one of the following:
   - Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Terminating virtual copy sessions

Before you begin

TimeFinder/Snap requires Enginuity version 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Snap operations are mapped to their TimeFinder/SnapVX equivalents.

This procedure explains how to terminate an active virtual copy session at any time.

Procedure

1. To terminate virtual copy sessions:
   1. Select the storage system.
   2. Select DATA PROTECTION > Device Groups.
   3. Click the TimeFinder Snap tab to open the TimeFinder Snap list view.
   4. Do one of the following, depending on whether you want to perform the operation at the group level or pair level:
      - **Group level:**
        Select a group and select Terminate.
        Select a source type and a target type.
      - **Pair level:**
        a. Select a group, and click \(\text{ }\) to open its Details view.
        b. Select one or more pairs and select Terminate.
   5. To attach Session Options to the operation, select Advanced Options and select any number of options.
   6. Do one of the following:
      - Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
      - Expand Add to Job List, and click Run Now to perform the operation now.
Viewing snap pair details

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > Device Groups.
3. Click the TimeFinder Snap tab to open the TimeFinder Snap list view.
4. Select a group, and click to open its Details view.
5. Click on the number next to Snap Pairs.
6. Select a pair and click to open its Details view.
   The following properties display:
   - **Source Volume** — Name of the source volume.
   - **Source LDev** — Logical name of the source volume.
   - **Target Volume** — Name of the target volume.
   - **Target LDev** — Logical name of the target volume.
   - **State** — Session state of the pair.
   - **Snap Pool** — The name of the snap pool.
   - **Percent Copied** — The percentage of copying that is complete.
   - **Timestamp** — Date and time the snapshot was created.

Viewing snap pairs

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > Device Groups.
3. Click the TimeFinder Snap tab to open the TimeFinder Snap list view.
4. Select a group and click to open its Details view.
5. Click on the number next to Snap Pairs.
   The following properties display:
   - **Source Volume** — The name of the source volume.
   - **Target Volume** — The name of the target volume.
   - **Source LDev** — The logical name of the source volume.
   - **Target LDev** — The logical name of the target volume.
   - **State** — The session state of the pair.
   The following controls are available:
   - **Viewing snap pair details** on page 380
   - **Create Pairs** — Creating virtual copy sessions on page 373
   - **Activate** — Activating virtual copy sessions on page 374
Snap session options

The following table describes the TimeFinder/Snap session options:

**Table 6 TimeFinder/Snap session options**

<table>
<thead>
<tr>
<th>Session option</th>
<th>Description</th>
<th>Available with action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistent</td>
<td>Causes the source and VDEV pairs to be consistently activated.</td>
<td>Activate</td>
</tr>
<tr>
<td>Duplicate</td>
<td>Indicates that the action is being performed on a duplicate virtual copy session (that is, on a VDEV to a VDEV pair).</td>
<td>Create, Activate, Terminate</td>
</tr>
<tr>
<td>Force</td>
<td>Overrides any restrictions and forces the operation, even though one or more paired volumes may not be in the expected state. Use caution when checking this option because improper use may result in data loss.</td>
<td>Create, Activate, Terminate, Restore, Incremental Restore</td>
</tr>
<tr>
<td>Not Ready</td>
<td>Sets the VDEVs as Not Ready.</td>
<td>Activate, Restore, Incremental Restore</td>
</tr>
<tr>
<td>Restore</td>
<td>Must be used with the terminate action when terminating a restore session.</td>
<td>Terminate</td>
</tr>
<tr>
<td>Star</td>
<td>Indicates that the action is being performed on a volume that is in SRDF/Star mode.</td>
<td>Create, Activate, Recreate, Terminate, Restore</td>
</tr>
<tr>
<td>SymForce</td>
<td>Forces an operation on the volume pair including pairs that would be rejected. Use caution when checking this option because improper use may result in data loss.</td>
<td>Terminate</td>
</tr>
</tbody>
</table>
Set TimeFinder Snap Pairs dialog box

When creating, activating, restoring, or establishing a TimeFinder/Snap pairs, this dialog box allows you to define the pairs used in the operation.

Procedure

1. To define the pairs:
   1. Select the Source Volumes and Target Volumes and click Add to move them to the Selected Pairs table.
   2. Click OK.

Managing TimeFinder/Mirror sessions

Before you begin

- TimeFinder/Mirror requires Enginuity version 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Mirror operations are mapped to their TimeFinder/SnapVX equivalents.
- TimeFinder operations are not supported on ORS control volumes on storage systems running HYPERMAX OS 5977 or higher.

The TimeFinder/Mirror dashboard provides you with a single place to monitor and manage TimeFinder/Mirror sessions on a storage system.

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > Device Groups.
3. Click the TimeFinder Mirror tab to open the TimeFinder Mirror list view.

The following properties display:

- **Device Group**—Groups containing volumes using TimeFinder/Mirror.
- **Standard**—The number of standard volumes in the group.
- **BCVs**—The number of BCVs in the group.
- **State**—The combined state of the sessions in the group. If all the sessions are in the same state, then that state appears; otherwise, **Mixed** appears.
- **Group Type**—The type of group. Property values are: RDF1, RDF2, RDF21, and Regular
- **Group Valid**—Indicates whether the group is valid. Property values are: Yes and No.

Click and click the number next to Mirror Pairs to view the associated mirror pairs (see Viewing snap pairs on page 380).

Click to click the number next Storage Groups to view the associated storage groups.

The following controls are available:

- **Create Snapshot**—Creating Snapshots on page 383
- **Restore**—Restoring BCV pairs on page 384
- **Split**—Splitting BCV pairs on page 385
Creating Snapshots

Before you begin

- TimeFinder/Mirror requires Enginuity version 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Mirror operations are mapped to their TimeFinder SnapVX equivalents.
- Data Domain volumes are not supported.

Procedure

1. To create snapshots:
   1. Select the storage system.
   2. Select **DATA PROTECTION > Device Groups**.
   3. Click the **TimeFinder Mirror** tab to open the **TimeFinder Mirror** list view.
   4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
      - **Group level**:
        - Select a device group, and click **Create Snapshot** to open the **Create Snapshot - Mirror Pair** dialog.
      - **Pair level**:
        a. Select a device group, and click **Mirror Sessions List** to open its **Mirror Sessions List** view.
        b. Select one or more pairs, click **Create Snapshot** to open the **Create Snapshot - Mirror Pair** dialog.
   5. Select a **Snapshot Type**:
      - **Incremental**—Copies to the BCV volume only the new data that was updated on the standard volume while the BCV pair was split.
      - **Full**—Copies the entire contents of the standard volume to the BCV volume.
   6. If performing a full establish at the pair level, do the following:
      a. Click **Set Pairs** to open the **Set TimeFinder Mirror Pairs** dialog.
      b. Select a **Source Volume** and a **Target Volume**, and click **Add** to make them a pair. Repeat this step as required.
      c. Click **OK** to return to the **Create Snapshot - Mirror Pair** dialog.
   7. To attach session options to the operation, select **Advanced Options** and select any number of options.
   8. Do one of the following:
      - Expand **Add to Job List** and click **Add to Job List Now** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
      - Expand **Add to Job List**, and click **Run Now** to perform the operation now.
Restoring BCV pairs

Before you begin

TimeFinder/Mirror requires Enginuity version 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Mirror operations are mapped to their TimeFinder/SnapVX equivalents.

This procedure explains how to copy data from the BCV volumes to the standard volumes.

Procedure

1. To restore BCV pairs:
   1. Select the storage system.
   2. Select DATA PROTECTION > Device Groups.
   3. Click the TimeFinder Mirror tab to open the TimeFinder Mirror list view.
   4. Do the following, depending on whether you want to perform this operation at the group level or the pair level:
      
      **Group level:**
      Select a device group, and click Restore.
      
      **Pair level:**
      a. Select a device group, and click to open the Mirror Sessions List view.
      b. Select one or more pairs, and click Restore.
   
   5. Select a Restore Type:
      
      - **Incremental**—Copies to the standard volume only the new data that was updated on the BCV volume while the BCV pair was split.
      - **Full**—Copies the entire contents of the BCV volume to the standard volume.
   
   6. If performing a full establish at the pair level, do the following:
      
      a. Click Set Pairs to open the Set TimeFinder Mirror Pairs dialog.
      b. Select a Source Volume and a Target Volume, and click Add to make them a pair. Repeat this step as required.
      c. Click OK to return to the Restore - Mirror Pair dialog.
   
   7. To attach session options to the operation, select Advanced Options and select any number of options.
   
   8. Do one of the following:
      
      - Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
      - Expand Add to Job List, and click Run Now to perform the operation now.
Splitting BCV pairs

Before you begin
TimeFinder/Mirror requires Enginuity version 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Mirror operations are mapped to their TimeFinder/SnapVX equivalents.

This procedure explains how to split paired volumes to where each holds separate valid copies of the data.

Procedure
1. To split BCV pairs:
   1. Select the storage system.
   2. Select DATA PROTECTION > Device Groups.
   3. Click the TimeFinder Mirror tab to open the TimeFinder Mirror list view.
   4. Do the following, depending on whether you want to perform this operation at the group level or the pair level:
      Group level:
      Select a device group, and click Split.
      Pair level:
      a. Select a device group, and click to open the Mirror Sessions List view.
      b. Select one or more pairs, and click Split.
   5. To attach session options to the operation, select Advanced Options and select any number of options.
   6. Do one of the following:
      * Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
      * Expand Add to Job List, and click Run Now to perform the operation now.

Cancelling BCV pairs

TimeFinder/Mirror requires Enginuity version 5876. On storage systems running HYPERMAX OS 5977 or higher, TimeFinder/Mirror operations are mapped to their TimeFinder/SnapVX equivalents.

To cancel the relationship between volumes in a BCV pair:

Procedure
1. Select the storage system.
2. Select Data Protection > TimeFinder > TimeFinder/Mirror to open the TimeFinder/Mirror dashboard.
3. Do the following, depending on whether you want to perform this operation at the group level or the pair level.
   Group level:
• Select a device group and click Cancel.

Pair level:

a. Select a device group and click  to open the Mirror Sessions List view.

b. Select one or more pairs and click Cancel.

4. To attach session options to the operation, select Advanced Options and select any number of options.

5. Do one of the following:

• Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.

• Expand Add to Job List, and click Run Now to perform the operation now.

Viewing mirror pairs

Procedure

1. Select the storage system.

2. Select DATA PROTECTION > Device Groups.

3. Click the TimeFinder Mirror tab to open the TimeFinder Mirror list view.

4. Select a group and click  to open its Details view.

5. Click on the number next to Mirror Pairs.

The following properties display:

• Source Volume—The hexadecimal ID of the source volume.

• Source LDev—The logical name of the source volume.

• Target Volume—The hexadecimal ID of the target volume.

• Target LDev—The logical name of the target volume.

• Pair State—The session state of the pair.

• Timestamp—Date and time the snapshot was created.

The following controls are available:

• —Viewing mirror pair details on page 386

• Create Snapshot—Creating Snapshots on page 383

• Restore—Restoring BCV pairs on page 384

• Split—Splitting BCV pairs on page 385

• Cancel—Cancelling BCV pairs on page 385

Viewing mirror pair details

Procedure

1. Select the storage system.
2. Select **Data Protection** > **TimeFinder** > **TimeFinder/Mirror** to open the **TimeFinder/Mirror** view.

3. Select a device group, and click ![icon] to open its **Mirror Pairs List** view.

4. Select a pair and click ![icon] to open its Details view.

5. Click on the number next to **Mirror Pairs**.

6. Select a pair and click ![icon] to open its Details view.

- **Group**—Group name.
- **Source Volume**—Hexadecimal ID of the source volume.
- **Source LDev**—Logical name of the source volume.
- **Target Volume**—Hexadecimal ID of the target volume.
- **Target LDev**—Logical name of the target volume.
- **State**—Session state of the pair.
- **Percent Copied**—Percentage of copying complete.

**TimeFinder/Mirror session options**

The following table describes the TimeFinder/Mirror session options:

<table>
<thead>
<tr>
<th>Session option</th>
<th>Description</th>
<th>Available with action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bypass</td>
<td>Bypasses the storage system's exclusive locks for the local or remote array during mirror operations.</td>
<td>Split</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Full Restore</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Incremental Restore</td>
</tr>
<tr>
<td>Consistent</td>
<td>Causes the standard volumes being managed to be consistently split. Cannot be combined with the Instant option.</td>
<td>Split</td>
</tr>
<tr>
<td>Differential</td>
<td>Indicates that the split operation should initiate a differential data copy from the first mirror set member to the rest of the BCV mirror set members when the BCV pair split is done.</td>
<td>Split</td>
</tr>
<tr>
<td>Force</td>
<td>Overrides any restrictions and forces the operation, even though one or more paired volumes may not be in the expected state. Use caution when checking this option because improper use may result in data loss.</td>
<td>Full Establish</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Incremental Establish</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Split</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Full Restore</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Incremental Restore</td>
</tr>
</tbody>
</table>
### Table 7 TimeFinder/Mirror session options (continued)

<table>
<thead>
<tr>
<th>Session option</th>
<th>Description</th>
<th>Available with action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Differential</td>
<td>Used with either the Copy or Precopy option to create an SDDF session for maintaining changed track information. This must be used when creating copy sessions on which you plan on issuing a Restore action.</td>
<td>Create Establish</td>
</tr>
<tr>
<td>Force</td>
<td>Overrides any restrictions and forces the operation, even though one or more paired volumes may not be in the expected state. Use caution when checking this option because improper use may result in data loss.</td>
<td>Create Establish Activate Restore Split Terminate</td>
</tr>
<tr>
<td>Not Ready</td>
<td>Sets the target volumes as Not Ready. Upon completion of a split action, the target volumes are set as Not Ready. When a restore is initiated, the standard volumes are set as Not Ready.</td>
<td>Split Full Restore Incremental Restore</td>
</tr>
<tr>
<td>Optimize</td>
<td>Optimizes volume pairings across the local storage system without regard for whether the volumes belong to different RDF (RA) groups. For remote volumes, use the Optimize Rag option.</td>
<td>Full Establish</td>
</tr>
<tr>
<td>Optimize Rag</td>
<td>Uses optimization rules to create remote BCV pairs from volumes within the same RDF (RA) group on a Symmetrix system.</td>
<td>Full Establish</td>
</tr>
<tr>
<td>Protbcvest</td>
<td>Applies to two-way mirrored BCV volumes. Moves all mirrors of the BCV volume to join the mirrors of the standard volume.</td>
<td>Full Establish Incremental Establish</td>
</tr>
<tr>
<td>Protect</td>
<td>Indicates that the BCV should be write-protected before initiating a restore operation.</td>
<td>Split Full Restore Incremental Restore</td>
</tr>
<tr>
<td>Remote</td>
<td>Applicable only for split operations on a BCV RDF1 volume, or a restore operation from a BCV to a STD RDF2 volume. If this option is not specified, then the mode</td>
<td>Split Full Restore Incremental Restore</td>
</tr>
</tbody>
</table>
### Table 7 TimeFinder/Mirror session options (continued)

<table>
<thead>
<tr>
<th>Session option</th>
<th>Description</th>
<th>Available with action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>defaults to not propagate the data to the remote mirror of the RDF volume.</td>
<td></td>
</tr>
<tr>
<td>Reverse</td>
<td>With a split operation, initiates a reverse data copy from one or more fixed BCV mirrors to the first (moving) mirror of the BCV upon the completion of the split operation. With an establish or restore operation, requests a verification check that the BCV's fixed mirror has valid data. If at establish or restore time you anticipate a need to perform future BCV reverse split operations, you must apply a reverse establish or restore so that no invalid tracks on the fixed BCV mirror become used.</td>
<td>Full Establish, Incremental Establish, Split, Full Restore, Incremental Restore</td>
</tr>
<tr>
<td>Star</td>
<td>Targets the action at volumes in SRDF/Star mode.</td>
<td>Full Establish, Restore, Split, Cancel</td>
</tr>
<tr>
<td>SymForce</td>
<td>Forces an operation on the volume pair including pairs that would be rejected. Use caution when checking this option because improper use may result in data loss.</td>
<td>Full Establish, Incremental Establish, Split, Full Restore, Incremental Restore</td>
</tr>
</tbody>
</table>

### Setting TimeFinder/Mirror pairs

When establishing or restoring TimeFinder/Mirror pairs, this dialog box allows you to define the pairs used in the operation.

**Procedure**

1. To define the pairs:
   1. Select the **Source Volumes** and **Target Volumes** and click **Add** to move them to the **Selected Pairs** table.
   2. Click **OK**.

### Managing TimeFinder SnapVX

TimeFinder SnapVX is a local replication solution designed to non-disruptively create point-in-time copies (snapshots) of critical data. TimeFinder SnapVX creates...
snapshots by storing changed tracks (deltas) directly in the Storage Resource Pool of the source volume. With TimeFinder SnapVX, you do not need to specify a target volume and source/target pairs when you create a snapshot. If there is ever a need for the application to use the point-in-time data, you can create links from the snapshot to one or more target volumes. If there are multiple snapshots and the application needs to find a particular point-in-time copy for host access, you can link and relink until the correct snapshot is located.

The TimeFinder/SnapVX view provides a single place from you can manage TimeFinder SnapVX snapshots and their associated storage groups.

secure snaps—These are Snap VX snapshots that can't be deleted before the expiry time set by the StorageAdmin. Users can create a Secure snapshot or set Secure status on an existing snapshot. Once the retention time has expired, the Secure snapshot will be automatically terminated unless there is a linked device or an active restore session is ongoing. The expiry time on a Secure snapshot can be changed but the time can only be moved forward from the expiry time originally set. This feature requires an array running the HYPERMAX OS 5977 Q1 2017 Service Release or higher.

Note

Secure snapshots may only be terminated after they expire or by customer-authorized support. Please refer to Knowledge Base article 498316 for additional information.

Time To Live — From Unisphere 8.4 onwards, users can now specify a SnapVX snapshot's time to live in hours as well as days. Previously only days could be specified.

Before you begin

- The storage system must be running HYPERMAX OS 5977 or higher.
- TimeFinder/SnapVX operations are not supported on working ProtectPoint snapshots. TimeFinder/SnapVX operations are, however, supported to help repair failing ProtectPoint snapshots.

To access the TimeFinder/SnapVX view:

1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups and click on the SnapVX tab to open the TimeFinder/SnapVX view.

TimeFinder/SnapVX view

The following properties display:

- **Storage Groups**—Storage group associated with the snapshot.
- **Capacity**—Total capacity of the storage group.
- **Snapshots**—Number of snapshots associated with storage group.
- **Last Creation Time**—Date/time the most recent snapshot was created.

The following controls are available:

- **Create**—Creating snapshots on page 391
- **Modify**—Modifying TimeFinder SnapVX snapshots on page 393
- **Restore**—Restoring snapshots on page 397
- **Link**—Linking to snapshots on page 394
Creating snapshots

Before you begin

- To perform this operation, you must be a StorageAdmin.
- The storage system must be running HYPERMAX OS 5977 or higher.
- The maximum number of snapshots per source volume is 256.
- Snapshots off of linked targets are permitted only after the volume is fully defined.
- The Secure snapshot feature requires the HYPERMAX OS 5977 Q1 2017 Service Release or higher.
- You can perform this operation from the following: TimeFinder/SnapVX view, Storage view, or Data Protection dashboard. Depending on the location from which you are performing this operation, some of the following steps may not apply.

This procedure explains how to create TimeFinder SnapVX snapshots.

Note

Secure snapshots may only be terminated after they expire or by customer-authorized support. Please refer to Knowledge Base article 498316 for additional information.

To create snapshots:

Procedure

1. Select the storage system.
2. Do the following, depending on the location from which you want to perform the procedure:
   - TimeFinder/SnapVX view:
     a. Select DATA PROTECTION > Storage Groups and click on the SnapVX tab to open the TimeFinder/SnapVX view.
     b. Select a storage group and click Create to open the Create Snapshot dialog.
   - Storage Groups view:
     a. Select STORAGE > Storage Groups to open the Storage Groups view.
     b. Select the storage group and click Protect to open the Protect Storage Group wizard.
     c. If not already selected, select Point In Time Protection Using SnapVX.
     d. Click Next.
   - Data Protection dashboard:
a. Select **Replication** to open the **Data Protection** dashboard.

b. Click **CREATE SNAPSHOT**.

3. Select whether to create a new snapshot or reuse an existing snapshot.

4. If reusing an existing snapshot, select it from the list. When using this method, assigns generation numbers to the snapshots in the order in which they were created (latest = generation 0, previous incrementing by one). This naming convention allows you to differentiate point-in-time copies of the same volumes.

   **CAUTION**

   It is the users responsibility to manage the snapshot names being used. If snapshots are being applied to parent and child storage groups individually, care should be taken to never use the same snapshot name at different levels of the storage group construct. The same applies if some of the volumes are in multiple storage groups being snapshotted; the same snapshot names should also be avoided across the different storage groups.

5. Choose an expiry type from the drop-down menu. The options are:

   - **None** — If no automatic expiry time is set the snapshot will need to be manually deleted.

   - **Time to live** — Once the time you set has expired, the snapshot will be automatically terminated, provided that it is not linked to any target volumes. If an expired snapshot is linked, the system waits until the last link has been removed before terminating the snapshot. To override this behavior and terminate the snapshot, select the **Force** option under the **Advanced Options** link.

6. If you chose **Time to live** as the protection type, use the **Days** and **Hours** drop-down menus to set the snapshot's expiry time.

7. Click **Advanced Options** to see the advanced options. They are:

   - **Enable Secure Snaps** — Select this option to set a Secure snapshot that can't be deleted before the expiry time you set. Once you tick the **Secure** checkbox the **Days** and **Hours** drop-down menus will appear and you can use these to set the snapshot's expiry time. Once the retention time has expired, the Secure snapshot will be automatically terminated unless there is a linked device or an active restore session is ongoing. StorageAdmins can choose to move the retention time forward.

   - **Both Sides** — Select this option to create a snapshot at both sides of an SRDF pairing simultaneously. The following limitations apply:

     - A consistent snapshot on both sides is only allowed when the SRDF pairs exist on the source Storage Group volumes in Synchronous RDF mode and the SRDF pair state is Synchronous.

     - A consistent snapshot on both sides is only allowed when the SRDF pairs are in Active SRDF mode and the SRDF pair state is ActiveActive or ActiveBias.

     - A mixture of R1 and R2 devices is not allowed.

     - All the RDF devices in the SG must be in same RDF group.

     - Concurrent RDF is not supported.
For cascaded SRDF setups, the Both Sides option is supported by selected Storage Group and the next immediate hop, but not the subsequent hops.

- **Enable Force Flag** — Select this option to force the operation even though one or more volumes may not be in the normal, expected states.

8. Click **Next**.

9. Choose one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. This option can be used to create a recurring daily SnapVX snapshot for a given time. In the event of a failed recurring snapshot, an Alert will be raised to notify the user. The schedule continues to run in the event of a failed snapshot, issuing alerts to the user. The alerts list view will retain a record of the failed snapshots (unless the alert is deleted). A warning level alert will be issued. There will not be an end date for the schedule specified when setting it up, so you will need to cancel the schedule manually, if desired. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.

- Expand **Add to Job List** and click **Run Now** to perform the operation now.

### Modifying TimeFinder SnapVX snapshots

**Before you begin**

- To perform this operation, you must be a StorageAdmin.
- The Secure snapshot feature requires the HYPERMAX OS 5977 Q1 2017 Service Release or higher.

To modify TimeFinder SnapVX snapshots:

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > Storage Groups** and click on the **SnapVX** tab to open the **TimeFinder/SnapVX** view.
3. Select a snapshot and click **Modify** to open the **Edit Snapshot** dialog.
4. Enter the new name for the snapshot.
5. Choose one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. This option can be used to create a recurring daily SnapVX snapshot for a given time. In the event of a failed recurring snapshot, an Alert will be raised to notify the user. The schedule continues to run in the event of a failed snapshot, issuing alerts to the user. The alerts list view will retain a record of the failed snapshots (unless the alert is deleted). A warning level alert will be issued. There will not be an end date for the schedule specified when setting it up, so you will need to cancel the schedule manually, if desired. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.

- Expand **Add to Job List** and click **Run Now** to perform the operation now.
Linking to snapshots

Before you begin

- To perform this operation, you must be assigned the StorageAdmin role.
- The storage system must be running HYPERMAX OS 5977 or higher.
- The targets must not be linked to any other snapshots.
- The target volume must be of equal or greater size than the source volume.
- Any pre-existing data that was exclusive to the target will be lost during a link or relink.
- The SnapVX link storage group dialog is updated to always create CKD devices when the New storage group target name radio button is selected.
- Storage groups of Cellera FBA emulation may be managed externally using eNAS.

This procedure explains how to perform this operation from the TimeFinder/SnapVX view. You can also perform this operation from other locations in the interface. Depending on the location, some of the steps may not apply.

This procedure explains how to link one or more host-mapped target volumes to a snapshot, thereby making the snapshot's point-in-time data available to applications running on the host.

Snapshots can be linked to target volumes in the following modes:

- **NoCopy mode**—Creates a temporary, space-saving snapshot of only the changed data on the snapshot's Storage Resource Pool (SRP). Target volumes linked in this mode will not retain data after the links are removed. This is the default mode. This mode cannot be used when either the source or link target volume is a Data Domain volume.
- **Copy mode**—Creates a permanent, full-volume copy of the data on the target volume's SRP. Target volumes linked in this mode will retain data after the links are removed.

Linking a Storage Groups snapshot after the SG volumes have been subsequently expanded will pick volumes to link to by using the volume size at the time of the snapshot being taken.

**Procedure**

1. To link to snapshots:
   1. Select the storage system.
   2. Select DATA PROTECTION > Storage Groups and click on the SnapVX tab to open the TimeFinder/SnapVX view.
   3. Select the storage group and click Link.
   4. Select the Snapshot Name.
   5. Specify whether to link to a new target storage group (one not already linked to a snapshot) or an existing target storage group.
   6. Optional: Modify the default name for the new storage group.
   7. Click Advanced Options to continue setting the advanced options, as described next.

Setting Advanced options:

To force the operation even though one or more volumes may not be in the normal, expected state(s), select Force.
Setting advanced options

- To create a permanent, full-time copy of the data on the target volume's SRP, select Copy. Selecting Copy enables the Remote option.
- To force the operation even though one or more volumes may not be in the normal, expected state(s), select Force.
- To specify that the operation is for devices in STAR mode, select Star.
- Optional: Uncheck the Compression check box to turn off Compression. Compression is only allowed on All Flash systems running the HYPERMAX OS 5977 Q3 2016 Service Release or higher.

8. Do one of the following:

- Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
- Expand Add to Job List, and click Run Now to perform the operation now.

**Relinking to snapshots**

**Before you begin**

- To perform this operation, you must be a StorageAdmin.
- The storage system must be running HYPERMAX OS 5977 or higher.
- To relink in Copy mode:
  - The original link must be fully copied prior to the relink.
  - The copy will be differential between the original linked snapshot and the newly linked snapshot.
- Any pre-existing data that was exclusive to the target will be lost during a link or relink.

This procedure explains how to perform this operation from the TimeFinder/SnapVX view. You can also perform this operation from other locations in the interface. Depending on the location, some of the steps may not apply.

This procedure explains how to unlink a target storage group from a snapshot, and then automatically link it to another snapshot. After a relink operation, the copy between the original linked snapshot and the newly linked snapshot is differential.

You can also relink storage group to the same snapshot, thereby refreshing the point-in-time copy on the target storage group when it's been modified by host writes.

**Procedure**

1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups and click on the SnapVX tab to open the TimeFinder/SnapVX view.
3. Select the storage group, click ..., and select Relink to open the Relink dialog box.
4. Select the link target Storage group and the Snapshot Name.
5. Click Advanced Options to continue setting the advanced options, as described next.

Setting Advanced options:
To create a permanent, full-time copy of the data on the target volume’s SRP, select **Copy**. Selecting **Copy** enables the **Remote** option.

To specify that the operation is for devices in STAR mode, select **Star**.

To force the operation even though one or more volumes may not be in the normal, expected state(s), select **Force**.

6. Do one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.

- Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**Unlinking from snapshots**

**Before you begin**

- To perform this operation, you must be a StorageAdmin.

- The storage system must be running HYPERMAX OS 5977 or higher.

- This procedure explains how to perform this operation from the TimeFinder/SnapVX dashboard. You can also perform this operation from other locations in the interface. Depending on the location, some of the steps may not apply.

This procedure explains how to unlink target volumes from their snapshots.

For instructions on unlinking target volumes, and then automatically linking to other snapshots, refer to Relinking to snapshots on page 395.

**Procedure**

1. Select the storage system.

2. Select DATA PROTECTION > Storage Groups and click on the SnapVX tab to open the TimeFinder/SnapVX view.

3. Select the storage group, click , and select **Unlink** to open the **Unlink** dialog box.

4. Select the **Snapshot Name**.

5. Click **Advanced Options** to continue setting the advanced options, as described next.

**Setting Advanced options:**

- To force the operation even though one or more volumes may not be in the normal, expected state(s), select **Force**.

- To specify that the operation is for devices in STAR mode, select **Star**.

- To force the operation when the operation would normally be rejected, select **SymForce**.

6. Do one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.

- Expand **Add to Job List**, and click **Run Now** to perform the operation now.
Restoring snapshots

Before you begin

- To perform this operation, you must be a StorageAdmin.
- The storage system must be running HYPERMAX OS 5977 or higher.
- This procedure explains how to perform this operation from the TimeFinder/ SnapVX view. You can also perform this operation from other locations in the interface. Depending on the location, some of the steps may not apply.

This procedure explains how to restore snapshot data back to the original source volumes. TimeFinder SnapVX restore operations are inherently differential, meaning that only tracks that have changed since the snapshot was created are copied back to the source volumes.

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups and click on the SnapVX tab to open the TimeFinder/SnapVX view.
3. Select the storage group and click Restore .
4. Select the Snapshot Name and Creation Date (0 is the latest).
5. Click Advanced Options to continue setting the advanced options, as described next.
   Setting Advanced options: 
   To force the operation even though one or more volumes may not be in the normal, expected state(s), select Force.
   To specify that the operation is for devices in STAR mode, select Star.
6. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Setting snapshots to automatically terminate

Before you begin

- To perform this operation, you must be a StorageAdmin.
- The storage system must be running HYPERMAX OS 5977 or higher.
- This procedure explains how to perform this operation from the TimeFinder/ SnapVX dashboard. You can also perform this operation from other locations in the interface. Depending on the location, some of the steps may not apply.

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups and click on the SnapVX tab to open the TimeFinder/SnapVX view.
3. Select the storage group, click Set Time to Live, and select Set Time to Live to open the Set Time to Live dialog box.

4. Select the Snapshot Name and Creation Date.

5. Select the amount of days and hours you want the snapshot to exist for.

   Once the time has expired, the snapshot is automatically terminated, provided that it is not linked to any target volumes. If an expired snapshot is linked, the system will wait until the last link has been removed before terminating the snapshot. To override this behavior, select the Force option, which will allow the system to terminate the snapshot regardless of whether it is linked. To remove the Time to Live attribute, select None.

6. Click Advanced Options to continue setting the advanced options, as described next.

   Setting Advanced options:
   To force the operation even though one or more volumes may not be in the normal, expected state(s), select Force.
   To specify that the operation is for devices in STAR mode, select Star.

7. Do one of the following:
   • Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   • Expand Add to Job List, and click Run Now to perform the operation now.

---

**Setting "Secure" status on an existing snapshot**

**Before you begin**

To perform this operation, you must be a StorageAdmin.

The Secure snapshot feature requires the HYPERMAX OS 5977 Q1 2017 Service Release or higher.

This procedure explains how to set "Secure" status on an existing snapshot. It can also be performed by clicking on a storage group in the TimeFinder SnapVX view to open the Snapshots view.

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**Note**

Secure snapshots may only be terminated after they expire or by customer-authorized support. Please refer to Knowledge Base article 498316 for additional information.

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**Procedure**

1. Select the storage system.

2. Select DATA PROTECTION > Storage Groups and click on the SnapVX tab to open the TimeFinder/SnapVX view.

3. Select the storage group, click , and select Terminate to open the Terminate dialog box.

4. Select the name of an existing snapshot and then use the Days and Hours drop-down menus to set the expiry time.
5. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

Terminating snapshots

**Before you begin**

- To perform this operation, you must be a StorageAdmin.
- The storage system must be running HYPERMAX OS 5977 or higher.
- The snapshot must not have any links.
- This procedure explains how to perform this operation from the TimeFinder/SnapVX dashboard. You can also perform this operation from other locations in the interface. Depending on the location, some of the steps may not apply.
- If the snapshot is Restored, then this action terminates the restore session. If you want to terminate the snapshot, the dialog and action have to be executed again.

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > Storage Groups** and click on the **SnapVX** tab to open the TimeFinder/SnapVX view.
3. Select the storage group, click , and select **Terminate** to open the **Terminate** dialog box.
4. Select the **Snapshot Name**.
5. Click **Advanced Options** to continue setting the advanced options, as described next.

   **Setting Advanced options:**
   - To force the operation even though one or more volumes may not be in the normal, expected state(s), select **Force**.
   - To specify that the operation is for devices in STAR mode, select **Star**.
   - To force the operation when the operation would normally be rejected, select **SymForce**.

   **CAUTION**

   Use extreme caution with this option. If used when a link is copy in progress or when a restore is restore in progress, this will cause an incomplete copy and data on the copy target would not be usable.

6. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.
Setting copy mode for snapshots

Before you begin

- To perform this operation, you must be a StorageAdmin.
- The storage system must be running HYPERMAX OS 5977 or higher.
- This procedure explains how to perform this operation from the TimeFinder/SnapVX dashboard. You can also perform this operation from other locations in the interface. Depending on the location, some of the steps may not apply.

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups and click on the SnapVX tab to open the TimeFinder/SnapVX view.
3. Select the storage group, click , and select Set Mode to open the Set Mode dialog box.
4. Select the Snapshot Name.
5. Select a new mode:
   - **Copy**—Creates a permanent, full-volume copy of the data on the target volume's SRP. Target volumes linked in this mode will retain data after the links are removed.
   - **No Copy**—Creates a temporary, space-saving snapshot of only the changed data on the snapshot's Storage Resource Pool (SRP). Target volumes linked in this mode will not retain data after the links are removed. This is the default mode.
6. Click Advanced Options to continue setting the advanced options, as described next.

   Setting Advanced options:

   To force the operation even though one or more volumes may not be in the normal, expected state(s), select Force.

   To specify that the operation is for devices in STAR mode, select Star.
7. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Viewing snapshots

Before you begin

The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to view and manage snapshots of a storage group.

Procedure

1. Select the storage system.
2. Select **DATA PROTECTION > Storage Groups** and click on the **SnapVX** tab to open the **TimeFinder/SnapVX** view.

3. Select a storage group, click \( i \) and click on the number next to **Number of Snapshots**
   
The storage group **Snapshots** list view allows you to view and manage the snapshots associated with a storage group.

   The following properties display:

   - **Snapshot**—Name of the snapshot.
   - **Creation Time**—Date, time, and generation number for the snapshot.
   - **Linked**—Indication whether the snapshot is linked to another storage group. A checkmark indicates that the snapshot is linked.
   - **Restored**—Indication whether the snapshot is restored to the source. A checkmark indicates that the snapshot is restored.
   - **Time To Live**—time the snapshot has to live.
   - **Secured**—Whether the snapshot is Secured or not. A checkmark indicates that the snapshot is Secured, a dash indicates that it isn’t. "Expired" indicates that the snapshot was Secured but is now expired.

   - \( i \)—Viewing snapshot details on page 401
   - **Create**—Creating snapshots on page 391
   - **Modify**—Modifying TimeFinder SnapVX snapshots on page 393
   - **Restore**—Restoring snapshots on page 397
   - **Link**—Linking to snapshots on page 394
   - **Unlink**—Unlinking from snapshots on page 396
   - **Relink**—Relinking to snapshots on page 395
   - **Set Mode**—Setting copy mode for snapshots on page 400
   - **Set Time to Live**—Setting snapshots to automatically terminate on page 397
   - **Set Secure**—Setting "Secure" status on an existing snapshot on page 398
   - **Terminate**—Terminating snapshots on page 399

### Viewing snapshot details

**Before you begin**

The storage system must be running HYPERMAX OS 5977 or higher.

**Procedure**

1. Select the storage system.

2. Select **DATA PROTECTION > Storage Groups** and click on the **SnapVX** tab to open the **TimeFinder/SnapVX** view.

3. Select a storage group, click \( i \) and click on the number next to **Number of Snapshots**

4. Select a snapshot and select \( i \) to open the snapshot **Details** view.
The Snapshot Details view allows you to view and manage a snapshot.

Properties panel

The following properties display:

- **Name**—Name of the snapshot.
- **Storage Group Name**—Name of the snapshot.
- **Generation**—Generation number assigned to the snapshot. This number is used to differentiate between point-in-time copies of the same name and same volumes. Assigns generation numbers to the snapshots in the order in which they were created (latest = generation 0, previous incrementing by one).
- **Creation Time**—Date and time the snapshot was created.
- **Expiry Date**—Date and time the snapshot is set to automatically terminate if either "Secure" or "Time to Live" has been set. If the snapshot is not set to automatically terminate, this field displays N/A.
- **State**—Snapshot state.
- **Secured**—Indicates whether the snapshot is Secured or not. A checkmark indicates that the snapshot is Secured, a dash indicates that it isn't. "Expired" indicates that the snapshot was Secured but is now expired.

There are also links to views displaying objects (Source Volumes, Links and SRP) contained in and associated with the snapshot. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking **Links** opens a view listing the links associated with the snapshot.

### Viewing snapshot links

**Before you begin**

The storage system must be running HYPERMAX OS 5977 or higher.

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION** > **Storage Groups** and click on the SnapVX tab to open the TimeFinder/SnapVX view.
3. Select a storage group, click ![link](i) and click on the number next to **Number of Snapshots**.
4. Select a snapshot and select ![link](i) to open the snapshot Details view.
5. Click on the number next to **Links** to open the snapshot Links list view.

The snapshot Links list view allows you to view and manage the storage groups containing the linked volumes.

The following properties display:

- **Storage Group**—Name of the storage group.
- **State**—Snapshot state.
- **Snapshot Timestamp**—Date and time the snapshot was created.
- **Link Timestamp**—Date and time the link was created.

The following controls are available:
- Displays a properties panel listing the following properties: Source Storage Group and Linked Volumes.
- Unlink—Unlinking from snapshots on page 396
- Relink—Relinking to snapshots on page 395

Viewing snapshot link details

Before you begin
The storage system must be running HYPERMAX OS 5977 or higher.

Procedure
1. To view snapshot link details:
   1. Select the storage system.
   2. Select DATA PROTECTION > Storage Groups and click on the SnapVX tab to open the TimeFinder/SnapVX view.
3. Select a storage group, click ∨ and click on the number next to Number of Snapshots
4. Select a snapshot and select ∨ to open the snapshot Details view.
5. Click on the number next to Links to open the snapshot Links list view.
6. Select a snapshot and select ∨ to open the snapshot links Details view.
   The snapshot link Details view allow you to view and manage the linked volume pairs.
   The following properties display:
   - Source Volume—Name of the source volume.
   - Linked Volumes—Name of the linked volume(s).
   - State—Snapshot state.
   - Flags (FCMD)—Snapshot flags. Possible values are: Failed, Copied, Modified, Defined (FCMD).

Viewing snapshot source volumes

Before you begin
The storage system must be running HYPERMAX OS 5977 or higher.

This view displays SnapVX ICDP snapshots created from the Mainframe product. Management of these snapshots is not supported.

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups and click on the SnapVX tab to open the TimeFinder/SnapVX view.
3. Select a storage group, click ∨ and click on the number next to Number of Snapshots
4. Select a snapshot and select  ⌁ to open the snapshot Details view.

5. Click on the number next to Source Volumes to open the snapshot Source Volumes list view.

   The snapshot Source Volumes view allow you to view and manage the source volumes in a snapshot.

   The following properties are displayed:
   - Name—Name of volume
   - State—Snapshot state.
   - Creation Date—Date and time the snapshot was created.
   - Failed—Indication of failure.
   - Linked—Indication of link status.
   - Restored—Indication of restoration status.

   The following controls are available:
   - Viewing snapshot source volume details on page 404
   - Restore—Restoring snapshots on page 397
   - Link—Linking to snapshots on page 394
   - Relink—Relinking to snapshots on page 395
   - Unlink—Unlinking from snapshots on page 396
   - Set Mode—Setting copy mode for snapshots on page 400
   - Set Time to Live—Setting snapshots to automatically terminate on page 397
   - Set Secure—Setting "Secure" status on an existing snapshot on page 398
   - Terminate—Terminating snapshots on page 399

Viewing snapshot source volume details

Before you begin
The storage system must be running HYPERMAX OS 5977 or higher.

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups and click on the SnapVX tab to open the TimeFinder/SnapVX view.
3. Select a storage group, click  ⌁ and click on the number next to Number of Snapshots
4. Select a snapshot and select  ⌁ to open the snapshot Details view.
5. Click on the number next to Source Volumes to open the snapshot Source Volumes list view.
6. Select the volume and click  ⌁ to open the snapshot source volume Details view.
The snapshot source volume Details view allows you to view and manage the source volume in a snapshot.

The following properties display:

- **Name**—Name of the volume.
- **State**—Snapshot state.
- **Secured**—Snapshot secured indication.
- **Flags**—Snapshot flags. Possible values are: Failed, Link, Restore, GCM, Type (FLRGFT).
- **Capacity (GB)**—Capacity of the volume.
- **Tracks**—Number of source tracks that the host has not yet overwritten.
- **Track Size**—Track size in bytes.
- **Linked Volumes**—Linked volumes.

### Viewing snapshot source volume linked volumes

**Before you begin**

The storage system must be running HYPERMAX OS 5977 or higher.

**Procedure**

1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups and click on the SnapVX tab to open the TimeFinder/SnapVX view.
3. Select a storage group, click and click on the number next to Number of Snapshots.
4. Select a snapshot and select to open the snapshot Details view.
5. Click on the number next to Source Volumes to open the snapshot Source Volumes list view.
6. Select the volume and click to open the snapshot source volume Details view.
7. Click the number next to Linked Volumes to open the snapshot source volume Link Volumes list view.

The snapshot source volume Link Volumes list view allow you to view and manage the linked volumes for a snapshot source volume.

The following properties display:

- **Name**—Name of the volume.
- **Storage Group**—Storage group that contains the target volume.
- **State**—Snapshot state.
- **Snapshot Timestamp**—Date and time the snapshot was created.
- **LinkTimestamp**—Date and time the link was created.

The following controls are available:

- **Unlink**—Unlinking from snapshots on page 396
RBAC roles for performing local and remote replication actions

The table below details the roles needed to perform TimeFinder SnapVX local and remote replication actions.

Note

Unisphere for PowerMax does not support RBAC Device Group management.

<table>
<thead>
<tr>
<th>Role</th>
<th>Local Replication</th>
<th>Remote Replication</th>
<th>Device Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protection Wizard - Create SnapVX Snapshot</td>
<td>Yes (a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create Snapshot</td>
<td>Yes (a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Edit Snapshot</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Link Snapshot</td>
<td>Yes (b) (c)</td>
<td></td>
<td>Yes (d)</td>
</tr>
<tr>
<td>Relink Snapshot</td>
<td>Yes (b) (c)</td>
<td></td>
<td>Yes (d)</td>
</tr>
<tr>
<td>Restore Snapshot</td>
<td>Yes (b)</td>
<td></td>
<td>Yes (b)</td>
</tr>
<tr>
<td>Set Time To Live</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set Mode</td>
<td>Yes (b)</td>
<td></td>
<td>Yes (d)</td>
</tr>
<tr>
<td>Terminate Snapshot</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unlink Snapshot</td>
<td>Yes (b)</td>
<td></td>
<td>Yes (d)</td>
</tr>
</tbody>
</table>

(a) - Set Secure will be blocked for users who only have Local_REP rights.
(b) - The user must have the specified rights on the source volumes.
(c) - The user may only choose existing storage groups to link to. Creating a new storage group requires Storage Admin rights.
(d) - The user must have the specified rights on the link volumes.

Managing remote replication sessions

The SRDF dashboard provides a single place to monitor and manage SRDF sessions on a storage system. This includes device groups types R1, R2, and R21.

Unisphere provides the ability to monitor and manage the SRDF replication on storage groups directly without the need to map to a device group.

Unisphere provides the ability to monitor and manage SRDF/Metro from the SRDF dashboard. SRDF/Metro delivers active-active high availability for non-stop data access and workload mobility – within a data center and across metro distance. It provides array clustering for storage systems running HYPERMAX OS 5977 or higher enabling even more resiliency, agility, and data mobility. SRDF/Metro enables hosts and host clusters to directly access a LUN or storage group on the primary SRDF array and secondary SRDF array (sites A and B). This level of flexibility delivers the highest availability and best agility for rapidly changing business environments.
In an SRDF/Metro configuration, SRDF/Metro utilizes the SRDF link between the two sides of the SRDF device pair to ensure consistency of the data on the two sides. If the SRDF device pair becomes Not Ready (NR) on the SRDF link, SRDF/Metro must respond by choosing one side of the SRDF device pair to remain accessible to the hosts, while making the other side of the SRDF device pair inaccessible. There are two options which enable this, Bias and Witness.

The first option, Bias, is a function of the two storage systems running HYPERMAX OS 5977 taking part in the SRDF/Metro and is a required and integral component of the configuration. The second option, Witness, is an optional component of SRDF/Metro which allows a third storage system running Enginuity 5876 or HYPERMAX OS 5977 system to act as an external arbitrator to avoid an inconsistent result in cases where the bias functionality alone may not result in continued host availability of a surviving non-biased array.

Creating SRDF connections

This task provides a mechanism to make a connection to storage array that is currently not visible to the Unisphere server and to bring the connected array into Unisphere as remote.

Before you begin:

The physical connectivity and zoning must be in place before undertaking this task.

To create SRDF connections:

**Procedure**

1. Select the storage system.
2. Select DATA PROTECTION > SRDF Groups.
3. Select an SRDF group, click , and select Create SRDF Connection to open the Create SRDF Connection wizard.
4. On the Local page, specify the following information:
   - Type a value for the SRDF group label.
   - Select a SRDF Group Number from the list of unused RDFG numbers for the local array.
   - From the list, select a local port to be used by the new SRDF Group.
5. (Optional) Click NEXT.
6. On the Remote page, specify the following information:
   - Select Scan to scan the SRDF SAN for the port selected on the local page.
   - Select an Array ID from the list.
   - Type a value for the SRDF Group Number. This is not selectable as there is no knowledge of the remote candidate array’s used RDFG numbers at this point.
   - From the list, select a remote port to be used by the new SRDF Group.
7. (Optional) Click NEXT.
8. On the Summary page, verify your selections. To change any of them, click BACK. Note that some changes may require you to make additional changes to your configuration.
9. Do one of the following:

- Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.

- Expand Add to Job List, and click Run Now to perform the operation now.

Results

A SRDF group has been created with a single port on each side. After creation, further SRDF group changes can be performed using Unisphere functionality.

Creating SRDF pairs

Before you begin

Creation of an SRDF pair can be blocked when the R2 is larger than the R1. This feature requires that you disable the SYMAPI_RDF_CREATEPAIR_LARGER_R2 option in the SYMAPI options file (enabled by default). For more information on disabling SYMAPI options, refer to the Solutions Enabler Installation Guide.

You can create SRDF pairs containing standard and thin volumes, or thin and diskless volumes. To use this feature, the thin and diskless volumes must be on a storage system running Enginuity OS 5876 or higher, and the standard volume must be on a storage system running Enginuity OS 5876.

Meta volumes are supported on storage systems running Enginuity OS 5876.

On storage systems running HYPERMAX OS 5977 or higher, you can specify a RecoverPoint volume as the R1 volume.

The cascaded R1 -> R21 -> R2 configuration of which an SRDF pair can be part, depends on the Enginuity/HYPERMAX OS version of each of the devices. The following combinations are supported:

Unisphere provides support for creating RDF pairs in a concurrent RDF in a SRDF/Metro configuration resulting in one Metro RDF mirror and one Async or Adaptive Copy RDF mirror.
The following restrictions apply:

- Adding a Metro RDF mirror when the device is already part of an SRDF/Metro configuration.
- Adding a Metro RDF mirror when the device is already an R2 device.
- Adding a non-Metro RDF R2 mirror to a device that has a Metro RDF mirror.
- Adding a Metro RDF mirror when the non-Metro RDF mirror is in Synchronous mode.
- Adding a non-Metro RDF mirror in Synchronous mode when the device is already part of an SRDF/Metro configuration.
- Operations that make the Metro RDF mirror RW on the RDF link are not allowed if the Metro device is the target of the data copy from the non-Metro RDF mirror.
- Operations that make the non-Metro RDF mirror RW on the RDF link and result in the data copy to the Metro device are not allowed if the Metro RDF mirror is RW on the RDF link.
- The Create Pair - Invalidate R1 operation is not allowed on the non-Metro RDF mirror if it results in a Metro device becoming write-disabled (WD).

<table>
<thead>
<tr>
<th>R1</th>
<th>R21</th>
<th>R2</th>
</tr>
</thead>
<tbody>
<tr>
<td>5977</td>
<td>5977</td>
<td>5977</td>
</tr>
<tr>
<td>5977</td>
<td>5977</td>
<td>5876</td>
</tr>
<tr>
<td>5977</td>
<td>5876</td>
<td>5876</td>
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<td>5876</td>
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<td>5977</td>
</tr>
<tr>
<td>5876</td>
<td>5977</td>
<td>5876</td>
</tr>
</tbody>
</table>

If the RDF interaction includes a storage system running HYPERMAX OS 5977 or higher, then the other storage system must be running Enginuity OS 5876 or higher.

It is possible to create a SRDF/Metro device pair when SRDF/Metro exist in a current group or an empty SRDF group exists on the storage device.

CKD devices are not supported by SRDF/Metro.

Only CKD storage groups are selectable if the volumes chosen are of that emulation.

If Local or Remote storage system is running Enginuity OS 5876, only Bound TDEVs are supported, and this requires the selection of a thin pool.

Adding to Storage Groups will list SGs which are either empty or not a parent (i.e. child or standalone). SGs which already contain devices must have those devices in the SRDF group which the wizard is being run against, and have the devices of the same SRDF polarity (R1s or R2s).

This procedure supports adding SRDF pairs to a SRDF/Metro group.

To create an SRDF pair:
Procedure

1. Select the storage system.
2. Select DATA PROTECTION > SRDF Groups to open the SRDF Groups list view.
3. Select the SRDF group and click Create Pairs to open the Create SRDF Pairs dialog box. This selection will determine the remote storage system.
4. Select Mirror Type to apply to the local devices.
5. Select SRDF Mode.
6. Select Adaptive Copy Mode option for (Disk / Write Pending) (storage systems running Enginuity OS 5876 only)
7. Select one of the following options:
   - **Invalidate R1**: Invalidates the source R1 device(s) so that a full copy can be initiated from the remote mirror.
   - **Invalidate R2**: Invalidates the target R2 device(s) so that a full copy can be initiated from the remote mirror.
   - **Establish**: Begins a full copy from the source to the target, synchronizing the dynamic SRDF pairs in the device file.
   - **Restore**: Begins a full copy from the target to the source, synchronizing the dynamic SRDF pairs in the device file.
   - **Format**: No data resynchronization is done between source and target dynamic SRDF pairs in the device file after all tracks are cleared on what will become the R1 and R2 side.
8. Optional: Select No WD - Bypasses the check that ensures that the target of the operation is not writable by the host.
9. Click NEXT to go to the Local Volumes page.
10. If you wish to do manual selection for local devices, turn Automatic Selection off.
11. Select the thin pool name.
12. Specify criteria to find the volumes of interest, and choose volumes.
13. Click Add to Storage Group checkbox and select a storage group.
14. Click NEXT to go to the Remote Volumes page.
15. If you wish to do manual selection for remote devices, turn Automatic Selection off.
16. Select the thin pool name.
17. Click Add to Storage Group checkbox and select a storage group.
18. Click NEXT to go to the Summary page.
19. Review the changes.
20. Do one of the following:
   - Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.
Deleting SRDF pairs

Deleting SRDF pairs cancels the dynamic SRDF pairing by removing the pairing information from the storage system and converting the volumes from SRDF to regular volumes. This operation can be performed on a storage group, a SRDF/Metro, or a device group.

To delete SRDF pairs from the SRDF List Volumes View, refer to Deleting SRDF pairs from the SRDF List Volumes View on page 425.

Half deleting SRDF pairs cancels the dynamic SRDF pairing information for one side (R1s or R2s) of the specified volume pairs and converts the volumes from RDF to regular volumes. This operation can only be performed on a device group.

If you select all pairs for a delete pair action, then the option to remove the devices from the device group, or the local or remote Storage Group is not displayed, as it will not render the device group, storage group, or SRDF/Metro unmanageable.

Before you begin:

SRDF requires Enginuity version 5876 or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

This procedure supports the deletion of SRDF pairs from a SRDF/Metro group.

To delete SRDF pairs:

**Procedure**

1. Select the storage system.
2. Select Data Protection > SRDF.
3. Click Storage Groups, Device Groups or SRDF/Metro.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - Group level:
     - Select a group, click , and select Delete Pair.
     - Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
     - Select the Half Delete option if deleting one side of the volume pair.
     - Optional: Select Remove from local Storage Groups, Remove from remote Storage Groups, and Remove from local Storage Groups if the pair deletion results in devices that are no longer SRDF protected, and results in the related device groups becoming invalid.
     - Only one side of the RDF device pairs that are removed from the SRDF/Metro session will remain host-accessible when the operation completes. The Keep R1 or Keep R2 option is used to specify the side that should remain host-accessible.
     - Click Advanced Options. Select the advanced SRDF session options and click OK.
Do one of the following:

- Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to *Scheduling jobs* on page 812 and *Previewing jobs* on page 812.
- Expand **Add to Job List**, and click **Run Now** to perform the operation now.

Pair level:

- Select a group and click .
- Select one or more pairs and click **Delete Pair**.
- Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (only applicable for device groups).
- Select the **Half Delete** option if deleting one side of the volume pair.
- Optional: Deselect the selected (by default) **Remove from local Storage Groups**, **Remove from remote Storage Groups**, and **Remove from Device Groups** check boxes. If you deselect the selected defaults, you will be warned if the pair deletion results in devices that are no longer SRDF protected, and results in the related device groups becoming invalid. This option is not displayed if all pairs are selected.
- Click **Advanced Options**. Select the advanced **SRDF session options** and click **OK**.
- Do one of the following:
  - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to *Scheduling jobs* on page 812 and *Previewing jobs* on page 812.
  - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**Moving SRDF pairs**

This procedure explains how to move the SRDF pair from one SRDF group to another. The move type can be a full move or a half move. A half move specifies to move only the local half of the RDF pair. When using this action on an RDF 1 type pair, only the R1 volume is moved. When using this action on an RDF 2 type pair, only the R2 volume is moved. This procedure supports moving SRDF pairs to a SRDF/Metro group.

To move SRDF pairs:

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > Storage Groups > SRDF or DATA PROTECTION > Device Groups > SRDF**.
3. Select a group, click , and select **Move**.
4. Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (only applicable for device groups).
5. Select **New SRDF Group**.
6. Select **Full Move** or **Half Move**.

7. Optional: Select **Use Consistency Exempt**.
   
   This allows volumes to be added, removed, or suspended without affecting the state of the SRDF/A session.

8. Only one side of the RDF device pairs that are moved from the SRDF/Metro session will remain host-accessible when the operation completes. The **Keep R1** or **Keep R2** option is used to specify the side that should remain host-accessible.

9. Click **Advanced Options**. Select the advanced **SRDF session options** and click **OK**.

10. Do one of the following:
    
    - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
    
    - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Setting SRDF mode

This procedure explains how to set the mode of operation for an SRDF configuration. SRDF modes determine the following:

- How R1 volumes are remotely mirrored to R2 volumes across the SRDF links
- How I/Os are processed in an SRDF solution
- When acknowledgments are returned to the production host that issued a write I/O command

**Before you begin:**

SRDF requires Enginuity version 5876 or HYPERMAX OS 5977 or higher.

The Adaptive Copy Mode value **Enabled: WP Mode** is not available if the R1 mirror of an SRDF pair is on a storage system running HYPERMAX OS 5977 or higher.

It is not allowed to set SRDF devices in the non-Metro SRDF mirror to operate in Synchronous mode.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

**To set SRDF mode:**

**Procedure**

1. Select the storage system.

2. Select **DATA PROTECTION > Storage Groups > SRDF** or **DATA PROTECTION > Device Groups > SRDF**.

3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   
   - **Group level:**
     
     - Select a group, click , and select **Set Mode**.
Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).

- Select **SRDF Mode**, **Adaptive Copy Mode** and **AC Skew** to set the type of SRDF session modes.
- Select **Use Consistent** to set consistent transition from asynchronous to synchronous mode.

**Pair level:**
- Select a group, click ![info](https://example.com/info-icon.png) and click the number next to SRDF Pairs.

- Select one or more pairs, click ![mode](https://example.com/mode-icon.png), and select **Set Mode**.
- Select **SRDF Mode**, **Adaptive Copy Mode** and **AC Skew** to set the type of SRDF session modes.
- Select **Use Consistent** to set consistent transition from asynchronous to synchronous mode.

4. Click **Advanced Options**. Select the advanced SRDF session options and click **OK**.

5. Do one of the following:
- Expand **Add to Job List** and click **Add to Job List Now** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
- Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**Viewing SRDF volume pairs**

This procedure explains how to view and manage the volume pairs in a SRDF group.

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > SRDF**.
3. Select a device group from the list and click ![open](https://example.com/open-icon.png) to open the SRDF Pair List view.

The following properties display:

Show Group Details:

Displays the following device group properties:

- **Group Valid**—Indicates if device group is valid or invalid for SRDF management.
- **Application ID**—Application name managing SRDF actions.
- **Vendor ID**—Vendor name.
- **Group Creation Time**—Group creation time stamp.
- **Group Modify Time**—Group modification time stamp.
- **Remote Symmetrix**—Remote storage system ID
- **Volume Pacing Exempt State**—Indicates if volume pacing exempt is enabled.
- **Write Pacing Exempt State**—Indicates if write pacing exempt is enabled.
Effective Write Pacing Exempt State—Indicates if effective write pacing exempt is enabled.

Local tab:
Displays the following local SRDF link properties:
- **Source Volume**—Source volume ID.
- **Source LDev**—Source logical volume ID
- **Group**—SRDF group ID.
- **Remote Symmetrix**—Remote storage system ID.
- **Target Volume**—Target volume ID.
- **State**—State of the RDF volume pairs.
- **Volume State**—State of the source volume.
- **Remote Volume State**—State of the remote volume.
- **SRDF Mode**—SRDF copy type.
- **Local R1 Invalid**—Number of invalid R1 tracks on the source volume.
- **Local R2 Invalid**—Number of invalid R2 tracks on the source volume.
- **Remote R1 Invalid**—Number of invalid R1 tracks on the target volume.
- **Remote R2 Invalid**—Number of invalid R2 tracks on the target volume.

Hop2 tab:
Displays the following remote SRDF link properties:
- **Source LDev**—Source logical volume ID
- **Concurrent Volume**—Concurrent volume ID.
- **SRDF Group**—SRDF group ID.
- **Remote Symmetrix**—Remote storage system ID.
- **Target Volume**—Target volume ID.
- **State**—State of the RDF volume pairs.
- **Volume State**—State of the source volume.
- **Remote Volume State**—State of the remote volume.

The following controls are available:

- **Viewing SRDF volume pair details** on page 416
- **Establish**—Establishing SRDF pairs on page 425
- **Split**—Splitting SRDF pairs on page 440
- **Suspend**—Suspending SRDF pairs on page 440
- **Restore**—Restoring SRDF pairs on page 437
- **Resume**—Resuming SRDF links on page 433
- **Failover**—Failing over on page 426
- **Failback**—Failing back on page 427
- **Set SRDF/A**—Setting SRDF/A controls to prevent cache overflow on page 435
- **Invalidate**—Invalidating R1/R2 volumes on page 428
- **Ready**—Making R1/R2 volumes ready on page 429
Not Ready—Making R1/R2 volumes not ready on page 430
R1 Update—Updating R1 volumes on page 442
RW Enable—Read/write enabling R1/R2 volumes on page 432
Write Disable—Read/write disabling R1/R2 volumes on page 433
RW Disable R2—Read/write disabling R2 volumes on page 431
Refresh—Refreshing R1 or R2 volumes on page 434
Set Mode—Setting SRDF mode on page 413

Viewing SRDF volume pair details

Procedure
1. Select the storage system.
2. Select Data Protection > SRDF to open the SRDF dashboard.
3. Select a device group from the list and click to open the SRDF Pair List view.
4. On the Local tab, select the pair and click to open its details view.

The following properties display:
Device Group — Device group ID.
Source Volume — Source volume ID.
Source LDev — Source logical device ID.
SRDF Group — SRDF Group ID.
Remote Symmetrix — Remote storage system ID.
Remote SRDF Group — Remote SRDF Group ID.
Target Volume — Target volume ID.
Pair State — Indicates volume pair state.
SRDF mode — SRDF copy type.
Adaptive Copy Mode — Indicates if adaptive copy mode is enabled.
Consistency State — Indicates consistency state.
Consistency Exempt — Indicates if consistency is exempt.
Link Status — Indicates link state.
SRDF Domino — Indicates SRDF Domino state.
SRDF Hop2 Group — SRDF Hop2 Group ID.
Source Volume Invalid R1 Track Count — Number of invalid R1 tracks on source volume.
Source Volume Invalid R2 Track Count — Number of invalid R2 tracks on source volume.
Source Volume SRDF State — Indicates source volume SRDF state.
Source Volume SRDF Type — Indicates source volume SRDF type.
Source Volume Track Size — Source volume track size.
Target Volume Invalid R1 Track Count — Number of invalid R1 tracks on target volume.
Target Volume Invalid R2 Track Count—Number of invalid R2 tracks on target volume.

Target Volume SRDF State—Indicates target volume SRDF state.

Target Volume Track Size—Target volume track size.

SRDF/A Pacing Capable—Indicates if the SRDF pair allows write pacing capability.

Configured Group-level Exempt State—Indicates if group-level write pacing exemption capability is enabled or disabled.

Effective Group-level Exempt State—Indicates if effective group-level write pacing exemption capability is enabled or disabled.

Group Level Pacing State—Indicates if group level write pacing is enabled or disabled.

Volume Level Pacing State—Indicates if volume level write pacing is enabled or disabled.

SRDF/A Consistency Protection—Indicates SRDF/A consistency protection state.

SRDF/A Average Cycle Time—Average cycle time (seconds) configured for this session.

SRDF/A Minimum Cycle Time—Minimum cycle time (seconds) configured for this session.

SRDF/A Cycle Number—Indicates target volume SRDF state.

SRDF/A DSE Autostart—Indicates DSE autostart state.

SRDF/A Session Number—SRDF/A session number.

SRDF/A Session Priority—Priority used to determine which SRDF/A sessions to drop if cache becomes full. Values range from 1 to 64, with 1 being the highest priority (last to be dropped).

SRDF/A Duration Of Last Cycle—The cycle time (in secs) of the most recently completed cycle. It should be noted that in a regular case the cycles switch every ~30 sec, however, in most cases the collection interval is in minutes, which means some cycle times will be skipped. This an important counter to look at to figure out if SRDF/A is working as expected.

SRDF/A Flags—RDFA Flags:

<table>
<thead>
<tr>
<th>Flag</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(C)consistency:</td>
<td>X = Enabled, . = Disabled, - = N/A</td>
</tr>
<tr>
<td>(S)tatus:</td>
<td>A = Active, I = Inactive, - = N/A</td>
</tr>
<tr>
<td>(R)DFA Mode:</td>
<td>S = Single-session, M = MSC, - = N/A</td>
</tr>
<tr>
<td>(M)sc Cleanup:</td>
<td>C = MSC Cleanup required, - = N/A</td>
</tr>
<tr>
<td>(T)ransmit Idle:</td>
<td>X = Enabled, . = Disabled, - = N/A</td>
</tr>
<tr>
<td>(D)SE Status:</td>
<td>A = Active, I = Inactive, - = N/A</td>
</tr>
<tr>
<td>DSE (A)utostart:</td>
<td>X = Enabled, . = Disabled, - = N/A</td>
</tr>
</tbody>
</table>

SRDF/A Uncommitted Track Counts—Number of uncommitted tracks.

SRDF/A Number of Volumes in Session—Number of volumes in session.

SRDF/A Session Uncommitted Track Counts—Number of uncommitted session tracks.
SRDF/A R1 DSE Used Track Count—Number of tracks used for R1 DSE.
SRDF/A R1 Cache In Use Percent—Percent of R1 cache used.
SRDF/A R1 Shared Track Count—Number of R1 shared tracks.
SRDF/A R1 to R2 Lag Time —Time that R2 is behind R1 (RPO). This is calculated as the last cycle time plus the time since last switch. In a regular case, the cycles switch every ~30 sec and the samples are taken every few minutes, therefore this counter may not show very significant data, however, when cycles elongate beyond the sample time, this counter can help indicate an estimate of the RPO.
SRDF/A R2 DSE Used Track Count—Number of tracks used for R2 DSE.
SRDF/A R2 Cache In Use Percent—Percent of R2 cache used.
SRDF/A Session Minimum Cycle Time—Minimum cycle time (seconds) configured for this session.
SRDF/A Transmit Idle State—Indicates SRDF/A transmit idle state.
SRDF/A Transmit Idle Time—Time the transmit cycle has been idle.
Suspended State—Suspended state.
Sqar Mode—Indicates if SRDF pair is in a SQAR configuration.

There are are links to views for objects contained in and associated with the SRDF group. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking the number next to SRDF Group will open a view listing the volumes contained in the SRDF group.

Viewing SRDF volume pair details

This procedure explains how to view an SRDF pair’s SRDF group.

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > SRDF Groups.
3. Select a device group from the list and click SRDF Groups to open the SRDF Pair List view.
4. On the Local tab, select the pair and click SRDF Groups to open its details view.
5. Click the number next to SRDF Group to open the Pair’s SRDF Group view.

The following properties display:
Group—RDF group number.
SRDF Group Label—RDF group label.
Remote SRDF Group—Remote SRDF Group ID.
Remote Symmetrix—Remote Symmetrix ID.
SRDF Group Flags—SRDF group flags.
Volume Count—Number of volumes in the group.
Copy Jobs—Maximum number of RDF copy jobs per RDF group.
Link Limbo (sec)—Number of seconds (0-10) for the Symmetrix system to continue checking the local RDF link status.
SRDF/A Flags—RDFA Flags:
### Viewing SRDF protected storage group pairs

The SRDF SG pair list displays a notification if a capacity mismatch exists between R1 and R2 devices. Mismatch can be R1 > R2 or R1 < R2.

To view SRDF group volumes, refer to Viewing SRDF group volumes on page 458.

#### Procedure

1. Select the storage system.
2. Select **DATA PROTECTION > Storage Groups**.
3. Click **SRDF**.
4. Select a storage group instance and click to open the Storage Group pair list view.
5. Click the number next to **SRDF pairs** to open the SRDF pair list view.

Two tabs are displayed: **Local** and **Hop2**. The non-metro leg of a concurrent RDF pair is viewable in the SRDF/Metro view and the SRDF/Metro leg of the concurrent RDF pair is viewable in the standard RDF view.

The following properties display in the **Local** tab:

- **Source Volume**—The name of the source volume.
- **Source Type**—The source type of the source volume.
- **SRDF Group**—RDF group number.
- **Target Volume**—The target volume ID.
- **State**—The state of the storage group pair. Possible values are:
• Consistent
• Failed Over
• Invalid
• Partitioned
• R1 Updated
• R1 Update in progress
• Suspended
• Synchronization in progress
• Synchronized
• Transmit Idle

If Unisphere detects an asynchronous state change event for a SRDF group from Solutions Enabler, it updates the Unisphere state for the SRDF group and its related SRDF device groups and SRDF storage groups. The Storage Group list view must be refreshed so that the latest state is reflected.

The following properties display in the Hop2 tab:

**Concurrent Volume**—The name of the concurrent volume.

**Symmetrix ID**—Storage system ID.

**SRDF Group**—RDF group number.

**Remote Symmetrix**—Remote Symmetrix ID.

**Target Volume**—The target volume ID.

**State**—The state of the storage group pair. Possible values are:

• Consistent
• Failed Over
• Invalid
• Partitioned
• R1 Updated
• R1 Update in progress
• Suspended
• Synchronization in progress
• Synchronized
• Transmit Idle

If Unisphere detects an asynchronous state change event for a SRDF group from Solutions Enabler, it updates the Unisphere state for the SRDF group and its related SRDF device groups and SRDF storage groups. The Storage Group list view must be refreshed so that the latest state is reflected.

**SRDF Mode**—The SRDF copy mode.

The following controls are available, depending on the operating environment:
Note

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

Note

The dialogs associated with controls listed below do not display the **Use 2nd Hop** option if the hop2 is SRDF/Metro.

Note

In the event of a concurrent SRDF SG where one leg is SRDF/Metro and one is not SRDF/Metro, the action launching the dialog (Metro or non-Metro) preselects the correct RDFG in the combination box and disables edits on it. The selected RDFG is the one for the SRDF mode of the launching SG.

1. Viewing SRDF protected storage group pair properties on page 421

   Establish—Establishing SRDF pairs on page 425

   Split—Splitting SRDF pairs on page 440

   Suspend—Suspending SRDF pairs on page 440

   Restore—Restoring SRDF pairs on page 437

   Resume—Resuming SRDF links on page 433

   Delete Pair—Deleting SRDF pairs on page 411

   Move—Moving SRDF pairs on page 412

   Set Mode—Setting SRDF mode on page 413

   Set Volume Attributes > Invalidate—Invalidating R1/R2 volumes on page 428

   Set Volume Attributes > Ready—Making R1/R2 volumes ready on page 429

   Set Volume Attributes > R1 Update—Updating R1 volumes on page 442

   Set Volume Attributes > RW Enable—Read/write enabling R1/R2 volumes on page 432

   Set Volume Attributes > Write Disable—Read/write disabling R1/R2 volumes on page 433

   Set Volume Attributes > RW Disable R2—Read/write disabling R2 volumes on page 431

   Set Volume Attributes > Refresh—Refreshing R1 or R2 volumes on page 434

   Set SRDF/A—Setting SRDF/A controls to prevent cache overflow on page 435

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**Viewing SRDF protected storage group pair properties**

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > Storage Groups**.
3. Click **SRDF**.
4. Select a storage group and click ⌁ to open the storage group list view.
5. Click the number next to **SRDF pairs** to open the SRDF pair list view.
6. Select a pair and click ⌁ to open the SRDF pair list properties panel.

The following properties display, depending on the operating environment:

- **Storage Group** — The storage group ID.
- **Local Volume** — The local volume ID.
- **SRDF Group Number** — SRDF group number.
- **Remote SRDF Group Number** — Remote SRDF group number.
- **Remote Volume** — The remote volume ID.
- **Pair State** — The state of the SRDF pair.
- **SRDF Mode** — The SRDF mode.
- **Adaptive Copy Mode** — The adaptive copy mode.
- **Adaptive Copy Skew** — The adaptive copy skew.
- **Consistency State** — The consistency state.
- **Consistency Exempt** — Indicates consistency exempt status.
- **Link Status** — Indicates link state.
- **Link Domino** — Indicates link Domino state.
- **Local Volume Invalid R1 Track Count** — Indicates Local Volume Invalid R1 Track Count.
- **Local Volume Invalid R2 Track Count** — Indicates Local Volume Invalid R2 Track Count.
- **Local Volume SRDF State** — Indicates SRDF state of the local volume.
- **Local Volume SRDF Type** — Indicates SRDF type of the local volume.
- **Local Volume Remote Write Pacing Track Count** — Indicates Local Volume Remote Write Pacing Track Count.
- **Local Volume Track Size** — Indicates track size of the local volume.
- **Remote Local Volume Invalid R1 Track Count** — Indicates Remote Volume Invalid R1 Track Count.
- **Remote Local Volume Invalid R2 Track Count** — Indicates Remote Volume Invalid R2 Track Count.
- **Remote Volume SRDF State** — Indicates SRDF state of the remote volume.
- **Remote Volume Track Size** — Indicates track size of the remote volume.
- **SRDF/A Pacing capable** — Indicates SRDF/A pacing capability.
- **Configured Group Level Exempt State** — Configured Group Level Exempt state indication.
- **Effective Group Level Exempt State** — Effective Group Level Exempt state indication.
Volume Level Pacing State—Volume Level Pacing state indication.
SRDF/A Consistency Protection—SRDF/A Consistency Protection indication.
SRDF/A Average Cycle Time—SRDF/A Average Cycle Time.
SRDF/A Minimum Cycle Time—SRDF/A Minimum Cycle Time.
SRDF/A Cycle Number—SRDF/A Cycle Number.
SRDF/A Session Number—SRDF/A Session Number.
Transmit Queue Depth of R1 side—Transmit Queue Depth of R1 side.
SRDF/A Uncommitted Tracks Count—SRDF/A Uncommitted Tracks count.
SRDF/A Number of Volumes in Session—SRDF/A Number of Volumes in session.
SRDF/A Session Uncommitted Tracks Count—SRDF/A Session Uncommitted Tracks count.
SRDF/A R1 DSE Used Track Count—SRDF/A R1 DSE Used Track count.
SRDF/A R1 Cache In Use Percent—SRDF/A R1 Cache In Use Percent.
SRDF/A R1 Shared Track Count—SRDF/A R1 Shared Track count.
SRDF/A R1 to R2 Lag Time—SRDF/A R1 to R2 Lag Time.
SRDF/A R2 DSE Used Track Count—SRDF/A R2 DSE Used Track count.
SRDF/A R2 Cache In Use Percent—SRDF/A R2 Cache In Use Percent.
SRDF/A Session Minimum Cycle Time—SRDF/A Session Minimum Cycle time.
SRDF/A Transmit Idle State—SRDF/A Transmit Idle state.
SRDF/A Transmit Idle Time—SRDF/A Transmit Idle time.
Suspended State—Suspended state.
SQAR Mode—SQAR Mode status (enabled or disabled).

There are also links to views displaying objects contained in and associated with the SRDF pair. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking the number next to SRDF Group Number opens a view listing the related SRDF groups.

Deleting SRDF pairs

Deleting SRDF pairs cancels the dynamic SRDF pairing by removing the pairing information from the storage system and converting the volumes from SRDF to regular volumes. This operation can be performed on a storage group, a SRDF/Metro, or a device group.

To delete SRDF pairs from the SRDF List Volumes View, refer to Deleting SRDF pairs from the SRDF List Volumes View on page 425.

Half deleting SRDF pairs cancels the dynamic SRDF pairing information for one side (R1s or R2s) of the specified volume pairs and converts the volumes from RDF to regular volumes. This operation can only be performed on a device group.

If you select all pairs for a delete pair action, then the option to remove the devices from the device group, or the local or remote Storage Group is not displayed, as it will not render the device group, storage group, or SRDF/Metro unmanageable.

Before you begin:
SRDF requires Enginuity version 5876 or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

This procedure supports the deletion of SRDF pairs from a SRDF/Metro group.

To delete SRDF pairs:

**Procedure**

1. Select the storage system.
2. Select **Data Protection > SRDF**.
3. Click **Storage Groups, Device Groups or SRDF/Metro**.
4. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - **Group level:**
     - Select a group, click , and select **Delete Pair**.
     - Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
     - Select the **Half Delete** option if deleting one side of the volume pair.
     - Optional: Select **Remove from local Storage Groups**, **Remove from remote Storage Groups**, and **Remove from local Storage Groups** if the pair deletion results in devices that are no longer SRDF protected, and results in the related device groups becoming invalid.
     - Only one side of the RDF device pairs that are removed from the SRDF/Metro session will remain host-accessible when the operation completes. The **Keep R1** or **Keep R2** option is used to specify the side that should remain host-accessible.
     - Click **Advanced Options**. Select the advanced **SRDF session options** and click **OK**.
     - Do one of the following:
       - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
       - Expand **Add to Job List**, and click **Run Now** to perform the operation now.
   - **Pair level:**
     - Select a group and click .
     - Select one or more pairs and click **Delete Pair**.
     - Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (only applicable for device groups).
     - Select the **Half Delete** option if deleting one side of the volume pair.
Deleting SRDF pairs from the SRDF List Volumes View

To delete SRDF pairs from the SRDF List Volumes View:

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > SRDF Groups
3. Select a group and click 
4. Click the number next to Volumes.
5. Select a volume and click and select Delete Pairs to open the Delete Pair dialog box.
6. Select the Half Delete option if deleting one side of the volume pair.
7. Optional: Deselect the selected (by default) Remove from Local Storage Groups, Remove from Remote Storage Groups, and Remove from Device Groups check boxes. If you deselect the selected defaults, you will be warned if the pair deletion results in devices that are no longer SRDF protected, and results in the related device groups becoming invalid. This option is not displayed if all pairs are selected.
9. Click OK.

Establishing SRDF pairs

Before you begin
SRDF requires Enginuity version 5876 or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

You can run an establish operation on a cascaded R1 -> R21 -> R2 configuration if any of the storage systems in the cascaded configuration is running HYPERMAX OS Q1 2015 SR or later.
To establish SRDF pairs:

**Procedure**

1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups > SRDF or DATA PROTECTION > Device Groups > SRDF.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - Group level:
     a. Select a group and click *Establish*.
     b. Select *Full* or *Incremental* session type.
     c. Select the *Use 2nd Hop* option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
     d. Select *Witness* or *Bias* (only applicable for SRDF/Metro). Witness, if available, is the default option. If Witness is not available, Bias is set by the system and the radio buttons are disabled.
   - Pair level:
     a. Select a group, click ![image](image.png), and click the number next to SRDF Pairs.
     b. Select one or more pairs and click *Establish*.
     c. Select *Full* or *Incremental* establish type.
     d. Select the *Use 2nd Hop* option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
     e. Select *Witness* or *Bias* (only applicable for SRDF/Metro). Witness, if available, is the default option. If Witness is not available, Bias is set by the system and the radio buttons are disabled.
4. Click *Advanced Options* to set the advanced options. Select the advanced options and click *OK*.
5. Do one of the following:
   - Expand *Add to Job List* and click *Add to Job List Now* to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand *Add to Job List*, and click *Run Now* to perform the operation now.

**Failing over**

**Before you begin**

If the target (R2) volume is on a storage system running HYPERMAX OS 5977 or higher, and the mode of the source (R1) volume is Adaptive Copy Write Pending, SRDF will set the mode to Adaptive Copy Disk.

As a result of a failover (with establish or restore) operation, a cascaded R1 -> R21 -> R2 configuration can be created if any of the storage systems in the cascaded configuration is running HYPERMAX OS Q1 2015 SR or later.

In a period of scheduled downtime for maintenance, or after a serious system problem which has rendered either the host or storage system containing the source (R1) volumes unreachable, no read/write operations can occur on the source (R1) volumes.
In this situation, the fail over operation should be initiated to make the target (R2) volumes read/write enabled to their local hosts.

The Failing Over operation is not allowed on the non-Metro SRDF mirror if it results in a Metro device becoming write-disabled (WD).

To initiate a failover:

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > Storage Groups > SRDF** or **DATA PROTECTION > Device Groups > SRDF**.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - **Group level**:
     a. Select a group, click , and select **Failover**.
     b. Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (only applicable for device groups).
     c. Select the fail over.
   - **Pair level**:
     a. Select a group, click , and click the number next to SRDF Pairs.
     b. Select one or more pairs, click , and select **Failover**.
     c. Select the fail over.
4. Click **Advanced Options** to set the advanced options. Select the advanced options and click **OK**.
5. Do one of the following:
   - Expand **Add to Job List** and click **Add to Job List Now** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

---

**Failing back**

**Before you begin**

SRDF requires Enginuity version 5876 or HYPERMAX OS 5977 or higher.

A fail back operation is performed when you are ready to resume normal SRDF operations by initiating read/write operations on the source (R1) volumes, and stopping read/write operations on the target (R2) volumes. The target (R2) volumes become read-only to their local hosts while the source (R1) volumes are read/write enabled to their local hosts.

To initiate a failback:

**Procedure**

1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups > SRDF or DATA PROTECTION > Device Groups > SRDF.

3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - **Group level:**
     a. Select a group, click , and select Failback .
     b. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (only applicable for device groups).
     c. Select the fail over.
   - **Pair level:**
     a. Select a group, click , and click the number next to SRDF Pairs.
     b. Select one or more pairs, click , and select Failback .
     c. Select the fail over.

4. Click Advanced Options to set the advanced options. Select the advanced options and click OK.

5. Do one of the following:
   - Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

### Invalidating R1/R2 volumes

**Before you begin**

SRDF requires Enginuity version 5876 or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

This procedure explains how to run internal checks to see if a volume swap is valid. To invoke this operation, the RDF pairs at the source must already be Suspended and Write Disabled or Not Ready.

To invalidate R1/R2 volumes:

**Procedure**

1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups > SRDF or DATA PROTECTION > Device Groups > SRDF.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
Making R1/R2 volumes ready

Before you begin

SRDF requires Enginuity version 5876 or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

To make R1 or R2 volumes ready to their local hosts:

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups > SRDF or DATA PROTECTION > Device Groups > SRDF.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   a. Group level:
      Select a group, click , and select Set Volume Attributes > Ready.  
      b. Select side R1 or R2.
      c. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
Making R1/R2 volumes not ready

Before you begin

SRDF requires Enginuity version 5876 or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

This procedure explains how to set the source (R1) or the target (R2) volumes not ready to the local host.

To make R1/R2 volumes not ready:

Procedure

1. Select the storage system.

2. Select DATA PROTECTION > Storage Groups > SRDF or DATA PROTECTION > Device Groups > SRDF.

3. Do the following, depending on whether you want to perform the operation at the group level or pair level:

   • Group level:
     a. Select a group, click , and select Set Volume Attributes > Not Ready.
     b. Select side R1 or R2.
     c. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).

   • Pair level:
     a. Select a group, click , and click the number next to SRDF Pairs.
b. Select one or more pairs, click , and select **Set Volume Attributes** > **Not Ready**.

c. Select R1 or R2 volume type.

4. Click **Advanced Options** to set the advanced options. Select the advanced options and click **OK**.

5. Do one of the following:
   - Expand **Add to Job List** and click **Add to Job List Now** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

---

**Read/write disabling R2 volumes**

**Before you begin**

SRDF requires Enginuity version 5876 or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

To read/write disable R2 volumes:

**Procedure**

1. Select the storage system.

2. Select **DATA PROTECTION** > **Storage Groups** > **SRDF** or **DATA PROTECTION** > **Device Groups** > **SRDF**.

3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - Group level:
     a. Select a group, click , and select **Set Volume Attributes** > **RW Disable R2**.
     b. Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
   - Pair level:
     a. Select a group, click , and click the number next to SRDF Pairs.
     b. Select one or more pairs, click , and select **Set Volume Attributes** > **RW Disable R2**.

4. Click **Advanced Options** to set the advanced options. Select the advanced options and click **OK**.

5. Do one of the following:
Read/write enabling R1/R2 volumes

Before you begin

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

This procedure explains how to write enable the R1 (source) or R2 (target) volumes ready to their local hosts.

To read/write enable R1/R2 volumes:

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups > SRDF or DATA PROTECTION > Device Groups > SRDF.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   a. Group level:
      i. Select a group, click , and select RW Enable.
      ii. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
      iii. Select RW Enable R1s or RW Enable R2s volume type.
   b. Pair level:
      i. Select a group and click , and click the number next to SRDF Pairs.
      ii. Select one or more pairs, click , and select RW Enable.
      iii. Select R1 or R2 volume type.
4. Click Advanced Options to set the advanced options. Select the advanced options and click OK.
5. Do one of the following:
   a. Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   b. Expand Add to Job List, and click Run Now to perform the operation now.
Resuming SRDF links

Before you begin
You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

This procedure explains how to resume I/O traffic on the SRDF links for all remotely mirrored SRDF pairs in the group.

To resume SRDF links:

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups > SRDF or DATA PROTECTION > Device Groups > SRDF.
3. Select a group, click , and select Resume.
4. Click Advanced Options to set the advanced options. Select the advanced options and click OK.
5. Do one of the following:
   - Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Read/write disabling R1/R2 volumes

Before you begin
You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

This procedure explains how to write disable source (R1) volumes/target (R2) volumes to their local hosts.

The Write Disable R1 operation is not allowed on the non-Metro RDF mirror if it results in a Metro device becoming write-disabled (WD).

To write disable R1/R2 volumes:

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups and click the SRDF tab.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - Group level:
Select a group, click , and click **Write Disable**.

Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).

Select Write Disable R1s or Write Disable R2s volume type.

- **Pair level:**
  - Select a group and click , and select **Write Disable**.
  - Select R1 or R2 volume type.

4. Click **Advanced Options** to set the advanced options. Select the advanced options and click **OK**.

5. Do one of the following:
   - Expand **Add to Job List** and click **Add to Job List Now** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Refreshing R1 or R2 volumes

**Before you begin**

To invoke this operation, the SRDF pair(s) must be in one of the following states:

- Suspended and Write Disabled at the source
- Suspended and Not Ready at the source
- Failed Over with the -force option specified
- This operation is rejected if the target has invalid local (R2) tracks.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

The refresh R1 action marks any changed tracks on the source (R1) volume to be refreshed from the target (R2) side. The Refresh R2 action marks any changed tracks on the target (R2) volume to be refreshed from the source (R1) side.

To refresh volumes:

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > Storage Groups > SRDF** or **DATA PROTECTION > Device Groups > SRDF**.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - Group level:
a. Select a group, click , and select Set Volume Attributes > Refresh.
b. Select R1 or R2 volume type.
c. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).

- **Pair level:**
  This action can also be run from pair level details view. Select a pair and click .
  
  a. Select a group and click , and click the number next to SRDF Pairs.
  b. Select one or more pairs, click , and select Set Volume Attributes > Refresh.
  c. Select R1 or R2 volume type.

4. Click Advanced Options to set the advanced options. Select the advanced options and click OK.

5. Do one of the following:
   - Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

### Setting SRDF/A controls to prevent cache overflow

**Before you begin**

SRDF requires Enginuity version 5876 or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

This procedure explains how to activate or deactivate SRDF/A control actions that detect cache overflow conditions and take corrective action to offload cache or slow down the host I/O rates to match the SRDF/A service rates.

To activate or deactivate SRDF/A controls:

**Procedure**

1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups > SRDF or DATA PROTECTION > Device Groups > SRDF.
3. Select a group, click more , and select Asynchronous > Set SRDF/A.
4. Select Activate SRDF/A or Deactivate SRDF/A.
5. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
6. Select **Activate Type** or **Deactivate Type**.

7. Click **Advanced Options** to set the advanced options. Select the advanced options and click **OK**.

8. Do one of the following:
   - Expand **Add to Job List** and click **Add to Job List Now** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Setting consistency protection

**Before you begin**

To set consistency protection:

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > Storage Groups > SRDF** or **DATA PROTECTION > Device Groups > SRDF**.
3. Select a group, click more , and select **Asynchronous > Set Consistency**.
4. Select **Enable** or **Disable**.
5. Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (only applicable for device groups).
6. Click **Advanced Options** to set the advanced options. Select the advanced options and click **OK**.
7. Do one of the following:
   - Expand **Add to Job List** and click **Add to Job List Now** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Resetting original device identity

After deleting a SRDF/Metro pair, the unbiased devices keep the new identity. This procedure explains how to reset the original device identity.

**To reset the original device identity:**

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > SRDF groups**.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - **Group level**
     - Select a former unbiased SRDF/Metro storage group and click **Reset SRDF/Metro Identity** to open the Reset Original Identity dialog box.
• Pair level:
  ■ Select STORAGE > Volumes.
  ■ Filter the view to display volume(s) that were formally part of a SRDF/Metro pair.
  ■ Do one of the following:
    – Select a volume and click Reset SRDF/Metro Identity.
    – Select a volume, click , and then click Reset SRDF/Metro Identity.

4. Click Advanced Options to set the advanced options. Select the advanced options and click OK.

5. Do one of the following:
   • Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   • Expand Add to Job List, and click Run Now to perform the operation now.

Restoring SRDF pairs

This procedure explains how to restore data from the target (R2) volumes to the source (R1) volumes. When you fully restore SRDF pairs, the entire contents of the R2 volume is copied to the R1 volume. When you incrementally restore the R1 volume, only the new data that was changed on the R2 volume while the RDF group pair was split is copied to the R1 volume.

Before you begin

SRDF requires Enginuity version 5876 or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

To restore SRDF pairs:

Procedure

1. Select the storage system.

2. Select DATA PROTECTION > Storage Groups > SRDF or DATA PROTECTION > Device Groups > SRDF.

3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   • Group level:
     a. Select a group and click Restore.
     b. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
     c. Select Full or Incremental restore type.
     d. Select Witness or Bias (only applicable for SRDF/Metro). Witness, if available, is the default option. If Witness is not available, Bias is set by the system and the radio buttons are disabled.
• Pair level:
  a. Select a group, click and click the number next to SRDF Pairs.
  b. Select one or more pairs and click Restore.
  c. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
  d. Select Full or Incremental restore type.
  e. Select Witness or Bias (only applicable for SRDF/Metro). Witness, if available, is the default option. If Witness is not available, Bias is set by the system and the radio buttons are disabled.

4. Click Advanced Options to set the advanced options. Select the advanced options and click OK.

5. Do one of the following:
   • Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   • Expand Add to Job List, and click Run Now to perform the operation now.

Setting bias location

This procedure explains how to set Bias. If Bias is chosen to be set as part of the Suspend operation, the side with the Bias is the side that the host can see after the Suspend operation completes.

---

Note

Set Bias cannot be invoked for a witness protected SRDF/Metro group.

To set bias:

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups > SRDF or DATA PROTECTION > Device Groups > SRDF.
3. Select a group, click , and select Set Bias.
4. Click Advanced Options to set the advanced options. Select the advanced options and click OK.
5. Do one of the following:
   • Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   • Expand Add to Job List, and click Run Now to perform the operation now.

Setting the SRDF GCM flag

This procedure supports the setting of the SRDF GCM flag at the Storage Group level and at the individual volume level.
The Geometry Compatible Mode (GCM) parameter modifies how a storage system running HYPERMAX OS 5997 or later manages the size of a volume. When the GCM attribute is set, the volume is treated as ½ a cylinder smaller than its true configured size. This enables a volume on a storage system running HYPERMAX OS 5977 to be paired with a volume on an storage system running Enginuity 5876, when the 5876 volume has an odd number of cylinders.

Before you begin:

SRDF requires HYPERMAX OS 5977 or later.

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > SRDF groups.
3. Do the following, depending on whether you want to perform the operation at the group level or volume level:
   Group level:
   a. Select a storage group and click Set SRDF GCM to open the Set GCM dialog box.
      • Click On to set the GCM flag or Off to unset the flag.
      
      Note
      The only way to unset this flag is to unmap the device which requires an outage at the host which would mean losing access to volumes.
      • Click OK.
   b. From the Storage Volumes View:
      • Select Storage > Storage Volumes to open the Storage Volumes view.
      • Select a storage group and click Set SRDF GCM to open the Set GCM dialog box.
      • Click On to set the GCM flag or Off to unset the flag.
      
      Note
      The only way to unset this flag is to unmap the device which requires an outage at the host which would mean losing access to volumes.
      • Click OK.

Setting volume status

After deleting an SRDF/Metro pair, the volumes can be in a Not Ready state. This dialog allows you to set the volume state.

Before you begin:

SRDF requires HYPERMAX OS 5977 or later.

To set the volume state:

Procedure

1. Select the storage system.
2. Select STORAGE > Storage Groups.
3. Select a former unbiased SRDF/Metro storage group and click **Set Volume Status**.
4. Click **OK**.

### Splitting SRDF pairs

This procedure explains how to stop SRDF pair mirroring.

**Before you begin**

SRDF requires Enginuity version 5876 or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

To split SRDF pairs:

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > Storage Groups > SRDF** or **DATA PROTECTION > Device Groups > SRDF**.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - **Group level:**
     a. Select a group and click **Split**.
     b. Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
     c. Select **Use Immediate** for immediate split on asynchronous devices.
   - **Pair level:**
     a. Select a group, click 1 and click the number next to SRDF Pairs.
     b. Select one or more pairs and click **Split**.
     c. Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
     d. Select **Use Immediate** for immediate split on asynchronous devices.
4. Click **Advanced Options** to set the advanced options. Select the advanced options and click **OK**.
5. Do one of the following:
   - Expand **Add to Job List** and click **Add to Job List Now** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

### Suspending SRDF pairs

This procedure explains how to stop data transfer between SRDF pairs.

**Before you begin**
You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard RDF view. If you are viewing a storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

To suspend SRDF pairs:

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > Storage Groups > SRDF** or **DATA PROTECTION > Device Groups > SRDF**.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - **Group level:**
     - Select a group and click **Suspend**.
     - Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
     - Select **Use Immediate** or **Use Consistency Exempt**
     - Click **Move Bias** to move the Bias from one side to the other (only applicable for SRDF/Metro). The side with the Bias set is the side that the host can see after the suspend action completes. This option is not allowed until all the devices in the SRDF/Metro config, both new and existing, are in the **ActiveActive** or **ActiveBias** SRDF pair state.
   - **Pair level:**
     - Select a group, click **i** and click the number next to SRDF Pairs.
     - Select one or more pairs and click **Suspend**.
     - Select the **Use 2nd Hop** option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
     - Select **Use Immediate** or **Use Consistency Exempt**
     - Click **Move Bias** to move the Bias from one side to the other (only applicable for SRDF/Metro). The side with the Bias set is the side that the host can see after the suspend action completes. This option is not allowed until all the devices in the SRDF/Metro config, both new and existing, are in the **ActiveActive** or **ActiveBias** SRDF pair state.
     - Only one side of the RDF device pairs that are suspended from the SRDF/Metro session will remain host-accessible when the operation completes. The **Keep R1** or **Keep R2** option is used to specify the side that should remain host-accessible. This applies to storage systems running PowerMaxOS 5978 only.
4. Click **Advanced Options** to set the advanced options. Select the advanced options and click **OK**.
5. Do one of the following:
   - Expand **Add to Job List** and click **Add to Job List Now** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.
Swapping SRDF personalities

This procedure explains how to swap the SRDF volume designations for a specified device group. It changes source (R1) volumes to target (R2) volumes and target (R2) volumes to source (R1) volumes.

Half swapping SRDF personalities swaps one side of the RDF device designations for a specified group. It changes source (R1) volumes to target (R2) volumes or target (R2) volumes to a source (R1) volumes.

Before you begin

SRDF requires Enginuity version 5876 or HYPERMAX OS 5977 or higher.

To swap SRDF personalities:

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups > SRDF or DATA PROTECTION > Device Groups > SRDF.
3. Select a group, click , and select Swap.
4. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration.
5. For optional Refreshing R1 or R2 volumes on page 434, select R1, R2 or None.
6. For optional half swapping, select Half Swap.
   When the SRDF device pairs of an SRDF/Metro configuration are Not Ready (NR) on the link, and the SRDF pair state is Partitioned, a half swap operation is allowed. If the half swap is issued to the R2, the SRDF link to the R1 must be unavailable.
   If the half swap is issued to the R1, the SRDF link to the other side must be available and the SRDF pair must be seen as R1 – R1 (duplicate pair).
7. Click Advanced Options to set the advanced options. Select the advanced options and click OK.
8. Do one of the following:
   - Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Updating R1 volumes

This procedure explains how to incrementally update R1 volumes with changed tracks from R2 volumes.

Before you begin

SRDF requires Enginuity version 5876 or HYPERMAX OS 5977 or higher.

You are not able to perform SRDF/Metro control actions at the SG level on the SRDF/Metro pairs in a standard SRDF view and you are not allowed to perform standard SRDF actions on the SRDF/Metro leg in a standard SRDF view. If you are viewing a
storage system not associated with either side of the pair of interest then you need to go to the view of the relevant storage system.

To update R1 volumes:

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups > SRDF or DATA PROTECTION > Device Groups > SRDF.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level:
   - Group level:
     a. Select a group, click , and click Set Volume Attributes > R1 Update.
     b. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (not applicable if the hop2 is SRDF/Metro).
     c. Select Remote if R1 volumes are a remote.
   - Pair level:
     a. Select a group, click and click the number next to SRDF Pairs.
     b. Select one or more pairs, click , and select Set Volume Attributes > R1 Update.
     c. Select Remote if R1 volumes are a remote.
4. Click Advanced Options to set the advanced options. Select the advanced options and click OK.
5. Do one of the following:
   - Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

**SRDF session options**

<table>
<thead>
<tr>
<th>Session option</th>
<th>Description</th>
<th>Available with action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bypass</td>
<td>Bypasses the exclusive locks for the local and/or remote storage system during SRDF operations. Use this option only if you are sure that no other SRDF operation is in progress on the local and/or remote storage systems.</td>
<td>Establish, Failback, Failover, Restore, Incremental Restore, Split, Suspend, Swap</td>
</tr>
<tr>
<td>Session option</td>
<td>Description</td>
<td>Available with action</td>
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<tr>
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<td>----------------------------------------------</td>
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<tr>
<td></td>
<td></td>
<td>Write Disable R1</td>
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<tr>
<td></td>
<td></td>
<td>Ready R1</td>
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<td></td>
<td></td>
<td>Ready R2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RWDisableR2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Enable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Disable</td>
</tr>
<tr>
<td>Consistent</td>
<td>Allows only consistent transition from async to sync mode.</td>
<td>Activate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consistency Exempt</td>
<td>Allows you to add or remove volumes from an RDF group that is in Async mode without requiring other volumes in the group to be suspended.</td>
<td>Half Move</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Move</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suspend</td>
</tr>
<tr>
<td>Establish</td>
<td>Fails over the volume pairs, performs a dynamic swap, and incrementally establishes the pairs. This option is not supported when volumes operating in Asynchronous mode are read/write on the RDF link. To perform a fail over operation on such volumes, specify the Restore option detailed higher in this table.</td>
<td>Failover</td>
</tr>
<tr>
<td>Force</td>
<td>Overrides any restrictions and forces the operation, even though one or more paired volumes may not be in the expected state. Use caution when checking this option because improper use may result in data loss.</td>
<td>Establish</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Incremental Establish</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Restore</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Incremental Restore</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Write Disable R1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ready R1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ready R2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RWDisableR2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Enable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Disable</td>
</tr>
<tr>
<td>Immediate</td>
<td>Causes the suspend, split, and failover actions on asynchronous volumes to happen immediately.</td>
<td>Suspend</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Split</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Failover</td>
</tr>
<tr>
<td>NoWD</td>
<td>No write disable - bypasses the check to ensure that the target of operation is write disabled to the host. This</td>
<td></td>
</tr>
<tr>
<td>Session option</td>
<td>Description</td>
<td>Available with action</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------</td>
<td>----------------------</td>
</tr>
<tr>
<td></td>
<td>applies to the source (R1) volumes when used with the Invalidate R1 option and to the target (R2) volumes when used with the Invalidate R2 option.</td>
<td>Restore, Incremental Restore, Write Disable R1, Ready R1, Ready R2, RWDisableR2, Enable, Disable Swap</td>
</tr>
<tr>
<td>SymForce</td>
<td>Forces an operation on the volume pair including pairs that would be rejected. Use caution when checking this option because improper use may result in data loss.</td>
<td>Restore, Incremental Restore, Write Disable R1, Ready R1, Ready R2, RWDisableR2, Enable, Disable Swap</td>
</tr>
<tr>
<td>RecoverPoint Tag</td>
<td>Specifies that the operation will be performed on RecoverPoint volumes.</td>
<td>Restore, Failback, Refresh, R1 Update</td>
</tr>
<tr>
<td>Refresh R1</td>
<td>Marks any changed tracks on the source (R1) volume to be refreshed from the target (R2) side.</td>
<td>Swap</td>
</tr>
<tr>
<td>Refresh R2</td>
<td>Marks any changed tracks on the target (R2) volume to be refreshed from the source (R1) side.</td>
<td>Swap</td>
</tr>
<tr>
<td>Remote</td>
<td>When performing a restore or failback action with the concurrent link up, data copied from the R2 to the R1 will also be copied to the concurrent R2. These actions require this option.</td>
<td>Restore, Incremental Restore, Failback</td>
</tr>
<tr>
<td>Restore</td>
<td>When the fail over swap completes, invalid tracks on the new R2 side (formerly the R1 side) will be restored to the new R1 side (formerly the R2 side). When used together with the Immediate option, the fail over operation will immediately deactivate the SRDF/A session without Failover</td>
<td></td>
</tr>
</tbody>
</table>
### Session option

<table>
<thead>
<tr>
<th>Description</th>
<th>Available with action</th>
</tr>
</thead>
<tbody>
<tr>
<td>waiting two cycle switches for session to terminate.</td>
<td>Establish, Failback, Failover, Restore, Incremental Restore, Split, Suspend, Write Disable R1, Ready R1, Ready R2, RWDDisableR2, Enable, Disable</td>
</tr>
</tbody>
</table>

### Star

Selecting this option indicates that the volume pair is part of an SRDF/Star configuration. SRDF/Star environments are three-site disaster recovery solutions that use one of the following:

- Concurrent SRDF sites with SRDF/Star
- Cascaded SRDF sites with SRDF/Star

This technology replicates data from a primary production (workload) site to both a nearby remote site and a distant remote site. Data is transferred in SRDF/Synchronous (SRDF/S) mode to the nearby remote site (referred to as the synchronous target site) and in SRDF/Asynchronous (SRDF/A) mode to the distant remote site (referred to as the asynchronous target site).

SRDFR/Star is supported on Enginuity 5876. The Solutions Enabler SRDF Family CLI Product Guide contains more information on SRDF/Star.

### SRDF session modes

<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaptive Copy</td>
<td>Allow the source (R1) volume and target (R2) volume to be out of synchronization by a number of I/Os that are defined by a skew value.</td>
</tr>
<tr>
<td>Adaptive Copy Disk Mode</td>
<td>Data is read from the disk and the unit of transfer across the SRDF link is the entire track. While less global memory is consumed it is typically slower to read data from disk than from global memory. Additionally, more bandwidth is used because the unit of transfer is the entire track. Additionally, because it is slower to read data from disk than global</td>
</tr>
<tr>
<td>Mode</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Adaptive Copy WP Mode</td>
<td>The unit of transfer across the SRDF link is the updated blocks rather than an entire track, resulting in more efficient use of SRDF link bandwidth. Data is read from global memory than from disk, thus improving overall system performance. However, the global memory is temporarily consumed by the data until it is transferred across the link. This mode requires that the device group containing the RDF pairs with R1 mirrors be on a storage system running Enginuity 5876.</td>
</tr>
<tr>
<td>Synchronous</td>
<td>Provides the host access to the source (R1) volume on a write operation only after the storage system containing the target (R2) volume acknowledges that it has received and checked the data.</td>
</tr>
<tr>
<td>Asynchronous</td>
<td>The storage system acknowledges all writes to the source (R1) volumes as if they were local devices. Host writes accumulate on the source (R1) side until the cycle time is reached and are then transferred to the target (R2) volume in one delta set. Write operations to the target device can be confirmed when the current SRDF/A cycle commits the data to disk by successfully destaging it to the R2 storage volumes. For storage systems running Enginuity 5876, you can put an RDF relationship into Asynchronous mode when the R2 device is a snap source volume.</td>
</tr>
<tr>
<td>AC Skew</td>
<td>Adaptive Copy Skew - sets the number of tracks per volume the source volume can be ahead of the target volume. Values are 0 - 65535.</td>
</tr>
</tbody>
</table>

**RBAC roles for performing local and remote replication actions**

The table below details the roles needed to perform SRDF local and remote replication actions.

---

**Note**

Unisphere for PowerMax does not support RBAC Device Group management.
### Table

<table>
<thead>
<tr>
<th>Feature</th>
<th>Local Replication</th>
<th>Remote Replication</th>
<th>Device Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRDF Delete</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRDF Establish</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRDF Failback</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRDF Failover</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRDF Invalidate</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRDF Move</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRDF Not Ready</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRDF R1 Update</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRDF Ready</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRDF Refresh</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRDF Restore</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRDF Resume</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRDF RW Disable R2</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRDF RW Enable</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRDF Set Bias</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRDF Set Consistency</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRDF Set Mode</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRDF Set SRDFA</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRDF Split</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRDF Suspend</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRDF Swap</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRDF Write Disable</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Understanding Virtual Witness

The Witness feature supports a third party that the two storage systems consult if they lose connectivity with each other, that is, their SRDF links go out of service. When this happens, the Witness helps to determine, for each SRDF/Metro Session, which of the storage systems should remain active (volumes continue to be read and write to hosts) and which goes inactive (volumes not accessible).

Prior to the HYPERMAX OS 5977 Q3 2016 or higher release, a Witness could only be a third storage system that the two storage systems involved in a SRDF/Metro Session could both connect to over their SRDF links.

Prior to the HYPERMAX OS 5977 Q3 2016 or higher release, a Witness could only be a third storage system that the two storage systems involved in a SRDF/Metro Session could both connect to over their SRDF links.

The HYPERMAX OS 5977 Q3 2016 or higher release adds the ability for these storage systems to instead use a Virtual Witness (vWitness) running within a management virtual application (vApp) deployed by the customer.

The following Virtual Witness tasks can be performed from Unisphere.
Adding SRDF Virtual Witness instances

Before you begin

Unisphere provides monitoring and management for SRDF/Metro Virtual Witness instances on Virtual Witness capable storage systems running HYPERMAX OS 5977 Q3 2016 or higher.

A Virtual Witness instance needs to be created for both participating arrays.

See Understanding Virtual Witness on page 448 for additional information.

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > Virtual Witness to open the Virtual Witness list view.
3. Click Create.
4. Type values for the following:
   - Virtual Witness Name—User-defined Virtual Witness instance name.
   - IP/DNS—IPv4 or IPv6 address, or DNS name from embedded Guest that is associated with Virtual Witness instance.
5. Optional: Select the Add Virtual Witness to remote arrays checkbox and select the arrays (these arrays support the Virtual Witness functionality) that are to have the same Virtual Witness added.

6.
7. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Removing SRDF Virtual Witness instances

Before you begin

Unisphere provides monitoring and management for SRDF/Metro Virtual Witness instances on Virtual Witness capable storage systems running HYPERMAX OS 5977 Q3 2016 or higher.

You cannot remove a Virtual Witness instance that is in use (protecting one or more SRDF/Metro sessions).

See Understanding Virtual Witness on page 448 for additional information.
**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > Virtual Witness** to open the **Virtual Witness** list view.
3. Select a virtual witness instance and click **DELETE**.
4. Do one of the following:
   - Expand **Add to Job List** and click **Add to Job List Now** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**Set state for SRDF Virtual Witness instances**

**Before you begin**

Unisphere provides monitoring and management for SRDF/Metro Virtual Witness instances on Virtual Witness capable storage systems running HYPERMAX OS 5977 Q3 2016 or higher.

The Virtual Witness disable operation may or may not require additional force flags based on if it is currently protecting SRDF/Metro sessions and if an alternate witness is available. If the vWitness is currently protecting Metro Sessions, the storage system performs a search for replacement Witnesses (virtual or physical) to use.

You cannot disable a Virtual Witness instance that is in use (protecting one or more SRDF/Metro sessions).

The **Set State** operation changes the state of the Virtual Witness instance from enabled to disabled or from disabled to enabled.

See **Understanding Virtual Witness** on page 448 for additional information.

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > Virtual Witness** to open the **Virtual Witness** list view.
3. Select a Virtual Witness instance and click **Set State**.

   **Note:** When disabling an enabled Virtual Witness instance:

   - Click **Advanced Options** and select the **Use Force** check box. The command fails if the virtual Witness is currently in use (protecting a SRDF/Metro Session) and there is another witness (either virtual or physical) that is available to take over for it. The **force** flag is needed in order to continue.
   - Click **Advanced Options** and select the **Use SymForce** check box. The command fails if the virtual Witness is currently in use (protecting a SRDF/Metro Session) and there is no other witness (either virtual or physical) that is available to take over for it. The **symforce** flag is needed in order to continue.

4. Do one of the following:
   - Expand **Add to Job List** and click **Add to Job List Now** to add this task to the job list, from which you can schedule or run the task at your convenience.
convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.

- Expand Add to Job List, and click Run Now to perform the operation now.

Viewing SRDF Virtual Witness instances

**Before you begin**

Unisphere provides monitoring and management for SRDF/Metro Virtual Witness instances on Virtual Witness capable storage systems running HYPERMAX OS 5977 Q3 2016 or higher.

A Virtual Witness needs to be created for both participating arrays.

See Understanding Virtual Witness on page 448 for additional information.

**Procedure**

1. Select the storage system.
2. Select DATA PROTECTION > Virtual Witness to open the Virtual Witness list view.
   
The following properties display, depending on the operating environment:
   - **Witness name**—User-defined Virtual Witness instance name.
   - **State**—State of Virtual Witness instance.
   - **Alive**—Flag to indicate if the Virtual Witness instance is alive.
   - **In Use**—Flag to indicate if the Virtual Witness instance is in use.

   The following controls are available, depending on the operating environment:
   - View SRDF Virtual Witness instances details on page 451
   - **Create**—Adding SRDF Virtual Witness instances on page 449
   - **Set State**—Set state for SRDF Virtual Witness instances on page 450
   - **Delete**—Removing SRDF Virtual Witness instances on page 449

Viewing SRDF Virtual Witnesses details

**Before you begin**

Unisphere provides monitoring and management for SRDF/Metro Virtual Witness on Virtual Witness capable storage systems running HYPERMAX OS 5977 Q3 2016 or higher.

See Understanding Virtual Witness on page 448 for additional information.

**Procedure**

1. Select the storage system.
2. Select DATA PROTECTION > Virtual Witness to open the Virtual Witness list view.
3. Select a Virtual Witness instance and click to open the Details view.
   
The following properties display:
   - **Witness name**—User-defined witness name.
- **IP/DNS**—IPv4 or IPv6 address, or DNS name from embedded Guest that is associated with Virtual Witness instance.
- **Port**—Port associated with Virtual Witness instance.
- **Alive**—Flag to indicate if the Virtual Witness instance is alive.
- **State**—State of Virtual Witness instance.
- **InUse**—Flag to indicate if the Virtual Witness instance is in use.
- **Duplicate**—Flag to indicate if the Virtual Witness instance is a duplicate. A duplicate witness is a witness which has the same unique ID as another witness on the storage system, for example, in the case where it was added twice.
- **SRDF Groups**—Number of SRDF groups.

There are links to views for objects associated with the Virtual Witness instance. Each group link is followed the name of the group, or by a number, indicating the number of objects in the corresponding view. For example, clicking **SRDF Groups** opens the view listing the SRDF Groups associated with the Virtual Witness instance.

### Creating SRDF/A DSE pools

**Before you begin**

SRDF/A DSE pools are supported on storage systems running Enginuity 5876.

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > SRDF/A DSE Pools** to open the SRDF/A DSE Pools list view.
3. Click **Create**.
   
   You can also create DSE pools from the DSE pools details view.
4. Type a **Pool Name**. DSE pool names can contain up to 12 alpha-numeric characters. The only special character allowed is the underscore ( _ ). The name DEFAULT_POOL is reserved for SAVE volumes that are enabled and not in any other pool.
5. Select the volumes to add.
6. Optional: Click on slider bar to enable the new pool member(s).
7. Click **OK**.

### Deleting SRDF/A DSE pools

**Before you begin**

SRDF/A DSE pools are supported on storage systems running Enginuity 5876.

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > SRDF/A DSE Pools** to open the SRDF/A DSE Pools list view.
3. Select a pool and click .
4. Click OK.

**Adding volumes to SRDF/A DSE pools**

**Before you begin**
SRDF/A DSE pools are supported on storage systems running Enginuity 5876.

**Procedure**
1. Select the storage system.
2. Select **DATA PROTECTION > SRDF/A DSE Pools** to open the **SRDF/A DSE Pools** list view.
3. Select a pool and click **Add**.
4. Select the volumes to add.
5. Optional: Click on slider bar to enable the new pool member(s).
6. Click **OK**.

**Removing volumes from SRDF/A DSE pools**

**Before you begin**
SRDF/A DSE pools are supported on storage systems running Enginuity 5876.

**Procedure**
1. Select the storage system.
2. Select **DATA PROTECTION > SRDF/A DSE Pools** to open the **SRDF/A DSE Pools** list view.
3. Select a pool and click **Remove**.
4. Click **OK**.

**Enabling all volumes in SRDF/A DSE pools**

**Before you begin**
SRDF/A DSE pools are supported on storage systems running Enginuity 5876.

**Procedure**
1. Select the storage system.
2. Select **DATA PROTECTION > SRDF/A DSE Pools** to open the **SRDF/A DSE Pools** list view.
3. Select a pool, click , and select **Enable All**.
4. Click **OK**.

**Disabling all volumes in SRDF/A DSE pools**

**Before you begin**
SRDF/A DSE pools are supported on storage systems running Enginuity 5876.

**Procedure**
1. Select the storage system.
2. Select **DATA PROTECTION > SRDF/A DSE Pools** to open the SRDF/A DSE Pools list view.

3. Select a pool, click ⚙️, and select **Disable All**.

4. Click OK.

**Viewing SRDF/A DSE pools**

**Before you begin**

SRDF/A DSE pools are supported on storage systems running Enginuity 5876.

**Procedure**

1. Select the storage system.

2. Select **DATA PROTECTION > SRDF/A DSE Pools** to open the SRDF/A DSE Pools list view.

   Use this list view to display and manage the SRDF/A DSE pools on a storage system. The following properties display:

   - **Name**—Name of the pool.
   - **DSE Pool Configuration**—Configuration of the volumes in the pool.
   - **Technology**—Technology on which the volumes in the pool reside.
   - **Emulation**—Emulation type.
   - **Pool State**—Whether the pool is Enabled or Disabled.
   - **% Used**—Percent of pool used.

   The following controls are available:

   - [Viewing SRDF DSE pool details](#)
   - [Create](#)
   - [Add](#)
   - [Delete](#)
   - [Enable All](#)
   - [Disable All](#)
   - [Assign Dynamic Cache Partition](#)

**Viewing SRDF DSE pool details**

**Before you begin**

SRDF/A DSE pools are supported on storage systems running Enginuity 5876.

**Procedure**

1. Select the storage system.

2. Select **DATA PROTECTION > SRDF/A DSE Pools** to open the SRDF/A DSE Pools list view.
Select the pool and click to open its Details view.

Use the SRDF/A DSE Pool Details view to display and manage a TimeFinder/Snap pool.

The following properties display:

- **Array ID**—Storage system on which the pool resides.
- **DSE Pool Name**—Name of the pool.
- **Pool Type**—Pool type.
- **Emulation**—Emulation type.
- **RAID Protection**—Protection level of the volumes in the pool.
- **Technology**—Technology on which the volumes in the pool reside.
- **Pool State**—Whether the pool is Enabled or Disabled.
- **Num Volumes**—Number of volumes in the pool.
- **Disabled Volumes**—Number of disabled volumes in the pool.
- **Enabled Volumes**—Number of enabled volumes in the pool.
- **Capacity (GB)**—Sum of all enabled and disabled volumes in the pool.
- **Enabled Capacity (GB)**—Sum of all enabled volumes in the pool.
- **Free Capacity (GB)**—Total free space in MB.
- **% Used**—Percentage used in GB.
- **Used (GB)**—Total used in GB.
- **Free (GB)**—Total free space in GB.

The properties panel provides links to views for objects contained in and associated with the pool. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking the number next to **NumVolumes** opens a view listing the SAVE volumes contained in the pool.

**Creating TimeFinder/Snap pools**

**Procedure**

1. Select the storage system.
2. Select DATA PROTECTION > TimeFinder Snap Pools to open the TimeFinder Snap Pools list view.
3. Click Create.
4. Type a Pool Name.
   
   Snap pool names can contain up to 12 alpha-numeric characters. The only special character allowed is the underscore (_). The name DEFAULT_POOL is reserved for SAVE volumes that are enabled and not in any other pool.
5. Select one or more volumes.
6. Optional: To enable new volumes in the pool, select Enable new pool Member.
   
   The total enabled pool capacity in GB is displayed.
7. Click OK.
Adding volumes to TimeFinder/Snap pools

TimeFinder/Snap pools are supported on storage systems running Enginuity OS 5876.

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > TimeFinder Snap Pools to open the TimeFinder Snap Pools list view.
3. Select a pool and click to open its Details view.
4. Click the number next to Num Volumes to open the SAVE Volumes view.
5. Select one or more volumes and click Add.
6. Select one or more volumes.
7. Optional: To enable new volumes in the pool, select Enable new pool Member.
   The total enabled pool capacity in GB is displayed.
8. Click OK.

Enabling all volumes in TimeFinder/Snap pools

TimeFinder/Snap pools are supported on storage systems running Enginuity OS 5876.

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > TimeFinder Snap Pools.
3. Select a snap pool, click, and select Enable All.
4. Click OK.

Disabling all volumes in TimeFinder/Snap pools

TimeFinder/Snap pools are supported on storage systems running Enginuity OS 5876.

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > TimeFinder Snap Pools.
3. Select a snap pool, click, and select Disable All.
4. Click OK.

Deleting TimeFinder/Snap Pools

TimeFinder/Snap pools are supported on storage systems running Enginuity OS 5876.

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > TimeFinder Snap Pools to open the TimeFinder Snap Pools list view.
3. Select a pool and click  .
4. Click OK.

Removing volumes from TimeFinder/Snap pools

TimeFinder/Snap pools are supported on storage systems running Enginuity OS 5876.

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > TimeFinder Snap Pools to open the TimeFinder Snap Pools list view.
3. Select a pool and click  to open its Details view.
4. Click the number next to Num Volumes to open the SAVE Volumes view.
5. Select one or more volumes and click Remove.
6. Click OK.

Viewing TimeFinder/Snap pools

TimeFinder/Snap pools are supported on storage systems running Enginuity OS 5876.

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > TimeFinder Snap Pools to open the TimeFinder Snap Pools list view.

Use the TimeFinder Snap Pools list view to display and manage the TimeFinder/Snap pools on a storage system.

The following properties display:

- **Name**—Name of the pool.
- **Configuration**—Configuration of the volumes in the pool.
- **Technology**—Technology on which the volumes in the pool reside.
- **Emulation**—Emulation type.
- **Capacity (GB)**—Capacity in GB.
- **Pool State**—Whether the pool is Enabled or Disabled.
- **% Used**—Percentage of pool used.
- **Used (GB)**—Total used space in GB.
- **Free (GB)**—Total free space in GB.

The following controls are available:

- View TimeFinder/Snap pool details on page 458
- Create—Creating TimeFinder/Snap pools on page 455
- Add—Adding volumes to TimeFinder/Snap pools on page 456
- Delete—Deleting TimeFinder/Snap Pools on page 456
Viewing TimeFinder/Snap pool details

TimeFinder/Snap pools are supported on storage systems running Enginuity OS 5876.

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > TimeFinder Snap Pools to open the TimeFinder Snap Pools list view.
3. Select a pool and click to open its Details view.

The following properties display:
- **Array ID** — Storage system on which the pool resides.
- **Name** — Name of the pool.
- **Pool Type** — Pool type.
- **RAID Protection** — Protection level of the volumes in the pool.
- **Technology** — Technology on which the volumes in the pool reside.
- **Pool State** — State of the pool (Enabled or Disabled).
- **Num Volumes** — Number of volumes in the pool.
- **Disabled Volumes** — Number of disabled volumes in the pool.
- **Enabled Volumes** — Number of enabled volumes in the pool.
- **Capacity (GB)** — Sum of all enabled and disabled volumes in the pool.
- **Enabled Capacity (GB)** — Sum of all enabled volumes in the pool.
- **Free (GB)** — Total free space in GB.
- **Used (GB)** — Total used space in GB.

There are links to views for objects contained in and associated with the pool. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking **NumVolumes** opens a view listing the SAVE volumes contained in the TimeFinder snap pool.

The Performance Views panel links you to the performance monitor and analyze views for the snap pool.

This panel only displays when the Performance option is installed. This panel displays with inactive links if the selected storage system is not registered for data collection.

Viewing SRDF group volumes

This procedure explains how to view the volumes in an SRDF group:
Procedure

1. Select the storage system.
2. Select Data Protection > SRDF groups to open the SRDF groups list view.
3. Select the SRDF group and click to open its Details view.
4. Click the number next to SRDF Group Volumes to open the SRDF List Volumes view.

The following properties display:

Name—Local volume ID.
Configuration—SRDF configuration.
Remote Symmetrix ID—Remote storage system ID.
Remote SRDF Group—Remote SRDF group ID.
Target Volume—Target volume ID.
State—Session state of the pair
Pair State—Volume pair state.
Remote Volume State—State of the remote volume.
SRDF Mode—SRDF copy type.
Larger SRDF Type—Volume pair state.

Viewing SRDF protected storage groups

Unisphere 8.1 and higher provides SRDF monitoring and management for storage groups. This includes SRDF/Metro protected storage groups on storage systems running HYPERMAX OS 5977 or higher. Only single hop SRDF is supported for SRDF/Metro, that is, current or cascaded setups are not supported. See Managing remote replication sessions on page 406 for additional information.

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups.
3. Click the SRDF tab.

The following properties display, depending on the operating environment:

- **Storage Group**—User-defined storage group name.
- **States**—The state of the storage group. Possible values are:
  - Active
  - ActiveBias
  - Consistent
  - Failed Over
  - Invalid
  - Partitioned
  - R1 Updated
  - R1 Update in progress
Suspended
Synchronization in progress
Synchronized
Transmit Idle

If Unisphere detects an asynchronous state change event for a SRDF group from Solutions Enabler, it updates the Unisphere state for the SRDF group and its related SRDF device groups and SRDF storage groups. The Storage Group list view must be refreshed so that the latest state is reflected.

- **Modes** — The SRDF modes.
- **SRDF Type** — The SRDF type. SGs with volumes having multiple SRDF types display multiples here, for example, R1 and R2.
- **SRDF Groups** — The SRDF group number. Concurrent SRDF setups list multiple SRDF Group numbers.

Click ![ ] to view the following additional properties:

- **Capacity(GB)** — Total capacity of the storage group in GB.
- **SRDF Pairs** — Number of associated SRDF pairs.
- **Masking Views** — The number of associated masking views.
- **Emulation** — The emulation type (ALL, FBA, CKD).
- **Group Type** — The group type.
- **Bias Type** — The bias type.
- **Production Volumes** — The number of production volumes.
- **Last Updated** — The date and time of the last update.

The following controls are available, depending on the operating environment and the mode:

- **Establish** — Establishing SRDF pairs on page 425
- **Split** — Splitting SRDF pairs on page 440
- **Suspend** — Suspending SRDF pairs on page 440
- **Restore** — Restoring SRDF pairs on page 437
- **Resume** — Resuming SRDF links on page 433
- **Failover** — Failing over on page 426
- **Failback** — Failing back on page 427
- **Swap** — Swapping SRDF personalities on page 442
- **Move** — Moving SRDF pairs on page 412
- **Delete Pair** — Deleting SRDF pairs on page 411
- **Set Mode** — Setting SRDF mode on page 413
- **Set Bias** — Setting bias location on page 438
- **Set Volume Attributes > Invalidate** — Invalidating R1/R2 volumes on page 428
- **Set Volume Attributes > Ready** — Making R1/R2 volumes ready on page 429
Viewing related SRDF groups

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups.
3. Click SRDF.
4. Select a storage group and click to open the Storage Group pair list view.
5. Click the number next to SRDF pairs to open the SRDF pair list view.
6. Select a pair and click to open the SRDF pair list properties panel.
7. Click the number next to SRDF Group Number to open the related SRDF groups list view.

The following properties display, depending on the operating environment:

- **SRDF Group Number** — SRDF group number.
- **SRDF Group label** — SRDF group label.
- **Remote SRDF Group Number** — Remote SRDF group number.
- **Remote Symmetrix ID** — Remote Symmetrix ID.
- **Volumes Count** — Indicates Volumes count.

Creating SRDF groups

SRDF groups provide a collective data transfer path linking volumes of two separate storage systems. These communication and transfer paths are used to synchronize data between the R1 and R2 volume pairs associated with the RDF group. At least one physical connection must exist between the two storage systems within the fabric topology.

Before you begin:
The maximum number of supported RDF groups differs by Enginuity version:

<table>
<thead>
<tr>
<th>Enginuity</th>
<th>Maximum number of RDF Groups supported per storage system</th>
<th>Group numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>per director</td>
<td></td>
</tr>
<tr>
<td></td>
<td>per port</td>
<td></td>
</tr>
<tr>
<td>5977 or higher</td>
<td>250</td>
<td>1 to 250</td>
</tr>
<tr>
<td>5876</td>
<td>250</td>
<td>1 to 250</td>
</tr>
</tbody>
</table>

- When specifying a local or remote director for a storage system running HYPERMAX OS 5977, you can select one or more SRDF ports.
- If the RDF interaction includes a storage system running HYPERMAX OS 5977, then the other storage system must be running Enginuity 5876. In addition, in this interaction the maximum storage system volume number allowed on the system running HYPERMAX OS 5977 is FFFF (65635).

To create an SRDF group:

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > SRDF Groups** and click **Create SRDF Group**, or select **CREATE SRDF GROUP** from the **REPLICATION** dashboard.
3. Select a **Communication Protocol** to use when moving data across the SRDF links.
   The value you select here will populate the **Director Port** list.
4. Select a **Remote Array ID**.
5. To refresh the remote storage system information, click **Scan**.
   The scan operation looks for SRDF capable systems known to Unisphere.
6. Type a **SRDF Group Label** (name).
7. Click **SRDF/Metro Witness Group**.
   This checkbox is selectable when the local storage system and the remote selected storage system are both Witness capable.
8. Select a local **SRDF Group Number**.
9. Select the local director ports through which the group will communicate.
10. Click **Advanced Options** to set the advanced options, as described next.

**Setting Advanced options:**

a. Select a local **Link Limbo Period**. This is a length of time for the storage system to continue checking the local SRDF link status. (The range is 0-120 seconds, default is 10.) If the link status is Not Ready after the link limbo time, the volumes are made Not Ready to the link.

b. Select (enable) **Local Link Domino** for the local group. With this feature enabled from either the local or remote side of group's RDF links, failure of the group's last remaining link will make all source (R1) volumes in the group unavailable (not ready) to their host when an R1-side operation occurs. This ensures that the data on the source (R1) and target (R2) devices is always in synch.

c. Select (enable) **Local Auto Link Recovery** for the local group. With this feature enabled, once the link failure is corrected, volumes that were ready
to their host before the failure will automatically be restored to the ready state.

d. Click OK.

11. Select a Remote SRDF Group Number.

12. Select the remote director ports through which the group will communicate.

13. Click Advanced Options to set the advanced options, as described next.

Setting Advanced options:

a. Select a Remote Link Limbo Period. This is a length of time for the storage system to continue checking the remote SRDF link status. (The range is 0-120 seconds, default is 10.) If the link status is Not Ready after the link limbo time, the volumes are made Not Ready to the link.

b. Select (enable) Remote Link Domino for the remote group. With this feature enabled from either the local or remote side of group's RDF links, failure of the group's last remaining link will make all source (R1) volumes in the group unavailable (not ready) to their host when an R1-side operation occurs. This ensures that the data on the source (R1) and target (R2) volumes is always in synch.

c. Select (enable) Remote Auto Link Recovery for the remote group. With this feature enabled, once the link failure is corrected, volumes that were ready to their host before the failure will automatically be restored to the ready state.

d. Click OK.

e. A summary page, displaying all values and options selected, is displayed.

14. Optional: Set one or more of the following:

- Select (enable) Software Compression for the local group. This enables SRDF software data compression for SRDF groups defined on GigE, or Fibre Channel. Although you can enable/disable software compression on the R2 side, the setting of hardware compression on the R1 side is what enables or disables the feature.

- Select (enable) Hardware Compression for the local group. This enables SRDF hardware data compression on an SRDF group defined on a GigE director. Although you can enable/disable hardware compression on the R2 side, the setting of hardware compression on the R1 side is what enables or disables the feature. This feature requires PowerMaxOS 5978 or higher.

15. Do one of the following:

- Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.

- Expand Add to Job List, and click Run Now to perform the operation now.

Modifying SRDF groups

To modify SRDF groups:

Procedure

1. Select the storage system.

2. Select DATA PROTECTION > SRDF Groups to open the SRDF groups list view.
3. Select a group and click **Modify**.

4. Do any number of the following steps:
   a. Select a new **Local Array** through which the group will communicate. When specifying a local or remote array for a storage system running HYPERMAX OS 5977, you can select one or more SRDF ports.
   b. Select a new **Remote Array** through which the group will communicate.

5. Select **Advanced Options** and do any number of the following steps:
   a. Select a local **Link Limbo Period**. The length of time for the storage system to continue checking the local SRDF link status. (The range is 0-120 seconds, default is 10.) If the link status is Not Ready after the link limbo time, the volumes are made Not Ready to the link.
   b. Select (enable) **Link Domino** for the local group. With this feature enabled from either the local or remote side of group's RDF links, failure of the group's last remaining link will make all source (R1) volumes in the group unavailable (not ready) to their host when an R1-side operation occurs. This ensures that the data on the source (R1) and target (R2) devices is always in synch.
   c. Select (enable) **Auto Link Recovery** for the local group. With this feature enabled, once the link failure is corrected, volumes that were ready to their host before the failure will automatically be restored to the ready state.
   d. Select (enable) **Software Compression** for the local group. This enables SRDF software data compression for SRDF groups defined on GigE, or Fibre Channel. Although you can enable/disable software compression on the R2 side, the setting of hardware compression on the R1 side is what enables or disables the feature. This feature requires Enginuity 5876 or later.
   e. Select (enable) **Hardware Compression** for the local group. This enables SRDF hardware data compression on an SRDF group defined on a GigE director. Although you can enable/disable hardware compression on the R2 side, the setting of hardware compression on the R1 side is what enables or disables the feature. This feature requires Enginuity 5876 or later.
   f. Select a remote **Link Limbo Period**. This is a length of time for the storage system to continue checking the remote SRDF link status. (The range is 0-120 seconds, default is 10.) If the link status is Not Ready after the link limbo time, the volumes are made Not Ready to the link.
   g. Select (enable) **Link Domino** for the remote group. With this feature enabled from either the local or remote side of group's RDF links, failure of the group's last remaining link will make all source (R1) volumes in the group unavailable (not ready) to their host when an R1-side operation occurs. This ensures that the data on the source (R1) and target (R2) volumes is always in synch.
   h. Select (enable) **Auto Link Recovery** for the remote group. With this feature enabled, once the link failure is corrected, volumes that were ready to their host before the failure will automatically be restored to the ready state.

6. Do one of the following:
   - Expand **Add to Job List** and click **Add to Job List Now** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
• Expand Add to Job List, and click Run Now to perform the operation now.

Setting SRDF/A DSE attributes

Procedure
1. Select a storage system.
2. Select DATA PROTECTION > SRDF Groups.
3. Select a group, click , and select SRDF/A DSE Setting.
4. Select the pool.
   For systems running HYPERMAX OS 5977, this option may not be available.
5. Type the percentage of the storage system’s write pending limit (Threshold). Once the cache usage of all active groups in the storage system exceeds this limit, data tracks for this group start to spill over to disks. Possible values are from 20 to 100, with 50 being the default.
6. (Optional) Select (enable) the SRDF/A write pacing feature to automatically start for the group when an SRDF/A session is activated (Autostart). This feature must be activated for host write I/O pacing to be invoked.
   For systems running HYPERMAX OS 5977, Autostart is always enabled.
7. Manually Activate/Deactivate the SRDF/A Delta Set Extension (DSE) feature. DSE allows SRDF/A cache to be extended by offloading some or all of the session cycle data to preconfigured disks or pools. Possible values are:
   • No change—Leaves the current write pacing setting.
   • Activate—Activates the feature for the local side of the SRDF link.
   • Activate Both Sides—Activates the feature for both sides of the SRDF link.
   • Deactivate—Deactivates the feature for the local side of the SRDF link.
   • Deactivate Both Sides—Deactivates the feature for both sides of the SRDF link.
   This feature is supported with thin devices.
8. Do one of the following:
   • Expand Add to Job List and click Add to Job List Now to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   • Expand Add to Job List, and click Run Now to perform the operation now.

Setting SRDF/A group attributes

Procedure
1. Select a storage system.
2. Select DATA PROTECTION > SRDF Groups to open the SRDF groups list view.
3. Select a group, click , and select SRDF/A Setting.
4. Type the **Minimum Cycle Time**. This is the minimum amount of time (in seconds) the storage system will wait before attempting to perform an RDF/A cycle switch. Possible values range from 1 to 60 seconds.

5. Type the **Session Priority**. This priority is used to determine which RDF/A session to drop if cache is full. Possible values range from 1 (highest) to 64 (lowest).

6. Select **Transmit Idle Enabled** to preserve the data in cache (if the link is idle) and then retry transmitting the data. This option must be enabled on both local and remote sides.

7. Do one of the following:
   - Expand **Add to Job List** and click **Add to Job List Now** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

---

### Setting SRDF/A pace attributes

**Procedure**

1. Select a storage system.

2. Select **DATA PROTECTION > SRDF Groups**.

3. Select a group, click , and select **SRDF/A Pacing Setting**.

4. Type the maximum I/O delay to apply to each host write I/O when the pacing algorithm is invoked (**Pacing Delay**). Possible values range from 1 to 1,000,000 usec (0.000001 to 1 second), with 50,000 (0.05 seconds or 50 ms) being the default.

5. Type the minimum cache percentage when host write pacing will start (**Threshold**). Possible values range from 1 to 99, with 60% being the default.

6. (Optional) Select to set the threshold on both the R1 and R2 sides (**Both Sides**).

7. (Optional) Set the following write pacing attributes for the RDF group, the volumes in the group, or both:
   a. Select (enable) the SRDF/A write pacing feature to automatically start when an SRDF/A session is activated (**Autostart Group Pacing** and **Autostart Volume Pacing**). This feature must be activated for host write I/O pacing to be invoked.
   b. Manually **Activate/Deactivate** the SRDF/A write pacing feature for the RDF group. Setting this option to **No Change** leaves the current write pacing setting.

SRDF/A write pacing can only be activated when the SRDF/A session is active.

8. Do one of the following:
   - Expand **Add to Job List** and click **Add to Job List Now** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.
Swapping SRDF groups

Before you begin

Before you begin:

- If the target (R2) volume is on a storage system running HYPERMAX OS 5977 or later, and the mode of the source (R1) volume is Adaptive Copy Write Pending, SRDF will set the mode to Adaptive Copy Disk.

- As a result of a swap, operation, a cascaded R1 -> R21 -> R2 configuration can be created if any of the storage systems in the cascaded configuration is running HYPERMAX OS Q1 2015 SR or later.

When you swap the SRDF personality of the designated SRDF volumes, the source (R1) volumes become target (R2) volumes and the target (R2) volumes become source (R1) volumes.

To swap SRDF groups:

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > SRDF Groups.
3. Select an SRDF group, click , and select Swap Groups.
4. Select the mirror to refresh.
5. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Setting consistency protection

Before you begin

To set consistency protection:

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > Storage Groups > SRDF or DATA PROTECTION > Device Groups > SRDF.
3. Select a group, click more , and select Asynchronous > Set Consistency.
4. select Enable or Disable.
5. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration (only applicable for device groups).
6. Click Advanced Options to set the advanced options. Select the advanced options and click OK.
7. Do one of the following:
Deleting SRDF groups

To delete SRDF groups:

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > SRDF Groups**.
3. Select the SRDF group and select .
4. Optional: Click **Advanced Options** and select the **Use Force** check box. This forces the operation.
5. Optional: Click **Advanced Options** and select the **Use SymForce** check box. This forces the operation when the operation would normally be rejected.
6. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

Viewing SRDF groups

The SRDF SG list displays a notification if a capacity mismatch exists between R1 and R2 devices. Mismatch can be R1 > R2 or R1 < R2.

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > SRDF Groups** to open the **SRDF groups** list view.
   
   Use the **SRDF groups** list view to display and manage SRDF groups.

   The following properties display:

   - **SRDF Group**—SRDF group number.
   - **SRDF Group Label**—SRDF group label, for example, Async, Metro, Witness.
   - **Remote SRDF group**—Remote RDF group number.
   - **Type**—Type of group, for example, Dynamic or Witness.
   - **SRDF Mode**—SRDF modes associated with the SRDF group.
   - **Online**—Indication if online.
   - **Transmit Idle**—Time the transmit cycle has been idle.
   - **Volumes Count**—Number of volumes in the group.

   The following controls are available:
Create SRDF Group—Creating SRDF groups on page 461
Modify—Modifying SRDF groups on page 463
Create Pairs—Creating SRDF pairs on page 408
      — Deleting SRDF groups on page 468
Create SRDF Connection—Creating SRDF connections on page 407
Swap Groups—Swapping SRDF groups on page 467
SRDF/A Pacing Setting—Setting SRDF/A pace attributes on page 466
SRDF/A Setting—Setting SRDF/A group attributes on page 465
SRDF/A DSE Setting—Setting SRDF/A DSE attributes on page 465
Assign Dynamic Cache Partition—Assigning dynamic cache partitions on page 837

Viewing SRDF group details

To view SRDF group details:

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > SRDF Groups to open the SRDF groups list view.
3. Select the SRDF group and click to open its Details view.

The properties listed depend on the specifics of the storage system. Some or all of the following properties display:

SRDF Group Number—SRDF group number.
SRDF Group Label—SRDF group label.
SRDF Group Volumes—SRDF group volumes.
Director Identity—Director identifier(s).
Remote SRDF Group—Remote group number(s).
Remote Array ID—Remote storage system serial ID(s).
Remote Director Identity—Remote director identifier(s).
SRDF Modes—SRDF Modes. Possible values are: N/A, Adaptive Copy, Synchronous, Asynchronous, Active, and Metro.
Prevent Auto Link Recovery—Indicates the state of preventing automatic data copy across SRDF links upon recovery.
Copy Jobs—Maximum number of SRDF copy jobs per SRDF group.
Prevent RAs Online Upon Power On—Indicates the state of preventing the SRDF directors from automatically coming back online with power on.
Link Domino—Sets the domino mode for the source (R1) volumes.
Link Config—Link configuration.
Director Config—Indicates the Fibre adapter type.
SRDF Group Configuration—RA group configuration. Possible values are: Dynamic, Static, Witness.
**Link Limbo (sec)** — Number of seconds (0-10) for the storage system to continue checking the local SRDF link status.

**Minimum Cycle Time** — Minimum cycle time (seconds) configured for this session.

**Transmit Idle Time** — Time the transmit cycle has been idle.

**Transmit Idle Enabled** — Whether SRDF/A Transmit Idle state is active for the SRDF group.

**Dynamic Cache Partition Name** — Cache partition name.

**SRDF/A Mode** — The SRDF/A mode. The status of the property can be Single-session, MSC, or N/A.

**MSC Cleanup Required** — Indicates if MSC cleanup is required. The status of the property can be Yes, No, or N/A.

**SRDF/A Session Status** — The SRDF/A session status. The status of the property can be Active, Inactive, or N/A.

**SRDF/A Consistency Protection** — Indicates if consistency protection is enabled. The status of the property can be Enabled, Disabled, or N/A.

**SRDF/A DSE Status** — Indicates if SRDF/A DSE is active.

**SRDF/A DSE Autostart** — Indicates if SRDF/A DSE is automatically enabled when an SRDF/A session is activated for the group.

**SRDF/Metro** — SRDF/Metro. Possible values are: Yes, No.

**SRDF/Metro Witness Degraded** — SRDF/Metro Witness Degraded. Possible values are: Yes, No.

**SRDF/A DSE Threshold** — Percentage of the storage systems write pending limit.

**SRDF/A Write Pacing Status** — Indicates if SRDF/A write pacing is active.

**SRDF/A Write Pacing Delay** — Max delay allowed for host I/O in seconds.

**SRDF/A Write Pacing Threshold** — Minimum cache percentage when host write pacing will start.

**Group Pacing Auto Start** — Indicates if group pacing auto start is enabled/disabled on the SRDF group.

**Device Pacing Supported** — Indicates if SRDF/A device pacing is supported.

**Group Level Pacing State** — Indicates if group level write pacing is enabled or disabled.

**Device Pacing Activated** — Group-level pacing status of the SRDF/A session. The status of the feature can be Active, Inactive, N/A.

**Group Pacing Auto Start** — Indicates if group pacing auto start is enabled/disabled on the SRDF group.

**SRDF Software Compression** — Indicates if software compression is enabled/disabled on the SRDF group.

**SRDF Single Round Trip** — Indicates if single round trip is enabled/disabled on the SRDF group.

**SRDF Hardware Compression** — Indicates if hardware compression is enabled/disabled on the SRDF group.

**SRDF Software Compression Support** — Indicates if SRDF software compression is enabled or disabled.
SRDF Hardware Compression Support — Indicates if SRDF hardware compression is supported on the storage system.

Star Mode — Indicates if SRDF group is in a star configuration.

SQAR Mode — Indicates if SRDF group is in a SQAR configuration.

Links are also provided to views for objects contained in and associated with the SRDF group. Each link is followed by a number, indicating the number of objects in the corresponding view. For example, clicking the number next to SRDF Group Volumes will open a view listing the volumes contained in the SRDF group.

Viewing SRDF protected device groups

The SRDF dashboard provides you with a single place to monitor and manage SRDF sessions on a storage system. This includes device groups types R1, R2, and R21. See Managing remote replication sessions on page 406 for additional information.

Before you begin:

SRDF requires Enginuity version 5876 or HYPERMAX OS 5977.

The following configurations are not supported:

- An R21 or R22 SRDF device on a system running HYPERMAX OS 5977.
- A cascaded SRDF configuration containing a system running HYPERMAX OS 5977.
- A concurrent R22 configuration containing a system running HYPERMAX OS 5977.

To access the SRDF dashboard:

**Procedure**

1. Select the storage system.
2. Select Data Protection > Device Groups.
3. Click SRDF.

The following properties display:

- **Device Group**—Device group name.
- **Standard**—Number of standard volumes.
- **BCV**—Number of BCV volumes.
- **State**—Current state of device group.
- **Group Type**—Device group type.
- **Group Valid**—Indicates if the group is valid or invalid for SRDF management.

The following controls are available:

- **Establish**—Establishing SRDF pairs on page 425
- **Split**—Splitting SRDF pairs on page 440
- **Suspend**—Suspending SRDF pairs on page 440
- **Restore**—Restoring SRDF pairs on page 437
- **Resume**—Resuming SRDF links on page 433
- **Failover**—Failing over on page 426
Resuming SRDF links

This procedure explains how to resume I/O traffic on the SRDF links for all remotely mirrored RDF pairs in a group.

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > SRDF groups.
3. Do the following, depending on whether you want to perform the operation at the group level or pair level:

   Group level:
   a. Select a group, click , and select Resume to open the Resume dialog box.
   b. Select the Use 2nd Hop option if including the second hop of a cascaded SRDF configuration.
   c. Click Advanced Options to set the advanced SRDF session options. Select the advanced options and click OK.
   d. Do one of the following:
      - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
      - Expand Add to Job List, and click Run Now to perform the operation now.
a. Select a group and click to open the SRDF pair list view.
b. Select one or more pairs, click more, and select Resume to open the Resume dialog box.
c. Click Advanced Options to set the advanced SRDF session options. Select the advanced options and click OK.
d. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Viewing SRDF group volumes

This procedure explains how to view the volumes in an SRDF group:

Procedure

1. Select the storage system.
2. Select Data Protection > SRDF groups to open the SRDF groups list view.
3. Select the SRDF group and click to open its Details view.
4. Click the number next to SRDF Group Volumes to open the SRDF List Volumes view.

The following properties display:

Name—Local volume ID.
Configuration—SRDF configuration.
Remote Symmetrix ID—Remote storage system ID.
Remote SRDF Group—Remote SRDF group ID.
Target Volume—Target volume ID.
State—Session state of the pair
Pair State—Volume pair state.
Remote Volume State—State of the remote volume.
SRDF Mode—SRDF copy type.
Larger SRDF Type—Volume pair state.

SRDF/A control actions

<table>
<thead>
<tr>
<th>Action</th>
<th>Activate Type</th>
<th>Write Pacing Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activate</td>
<td>DSE</td>
<td>N/A</td>
<td>Activates the SRDF/A Delta Set Extension feature, which extends the</td>
</tr>
</tbody>
</table>
### Action | Activate Type | Write Pacing Type | Description
--- | --- | --- | ---
Write Pacing | | Group write pacing | Activates SRDF/A write pacing at the group level.
This feature extends the availability of SRDF/A by preventing conditions that result in cache overflow on both the R1 and R2 sides.
Group level write pacing is supported on Symmetrix systems running Enginuity 5876 and higher.
Activates SRDF/A write pacing at the group level.
Group & Volume Write Pacing | | Activates SRDF/A write pacing at the group level and the volume level.
Volume Write Pacing | | Activates SRDF/A write pacing at the volume level.
Write Pacing Exempt | N/A | Activates write pacing exempt. Write pacing exempt allows you to remove a volume from write pacing.

### RDFA flags

<table>
<thead>
<tr>
<th>Flag</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>(C)onsistency</td>
<td>X = Enabled, . = Disabled, - = N/A</td>
</tr>
<tr>
<td>(S)tatus</td>
<td>A = Active, I = Inactive, - = N/A</td>
</tr>
<tr>
<td>(R)DFA Mode</td>
<td>S = Single-session, M = MSC, - = N/A</td>
</tr>
<tr>
<td>(M)sc Cleanup</td>
<td>C = MSC Cleanup required, - = N/A</td>
</tr>
<tr>
<td>(T)ransmit Idle</td>
<td>X = Enabled, . = Disabled, - = N/A</td>
</tr>
<tr>
<td>(D)SE Status</td>
<td>A = Active, I = Inactive, - = N/A</td>
</tr>
</tbody>
</table>
SRDF group modes

The following values can be set for SRDF groups:

**Synchronous**—Provides the host access to the source (R1) volume on a write operation only after the storage system containing the target (R2) volume acknowledges that it has received and checked the data.

**Asynchronous**—The storage system acknowledges all writes to the source (R1) volumes as if they were local volumes. Host writes accumulate on the source (R1) side until the cycle time is reached and are then transferred to the target (R2) volume in one delta set. Write operations to the target volume can be confirmed when the current SRDF/A cycle commits the data to disk by successfully de-staging it to the R2 storage volumes.

For storage systems running Enginuity 5876, you can put an RDF relationship into Asynchronous mode when the R2 volume is a snap source volume.

**Semi Synchronous**—The storage system containing the source (R1) volume informs the host of successful completion of the write operation when it receives the data. The RDF (RA) director transfers each write to the target (R2) volume as the RDF links become available. The storage system containing the target (R2) volume checks and acknowledges receipt of each write.

**AC WP Mode On**—(adaptive copy write pending) the storage system acknowledges all writes to the source (R1) volume as if it was a local volume. The new data accumulates in cache until it is successfully written to the source (R1) volume and the remote director has transferred the write to the target (R2) volume.

**AC Disk Mode On**—For situations requiring the transfer of large amounts of data without loss of performance; use this mode to temporarily to transfer the bulk of your data to target (R2) volumes; then switch to synchronous or semi-synchronous mode.

**Domino Mode On**—Ensures that the data on the source (R1) and target (R2) volumes are always in sync. The storage system forces the source (R1) volume to a Not Ready state to the host whenever it detects one side in a remotely mirrored pair is unavailable.

**Domino Mode Off**—The remotely mirrored volume continues processing I/Os with its host, even when an SRDF volume or link failure occurs.

**AC Mode Off**—Turns off the AC disk mode.

**AC Change Skew**—Modifies the adaptive copy skew threshold. When the skew threshold is exceeded, the remotely mirrored pair operates in the predetermined SRDF state (synchronous or semi-synchronous). As soon as the number of invalid tracks drop below this value, the remotely mirrored pair reverts back to the adaptive copy mode.

**(R2 NR If Invalid) On**—Sets the R2 device to Not Ready if there are invalid tracks.

**(R2 NR If Invalid) Of**—Turns off the (R2 NR_If_Invalid) On mode.

---

Understanding RecoverPoint

RecoverPoint provides block-level continuous data protection and continuous remote replication for on-demand protection and recovery at any point-in-time, and enables
you to implement a single, unified solution to protect and/or replicate data across heterogeneous servers and storage.

RecoverPoint operations on Unisphere require Enginuity 5876 on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.

**Tagging and untagging volumes for RecoverPoint (storage group level)**

**Before you begin**
- Volumes that are part of an RDF pair cannot be tagged for RecoverPoint.
- RecoverPoint operations on Unisphere require Enginuity 5876 or higher on the Symmetrix system.
- This feature is not supported on storage systems running HYPERMAX OS 5977.

This procedure explains how to tag (enable) or untag (disable) volumes for RecoverPoint. Enabling volumes makes them accessible to the RecoverPoint appliance.

**Procedure**
1. Select the storage system.
2. Select **Storage > Storage Groups**.
3. Do one of the following:
   - To tag the storage group, select it, click , and select **Tag for RecoverPoint**.
   - To untag the storage group, select it, click , and select **Untag for RecoverPoint**.
4. Click OK.

**Tagging and untagging volumes for RecoverPoint (volume level)**

**Before you begin**
- Volumes that are part of an RDF pair cannot be tagged for RecoverPoint.
- RecoverPoint operations on Unisphere require Enginuity 5876 or higher on the storage system.
- This feature is not supported on storage systems running HYPERMAX OS 5977.

This procedure explains how to tag (enable) or untag (disable) volumes for RecoverPoint. Enabling volumes makes them accessible to the RecoverPoint appliance.

**Procedure**
1. Select the storage system.
2. Select **Storage > Volumes**.
3. In the **All Volumes** panel, expand the type of volume to tag or untag.
4. Do one of the following:
   - To tag volumes, select volumes, click , and select **Tag for RecoverPoint**.
To untag volumes, select volumes, click Untag, and select Untag for RecoverPoint.

5. Click OK.

Untagging RecoverPoint tagged volumes

Before you begin
This feature is not supported on storage systems running HYPERMAX OS 5977.

Procedure
1. Select the storage system
2. Select DATA PROTECTION > Open Replicator.
3. Click the RecoverPoint Volumes tab.
   Opens the RecoverPoint Volumes view.
4. Select a volume and click Untag.
5. Click OK.

Viewing RecoverPoint copies

Before you begin
- RecoverPoint operations on Unisphere require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- To perform this operation, you must be a monitor or higher.

This procedure explains how to view the RecoverPoint copies for a particular consistency group.

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > RecoverPoint Systems.
   Opens the RecoverPoint list view.
3. Select a RecoverPoint system, click Consistency Groups and click the number next to Consistency Groups.
   Opens the Consistency Group list view.
4. Select a RecoverPoint consistency group and click the number next to Copies.
   Opens the Copies list view which lists the consistency groups on the selected RecoverPoint system.
   The following properties display:
   - **Copy Name**—Name of copy.
   - **State**—State of the copy. Valid values are Enabled or Suspended.
   - **Copy Size (GB)**—Size of the copy.
   - **Copy Role**—Current role of the copy. Valid values are Active or Replica.
   - **RTO (MB)**—Recovery time objective
• **Journal State** — Indicates the state of the journal. Valid values include *Locked* and *Distributing*.

• **Journal Size (GB)** — Size of the journal, in GB.

The following controls are available:

* Viewing RecoverPoint copy details on page 478

### Viewing RecoverPoint copy details

#### Before you begin

- RecoverPoint operations on Unisphere require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- To perform this operation, you must be a monitor or higher.

#### Procedure

1. Select the storage system.
2. Select **DATA PROTECTION > RecoverPoint Systems**.
   
   Opens the **RecoverPoint** list view.

3. Select a RecoverPoint system, click ![Viewing RecoverPoint copy details](image) and click the number next to **Consistency Groups**.
   
   Opens the **Consistency Group** list view.

4. Select a RecoverPoint consistency group and click the number next to **Copies**.

5. Select a copy and click ![Viewing RecoverPoint copy details](image).

   Opens the copy's details view.

   The following properties display:

   • **Name** — Name of copy.
   • **State** — State of the copy. Valid values are *Enabled* or *Suspended*.
   • **Role** — Current role of the copy. Valid values are *Active* or *Replica*.
   • **Copy Size** — Size of the copy.
   • **Journal Size** — Size of the journal, in GB.
   • **Journal State** — Indicates the state of the journal. Valid values include *Locked* and *Distributing*.
   • **Journal Volume Name** — Indicates the state of the journal. Valid values include *Locked* and *Distributing*.
   • **Cluster** — Indicates the state of the journal. Valid values include *Locked* and *Distributing*.
   • **RTO (seconds)** — Recovery time objective in seconds
   • **Journal Size Limit** — Journal size limit
   • **AllowDistribOfLargeSnaps** — Allow distribution of large snapshots
   • **AllowSymmWithOneRPA** — Allow storage system with one RPA
   • **ActivePrimaryRPA** — Active primary RPA
   • **FastForwardBound** — Fast forward bound
- **NumCopySplitters**—Number of copy splitters
- **NumCopyVolumes**—Number of copy volumes
- **NumJournalVolumes**—Number of journal volumes
- **PhoenixDevices**—Phoenix devices
- **TspWritesCleared**—Tsp writes cleared
- **UserSnapshot**—User snapshot
- **Production Copy**—Production copy.
- **Volumes**—Number of associated volumes.
- **Copy Capacity (GB)**—Capacity of the copy, in GB.

**Viewing RecoverPoint sessions**

**Procedure**
1. Select a storage system.
2. Select **DATA PROTECTION > Open Replicator**.
3. Click the **RecoverPoint Sessions** tab.
4. Use the RecoverPoint Sessions list view to view RecoverPoint sessions on the storage system.

   The following properties display:
   - **Cluster name**—Session name.
   - **Control volume**—Control volume name.
   - **Remote volume**—Remote volume name.
   - **Status**—Session status.
   - **Protected Tracks**—Number of protected tracks.

   The following controls are available:

   ![Viewing RecoverPoint session details](image)

**Viewing RecoverPoint session details**

**Procedure**
1. Select the storage system.
2. Select **DATA PROTECTION > Open Replicator**.
3. Click the **RecoverPoint Sessions** tab.
4. Select a session and click ![Viewing RecoverPoint session details](image).
   
   Opens the session details view.

   The following properties display:
   - **Cluster Name**—Session Name.
   - **Control Volume**—Control volume name.
   - **Remote Volume**—Remote volume name.
   - **Remote Volume Specification**—Indicates the remote volume name format.
- **Status**—Session status.
- **Copy pace**—Copy pace value.
- **Protected Tracks**—Number of protected tracks.

### Viewing RecoverPoint storage groups

**Before you begin**

RecoverPoint operations on Unisphererequire 5876. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.

To perform this operation, you must be a monitor or higher.

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > RecoverPoint Systems**.
3. Select a RecoverPoint system and click to open the **Consistency Group** list view.
4. Select a RecoverPoint consistency group and click the number next to **Copies** to open the **Copies** list view.
5. Select a copy and click to open the details view.
6. In the properties panel, click the number next to **Storage Groups**.
   
   The following information displays:
   
   - **Name**—Name of the storage group.
   - **Volumes**—Number of volumes in the group.
   - **Masking views**—Number of associated masking views.
   - **FAST_Policy**—FAST policy associated with the RecoverPoint storage group.
   - **Capacity**—Capacity of the storage group.
   - **Child SG**—For parent storage groups, this field displays the number of child storage groups; otherwise, this field displays zero.

### Viewing RecoverPoint tagged volumes

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > Open Replicator**.
3. Select the **RecoverPoint Volumes** tab to open the RecoverPoint Volumes list view.

   The following properties display:
   
   - **Name**—Volume name.
   - **Type**—Volume volume.
   - **Status**—Volume status.
   - **Reserved**—Indicates if volume is reserved.
   - **Capacity (GB)**—Volume capacity in GB.
   - **Emulation**—Volume emulation type.
The following controls are available:

- Viewing RecoverPoint tagged volume details on page 481
- Untag—Tagging and untagging volumes for RecoverPoint (volume level) on page 476

### Viewing RecoverPoint tagged volume details

**Procedure**

1. Select the storage system.
2. Select DATA PROTECTION > Open Replicator.
3. Select the **RecoverPoint Volumes** tab to open the RecoverPoint Volumes list view.
4. Select a volume and click to open its Details view.

This view allows you to view the volume details.

The following properties display:

- **Masking Info**—Number of masking groups.
- **Storage Groups**—Number of storage groups.
- **FBA Front End Paths**—Number of FBA front end paths.
- **RDF Info**—Number of SRDFs.
- **Volume Name**—Volume name.
- **Physical Name**—Physical name.
- **Volume Identifier**—Volume identifier.
- **Type**—Volume configuration.
- **Encapsulated Volume**—Whether the volumes is encapsulated. Relevant for external disks only.
- **Encapsulated WWN**—World Wide Name for encapsulated volume. Relevant for external disks only.
- **Encapsulated Device Flag**—Device flag for encapsulated volume. Relevant for external disks only.
- **Encapsulated Device Array ID**—Array ID for encapsulated volume. Relevant for external disks only.
- **Status**—Volume status.
- **Reserved**—Whether the volume is reserved.
- **Capacity (GB)**—Volume capacity in GBs.
- **Capacity (MB)**—Volume capacity in MBs.
- **Capacity (CYL)**—Volume capacity in cylinders.
- **Emulation**—Volume emulation.
- **Symmetrix ID**—Storage system on which the volume resides.
- **Symmetrix Vol ID**—Storage volume name/number.
- **HP Identifier Name**—User-defined volume name (1-128 alpha-numeric characters), applicable to HP-mapped devices. This value is mutually exclusive of the VMS ID.
VMS Identifier Name—Numeric value (not to exceed 32766) with relevance to VMS systems. This value is mutually exclusive of the HP ID.

Nice Name—Nice name generated by storage system.

WWN—World Wide Name of the volume.

External ID WWN—External ID World Wide Name of the volume.

DG Name—Name of the device group in which the volume resides, if applicable.

CG Name—Name of the device group in which the volume resides, if applicable.

Attached BCV—Defines the attached BCV to be paired with the standard volume.

Attached VDEV TGT Volume—Volume to which this source volume would be paired.

RDF Type—RDF configuration.

Geometry - Type—Method used to define the volume’s geometry.

Geometry - Number of Cylinders—Number of cylinders, as defined by the volume’s geometry.

Geometry - Sectors per Track—Number of sectors per track, as defined by the volume’s geometry.

Geometry - Tracks per Cylinder—Number of tracks per cylinder, as defined by the volume’s geometry.

Geometry - 512 Block Bytes—Number of 512 blocks, as defined by the volume’s geometry.

Geometry Capacity (GB)—Geometry capacity in GBs.

Geometry Limited—Indicates whether an encapsulated volume has a Symmetrix cylinder size larger than the reported user-defined geometry.

GCM—Indicator of GCM.

SSID—Subsystem ID.

Capacity (Tracks)—Capacity in tracks.

SA Status—Volume SA status.

Host Access Mode—Host access mode.

Pinned—Whether the volume is pinned.

RecoverPoint Tagged—Whether or not the volume is tagged for RecoverPoint.

Service State—Service state.

Defined Label Type—Type of user-defined label.

Dynamic RDF Capability—RDF capability of the volume.

Mirror Set Type—Mirror set for the volume and the volume characteristic of the mirror.

Mirror Set DA Status—Volume status information for each member in the mirror set.

Mirror Set Invalid Tracks—Number of invalid tracks for each mirror in the mirror set.
Priority QoS—Priority value assigned to the volume. Valid values are 1 (highest) through 16 (the lowest).

Dynamic Cache Partition Name—Name of the cache partition.

XtremSW Cache Attached—Whether the volume is currently controlled by cache cards.

Compressed Size (GB)—Size of the compressed volume.

Compressed Ratio (%)—Percentage of volume compressed.

Compressed Size Per Pool (GB)—Size of the compressed pool.

Optimized Read Miss—Cacheless read miss status.

System Managed—The storage system determines the appropriate optimized read miss mode.

Protecting storage groups using RecoverPoint

Before you begin

- RecoverPoint operations on Unisphere require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- To perform this operation you must be a StorageAdmin.
- The storage group being replicated must be masked to the host.
- The storage group being replicated must not contain any volumes that are already tagged for RecoverPoint.
- Connectivity to the RecoverPoint system/cluster is available.
- RecoverPoint 4.1 is setup and operational. For each cluster in the setup, gatekeepers and repository volumes must be configured in their relevant masking view. Uses a default journal masking view naming convention.
- Depending on the options selected as part of the Protect Storage Group wizard and the existing configuration, some values for some options might populate automatically.

Procedure

1. Select the storage system.
2. Select STORAGE > Storage Groups.
3. Select the storage group and click Protect.
5. Click NEXT.
6. On the Configure RecoverPoint page, specify the following information:
   - RecoverPoint System—RecoverPoint system.
   - RecoverPoint Group Name—Name of the RecoverPoint group.
   - RecoverPoint Cluster—RecoverPoint cluster.
   - Production Name—Name of the production.
   - Data Initiator Group—Data initiator group.
Journal Port Group — Journal port group.
Data Initiator Group — Journal initiator group.

7. Click NEXT.

8. On the Add Copies page, specify the following information:
   - RecoverPoint Cluster — RecoverPoint cluster.
   - Copy Name — Name of the RecoverPoint copy.
   - Mode — Specify whether the mode is Synchronous or Asynchronous.
   - Array — Storage system.
   - Target Storage Group — Specify whether the RecoverPoint copy targets a new storage group or an existing group.
   - Copy Storage Group — Name of storage group to be copied.
   - Data Thin Pool — Name of data thin pool.
   - Data Port Group — Name of data port group.
   - Journal Thin Pool — Name of journal thin pool.
   - Journal Port Group — Name of journal port group.

9. Click Add Copy.

   Lists the copy in the Copy Summary table.

10. Click NEXT.

11. On the FINISH page, verify your selections. To change any of them, click BACK. Some changes may require you to make additional changes to your configuration.

12. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, then click Run Now to perform the operation now.

### Viewing RecoverPoint volumes

**Before you begin**

RecoverPoint operations on Unisphere require Enginuity 5876. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.

To view information on RecoverPoint tagged volumes, refer to Viewing RecoverPoint tagged volumes on page 480.

To perform this operation, you must be a monitor or higher.

This procedure explains how to view the RecoverPoint volumes for a particular consistency group.

To view RecoverPoint volumes:

**Procedure**

1. Select the storage system.
2. Select DATA PROTECTION > RecoverPoint Systems to open the RecoverPoint Systems view.
3. Select a RecoverPoint system and click
4. Click the number next to RecoverPoint consistency group.
5. Select a RecoverPoint consistency group and click
6. Click the number next to Replication Sets.
7. Select the replication set and click
8. Click the number next to Volumes.

The following properties display:
- **Volume Name**—Name of the volume.
- **Capacity (GB)**—Capacity, in GB, of the volume.
- **Replication Set**—RecoverPoint replication set.
- **Copy Name**—RecoverPoint copy.
- **Storage Type**—Type of storage system.
- **Array ID**—Array ID.
- **Vendor**—Vendor of the volume.
- **Product Name**—Storage product installed.

### Viewing RecoverPoint clusters

**Before you begin**

RecoverPoint operations on Unisphere require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > RecoverPoint Systems**.

   Opens the **RecoverPoint Systems** list view.
3. Select a **RecoverPoint** system.
4. Click and click the number next to **Clusters**.

   Opens the **RecoverPoint Clusters** table view.

   The following information displays:
   - **Cluster Name**—Name of the cluster.
   - **RecoverPoint Appliances**—Number of RecoverPoint appliances.
   - **IPv4 Address**—IP address, in IPv4 format. If an IPv6 address is used, this column has the value "N/A".
   - **IPv6 Address**—IP address, in IPv6 format. If an IPv4 address is used, this column has the value "N/A".
   - **RPA Type**—RecoverPoint appliance type.
   - **Maintenance Mode**—Maintenance mode in use.
Viewing RecoverPoint cluster details

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > RecoverPoint Systems.
   Opens the RecoverPoint Systems list view.
3. Click \ and click the number next to Clusters.
   Opens the cluster list view.
4. Select a cluster and click \.
   Opens the cluster details view.
   The following properties display:
   - **Cluster Name**—Volume name.
   - **IPv4 Address**—IP address, in IPv4 format. If an IPv6 address is used, this column has the value "N/A".
   - **IPv6 Address**—IP address, in IPv6 format. If an IPv4 address is used, this column has the value "N/A".
   - **RecoverPoint Appliances**—Number of RecoverPoint appliances.
   - **RecoverPoint Splitters**—Number of RecoverPoint splitters.
   - **Software Serial ID**—Serial ID of the software.
   - **RPA Type**—RecoverPoint appliance type.
   - **Timezone**—Time zone.
   - **Maintenance Mode**—Maintenance mode in use.
   - **Internal Cluster Name**—Internal name of the cluster.

Viewing RecoverPoint splitters

Before you begin
RecoverPoint operations on Unisphere require Enginuity 5876 on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.

This procedure explains how to view RecoverPoint splitters.

To view RecoverPoint splitters:

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > RecoverPoint Systems.
   Opens the RecoverPoint Systems list view.
3. Select a RecoverPoint system.
4. Click \ and click the number next to Clusters.
   Opens the cluster list view.
5. Select a cluster and click \.
Opens the cluster details view.

6. Click the number next to **Splitters** to open the **RecoverPoint Splitters** list view.

   The following information displays:
   - **Name**—Name of the splitter.
   - **Array ID**—Array ID of the splitter.
   - **Array Type**—Array type of the splitter.
   - **Status**—Status of the splitter.
   - **Attached RPA Cluster**—Number of attached clusters.

### Viewing RecoverPoint appliances

**Before you begin**

RecoverPoint operations on Unisphere require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > RecoverPoint Systems**.
   - Opens the **RecoverPoint Systems** list view.
3. Select a RecoverPoint system.
4. Click \(\text{①} \) and click the number next to **Clusters**.
   - Opens the cluster list view.
5. Select a cluster and click \(\text{②} \).
   - Opens the cluster details view.
6. Click \(\text{①} \) and click the number next to **RecoverPoint Appliances**.
   - Opens the RecoverPoint Appliances view and displays the following information:
     - **Name**—Name of the RecoverPoint appliance.
     - **Status**—Status of the RecoverPoint appliance.
     - **WAN (IP)**—Wide Area Network (WAN) IP address
     - **Management IPv4**—IP address, in IPv4 format.
     - **Local Fibre Connectivity**—Local RPA Fibre Connectivity
     - **Remote Fibre Connectivity**—Remote RPA Fibre Connectivity

### RecoverPoint systems

**Manage RecoverPoint discovery**

To discover a RecoverPoint system, see **Discovering RecoverPoint Systems** on page 488.

To update RecoverPoint discovery information, see **Updating RecoverPoint discovery information** on page 488.
Discovering RecoverPoint Systems

Before you begin
- RecoverPoint operations on Unisphere require Enginuity 5876 on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- This operation requires StorageAdmin privileges.

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > RecoverPoint Systems.
3. Click Create.
4. In the Discover RecoverPoint System dialog box, type the following information:
   - System Name—RecoverPoint system name.
   - System IPv4—System IP address, in IPv4 format.
   - Port—System port number.
   - System Username—System username.
   - System Password—System password.
   - Confirm System Password—Re-enter system password.
5. Click OK.

Deleting RecoverPoint systems

Before you begin
RecoverPoint operations on Unisphere require Enginuity 5876 on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > RecoverPoint Systems
3. Select a RecoverPoint system and click Delete RecoverPoint System.
4. Click OK.

Updating RecoverPoint discovery information

Before you begin
- RecoverPoint operations on Unisphere require Enginuity 5876 on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- This operation requires StorageAdmin privileges.

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > RecoverPoint Systems.
3. Select a RecoverPoint system.
4. Click Update Discovery Information.
5. Type the following information.
   - **Port** — System port number.
   - **System Username** — System username.
   - **System Password** — System password.
   - **Confirm System Password** — Re-enter system password.
6. Click OK.

Viewing RecoverPoint systems

**Before you begin**
RecoverPoint operations on Unisphere require 5876 on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.

This procedure explains how to view previously discovered RecoverPoint systems.

To view RecoverPoint systems:

**Procedure**
1. Select the storage system.
2. Select **DATA PROTECTION > RecoverPoint Systems** to open the RecoverPoint Systems view.
   - The following properties display:
     - **System Name** — Name of the system.
     - **IPv4 Address** — IP address of the system.
     - **Port** — Port of the system.
     - **Clusters** — Number of RPA clusters in the system.
     - **Consistency Groups** — Number of consistency groups associated with the system.
     - **Error Events** — Number of events reported for the system.
     - **Error Alerts** — Number of alerts reported for the system.
   - The following controls are available:
     - **Viewing RecoverPoint system details** on page 489
     - **Create** — Discovering RecoverPoint Systems on page 488
     - **Update Discovery Information** — Updating RecoverPoint discovery information on page 488
     - **Delete RecoverPoint System** — Deleting RecoverPoint systems on page 488

Viewing RecoverPoint system details

**Before you begin**
RecoverPoint operations on Unisphere require Enginuity 5876. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.

To view RecoverPoint system details:
Procedure

1. Select the storage system.
2. Select **DATA PROTECTION > RecoverPoint Systems** to open the RecoverPoint Systems view.
3. Select the system and click 🔄 to open its Details view.
   The following properties display:
   - **RecoverPoint Systems**—Name of the system.
   - **Consistency Groups**—Number of consistency groups associated with the system.
   - **Clusters**—Number of RPA clusters in the system.
   - **Critical Alerts Count**—Number of critical alerts.
   - **OK Alerts Count**—Number of OK alerts.
   - **Warning Alerts Count**—Number of warning alerts.
   - **Critical Events Count**—Number of critical events.
   - **Warning Events Count**—Number of warning events.
   - **Events Error Count**—Number of events errors.

RecoverPoint consistency groups

Viewing RecoverPoint consistency groups

**Before you begin**

- RecoverPoint operations on Unisphere require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- To perform this operation, you must be a monitor or higher.

This procedure explains how to view the consistency groups used to protect the RecoverPoint volumes.

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > RecoverPoint**.
   Opens the **RecoverPoint** list view.
3. Select a RecoverPoint system, click 🔄 and click the number next to **Consistency Groups**.
   Opens the **Consistency Group** list view which lists the consistency groups on the selected RecoverPoint system.
   The following properties display:
   - **Consistency Group**—Consistency group name.
   - **Group Enabled**—Consistency group state.
   - **Link States**—Lists the states of associated links.
   - **Source Capacity (GB)**—Source capacity in GB.
   - **Primary RPA**—Primary RecoverPoint appliance number.
• **Production Copy**—Name of the production copy.

The following controls are available:

• Viewing RecoverPoint consistency group details on page 491
• **Copies**—Viewing RecoverPoint copies on page 477
• **Replication Sets**—Viewing RecoverPoint replication sets on page 492
• **Active Links**—Viewing RecoverPoint links on page 493

**Viewing RecoverPoint consistency group details**

**Before you begin**

• RecoverPoint operations on Unisphere require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.

• To perform this operation, you must be a monitor or higher.

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > RecoverPoint**.
   
   Opens the **RecoverPoint** list view.

3. Select a RecoverPoint system, click **i** and click the number next to **Consistency Groups**.

4. Select a consistency group and click **i** to view the properties of that Consistency Group.

Displays the properties of the Consistency Group.

The following properties display:

• **Group State**—State of the group.
• **Group Setting**—Group setting.
• **Production Copy**—Name of the production copy.
• **Copies**—Number of associated copies.
• **Replication Sets**—Number of associated replication sets.
• **Active Links**—Number of active links.
• **Passive Links**—Number of passive links.
• **Link States**—Lists the states of associated links.
• **Distributed Group**—Distributed group.
• **Managed by RecoverPoint**—Indicates if the consistency group is managed by RecoverPoint.
• **Read Only Replica Volumes**—Read-only replica volumes.
RecoverPoint replication sets

Viewing RecoverPoint replication sets

Before you begin

- RecoverPoint operations on Unisphere require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- To perform this operation, you must be a monitor or higher.

This procedure explains how to view the RecoverPoint replication sets for a particular consistency group.

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > RecoverPoint.
   
   Opens the RecoverPoint list view.
3. Select a RecoverPoint system, click and click the number next to Consistency Groups.
   
   Opens the Consistency Group list view.
4. Select a RecoverPoint consistency group and click the number next to Replication Sets.
   
   Opens the Replication Sets list view, which lists replication sets associated with the selected consistency group.
   The following properties display:
   - Name—Name of the replication set.
   - Capacity (GB)—Source capacity, in GB.
   - Production Volume Capacity (GB)—Production volume capacity, in GB.
   - Volumes—Number of associated volumes.
   The following control is available:
   - Viewing RecoverPoint replication set details on page 492

Viewing RecoverPoint replication set details

Before you begin

- RecoverPoint operations on Unisphere require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- To perform this operation, you must be a monitor or higher.

This procedure explains how to view the details of a RecoverPoint replication set.

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > RecoverPoint.
   
   Opens the RecoverPoint list view.
3. Select a RecoverPoint system, click 🔄 and click the number next to Consistency Groups.
   Opens the Consistency Group list view.

4. Select a RecoverPoint consistency group and click the number next to Replication Sets.

5. Select a replication set, and click 🔄.
   The following properties display:
   - Name—Name of the replication set.
   - Volumes—Number of associated volumes.
   - Volume Name—Name of associated volume.
   - Production Volume Capacity (GB)—Production volume capacity, in GB.
   - Capacity (GB)—Source capacity, in GB.

**RecoverPoint links**

Viewing RecoverPoint links

**Before you begin**
- RecoverPoint operations on Unisphere require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- To perform this operation, you must be a monitor or higher.

This procedure explains how to view the RecoverPoint links for a particular consistency group.

**Procedure**

1. Select the storage system.
2. Select DATA PROTECTION > RecoverPoint Systems.
   Opens the RecoverPoint Systems list view.

3. Select a RecoverPoint system, click 🔄 and click the number next to Consistency Groups.
   Opens the Consistency Group list view.

4. Select a RecoverPoint consistency group and click the number next to Links.
   Opens the Links list view, which lists the links associated with the selected consistency group.
   The following properties display:
   - Name—Name of the RecoverPoint link.
   - Transfer Enabled—Indicates if the transfer state is enabled for this RecoverPoint link.
   - Link State—Current role of the copy. Valid values are Active or Replica.
   - Local Link—Indicates if the link state is active or paused.
   - Protection Mode—Protection Mode.
   - RPO (seconds)—RPO.
The following control is available:

- Viewing RecoverPoint link details on page 494

Viewing RecoverPoint link details

Before you begin

- RecoverPoint operations on Unisphere require Enginuity 5876 or higher on the storage system. RecoverPoint operations are not supported on storage systems running HYPERMAX OS 5977 or higher.
- To perform this operation, you must be a monitor or higher.

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > RecoverPoint.
   Opens the RecoverPoint list view.
3. Select a RecoverPoint system, click and click the number next to Consistency Groups.
   Opens the Consistency Group list view.
4. Select a RecoverPoint consistency group and click the number next to Links.
5. Select a link and click .
   Opens the link’s details view.
   The following properties display:
   - Name—Name of the RecoverPoint link.
   - Transfer State—Indicates if the transfer state is enabled for this RecoverPoint link.
   - Link State—Indicates if the link state is active or paused.
   - Local—Indicates if the link is local.
   - RPO (seconds)—Recovery point objective in seconds.
   - First Copy—First copy.
   - Second Copy—Second copy.
   - Protection Mode—Protection Mode.
   - Replication Over WAN—Indicates if replication over WAN is supported.
   - WAN Compression—Specifies what WAN compression, if any, is being used.
   - Bandwidth Limit—Bandwidth limit.
   - Deduplication—Specifies if deduplication is enabled.
   - Snapshot Granularity—Snapshot granularity.

Creating Open Replicator copy sessions

Before you begin

When the ORS control volumes are on a storage system running HYPERMAX OS 5977 or higher, the following session options cannot be used:
There are many rules and limitations for running Open Replicator sessions. Refer to the Solutions Enabler Migration CLI Product Guide before creating a session. For a quick reference, refer to Open Replicator session options.

Procedure

1. Select the storage system.
2. Select Data Protection > Open Replicator > Open Replicator SAN View.
3. Filter the items displayed in the Filtered LUNs panel by selecting items within the Control Ports, Remote Ports, and Remote Volumes panels.
4. Select one or more volumes within the Filtered LUNs panel and click Create Copy Session.
5. Click Create Copy Session.
7. Click Next.
   The Source - Remote Volumes lists the remote volumes from the Open Replicator remote volumes list view. The Target - Control Volumes lists all the control volumes that can be paired with the remote volumes.
   For a cold push session, one control volume can concurrently push data to up to 16 remote volumes. For cold pull, hot push, and hot pull sessions only one control volume can push/pull to one remote device.
8. Select a remote volume and target volume, then click Add Pair.
   If the pair is valid, it is added to the Volume Pairs list.
9. Click Remove Pair to edit the Volume Pairs list.
10. Click Next.
11. Enter Session Name.
12. Enter Copy Pace value (0 - slowest to 9 - fastest).
   With offline copying, there is a slight pause between each track write. You can speed up a copy operation by reducing or eliminating this pause. While in the CopyInProgress or CopyOnAccess state, set a pace value higher than the default of 5. Setting the copy pace to 9 eliminates this pause.
   This feature is not supported when the ORS control volume is on a storage system running HYPERMAX OS 5977.
13. Select the Open Replicator session options and click Next.
14. View session Summary and click Finish to create session or click Back to edit session options.

Activating Open Replicator session

Before you begin
The copy session must be in a created or recreated state before you can activate it.

Procedure

1. Select the storage system.
2. Select Data Protection > Open Replicator > Open Replicator Sessions to open the Open Replicator Sessions list view.

3. Select a session and click Activate to open the Activate Session dialog box.

4. Select a copy option. Refer to Open Replicator session options for session copy and control options.

5. Click OK.

**Recreating Open Replicator sessions**

**Before you begin**

Recreating operations are not supported when the ORS control volume is on a storage system running HYPERMAX OS 5977.

**Procedure**

1. Select the storage system.
2. Select Data Protection > Open Replicator > Open Replicator Sessions.
3. Select a session and click Recreate.
4. Optional: Select the PreCopy or Force checkbox or both checkboxes.
5. Click OK.

**Restoring Open Replicator sessions**

**Before you begin**

- The restore operation restores the copy session back to the control volume by pulling back only the changed tracks from the remote volume. The session must have been created with differential copying, and must be in the copied state. Hot or cold differential push sessions can be restored.
- Restore operations are not supported when the ORS control volume is on a storage system running HYPERMAX OS 5977.

**Procedure**

1. Select the storage system.
2. Select Data Protection > Open Replicator > Open Replicator Sessions.
3. Select a session and click Restore.
4. Select any number of the available options. Refer to Open Replicator session options for session control options.
5. Click OK.

**Renaming Open Replicator sessions**

**Before you begin**

Renaming operations are not supported when the ORS control volume is on a storage system running HYPERMAX OS 5977.

**Procedure**

1. Select the storage system.
2. Select Data Protection > Open Replicator > Open Replicator Sessions.
3. Select a session and click Rename.
4. Type a new name for the session.
5. Click OK.

Removing Open Replicator sessions

Before you begin
Removing Open Replicator sessions is not supported when the ORS control volume is on a storage system running HYPERMAX OS 5977.

Procedure
1. Select the storage system.
2. Select Data Protection > Open Replicator > Open Replicator Sessions.
3. Select a session and click Remove, and click OK.
   An error message is displayed if the session is in a state that does not allow the session to be removed.

Setting Open Replicator session background copy mode

Before you begin
Setting background copy mode to precopy is not supported when the ORS control volume is on a storage system running HYPERMAX OS 5977.

This procedure sets the session background copy mode for an ORS session that has already been created.

Procedure
1. Select the storage system.
2. Select Data Protection > Open Replicator > Open Replicator Sessions.
3. Select a session and click Set Mode.
4. Select the background copy mode. Refer to Open Replicator session options for session control options.
5. Click OK.

Setting Open Replicator session donor update off

This procedure deactivates donor update for a session that was created with donor update.

Procedure
1. Select the storage system.
2. Select Data Protection > Open Replicator > Open Replicator Sessions to open the Open Replicator Sessions list view.
3. Select a session and click Donor Update Off to open the Set Donor Update Off dialog box.
4. Select the Open Replicator session options.
5. Click OK.

Setting Open Replicator session front end zero detection off

This procedure deactivates front end zero detection for a session that was created with front end zero.
**Setting Open Replicator session pace**

**Before you begin**
This feature is not supported on storage systems running HYPERMAX OS 5977 or higher.

This procedure sets how fast data copies between volumes during an ORS session. Values can range from 0 to 9, with 0 being the fastest pace, and 9 being the slowest pace. If set to 0, there is no inserted delay time and the replication will proceed as fast as possible.

Values of 1 - 9 add delays, which takes longer to complete copying but conserves system resources. The default for both online (hot) replication and offline (cold) replication is 5.

**Procedure**

1. Select the storage system.
2. Select **Data Protection > Open Replicator > Open Replicator Sessions**.
3. Select a session and click **Frontend Zero Off** to open **Set Frontend Zero Off** dialog box.
   Refer to **Open Replicator session options** for session control options.
4. Click **OK**.

**Setting Open Replicator ceiling**

The Open Replicator ceiling value is the percentage of bandwidth available for background copying. You should only set this value after understanding the bandwidth being used by other applications. By default, the ceiling value is NONE.

**Procedure**

1. Select a storage system.
2. Select **System > System Dashboard > Front End Directors** to open the **Front End Directors** list view.
3. Select a director and click **Set ORS Ceiling** to open the **Set ORS Ceiling** dialog box.
4. Type a **Open Replicator Ceiling** value from 1 (minimum) to 100 (maximum) and click **OK**.

**Terminating Open Replicator sessions**

**Procedure**

1. Select the storage system.
2. Select **Data Protection** > **Open Replicator** > **Open Replicator Sessions View** to open the **Open Replicator SAN View**.

3. Select a session and click **Terminate** to open the **Terminate** confirmation dialog box.

4. Select terminate options.

   Refer to **Open Replicator session options** for session control options.

5. Click **OK**.

---

**Viewing Open Replicator sessions**

**Procedure**

1. Select the storage system.

2. Select **DATA PROTECTION** > **Open Replicator** and click **Open Replicator Sessions**.

   Use this view to view and manage Open Replicator sessions.

   The following properties display:

   - **Session**—ORS session name.
   - **Control Volume**—Control volume name.
   - **Remote Volume**—Remote volume name.
   - **Status**—Session status.
   - **Protected Tracks**—Number of protected tracks.

   The following controls are available:

   - **Viewing Open Replicator session details** on page 500
   - **Activate**—Activating Open Replicator session on page 495
   - **Terminate**—Terminating Open Replicator sessions on page 498
   - **Front End Zero Off**—Setting Open Replicator session donor update off on page 497
   - **Donor Update Off**—Setting Open Replicator session donor update off on page 497
   - **Rename**—Renaming Open Replicator sessions on page 496 This option is not available for systems running HYPERMAX OS 5977 or higher.
   - **Remove**—Removing Open Replicator sessions on page 497 This option is not available for systems running HYPERMAX OS 5977 or higher.
   - **Restore**—Restoring Open Replicator sessions on page 496 This option is not available for systems running HYPERMAX OS 5977 or higher.
   - **Recreate**—Recreating Open Replicator sessions on page 496 This option is not available for systems running HYPERMAX OS 5977 or higher.
   - **Set Mode**—Setting Open Replicator session background copy mode on page 497
   - **Set Pace**—Setting Open Replicator session pace on page 498 This option is not available for systems running HYPERMAX OS 5977 or higher.
Viewing Open Replicator session details

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > Open Replicator and click Open Replicator Sessions.
3. Select a session and click to open the session details view.

Depending on the configured system, some or all of the following properties display:
- **Session**—ORS session name.
- **Control Volume**—Control volume name.
- **Remote Volume**—Remote volume name.
- **Remote Volume Specification**—Remote volume specification. (Not applicable for storage systems running HYPERMAX OS 5977 or higher.)
- **Status**—Session status.
- **Percent Complete**—Percent tracks copied. (Not applicable for storage systems running HYPERMAX OS 5977 or higher.)
- **Copy Pace**—Copy Pace value (0 - slowest to 9 - fastest, default is 5). (Not applicable for storage systems running HYPERMAX OS 5977 or higher.)
- **Protected Tracks**—Number of protected tracks.
- **Modified Tracks**—Number of modified tracks. (Not applicable for storage systems running HYPERMAX OS 5977 or higher.)
- **Background Copy**—Indicates if background copying is enabled.
- **Differential Copy**—Indicates if differential copying is enabled.
- **Pull Session**—Indicates if session is a pull session = Yes, or a push session = No.
- **Cold Copy Session**—Indicates if session is a cold copy session = Yes, or a hot copy session = No.
- **Donor Update**—Indicates if donor update is enabled.
- **RecoverPoint Session**—Indicates if session is a RecoverPoint session. (Not applicable for storage systems running HYPERMAX OS 5977 or higher.)
- **Standard ORS Session**—Indicates if session is a standard session. (Not applicable for storage systems running HYPERMAX OS 5977 or higher.)
- **Front-End Zero**—Indicates if front-end zero detection is enabled.

Viewing Open Replicator SAN View

Procedure
1. Select the storage system.
2. Select Data Protection > Open Replicator > Open Replicator SAN View.

Use this view to view select remote volumes in the Filtered LUNs panel to use for Open Replicator copy sessions. The list of volumes can be filtered further by
selecting items within the Control Ports, Remote Ports, and Remote Volumes panels.
The following controls are available:

- **Create Copy Session**—Creating Open Replicator copy sessions on page 494
- **Rescan**—Causes a rescan operation to be performed.

## Open Replicator session options

Depending on the operation you are performing, some of the following options may not apply.

<table>
<thead>
<tr>
<th>Session Option</th>
<th>Used with Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistent</td>
<td>Activate</td>
<td>Causes the volume pairs to be consistently activated.</td>
</tr>
<tr>
<td></td>
<td>Donor Update Off</td>
<td>Consistently stops the donor update portion of a session and maintains the consistency of data on the remote volumes.</td>
</tr>
<tr>
<td>Copy</td>
<td>Create</td>
<td>Volume copy takes place in the background. This is the default for both pull and push sessions.</td>
</tr>
<tr>
<td>Cold</td>
<td>Create</td>
<td>Control volume is write disabled to the host while the copy operation is in progress. A cold copy session can be created as long as one or more directors discovers the remote device.</td>
</tr>
<tr>
<td>Differential</td>
<td>Create</td>
<td>Creates a one-time full volume copy. Only sessions created with the differential option can be recreated.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For push operations, this option is selected by default.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For pull operations, this option is cleared by default (no differential session).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>This option is not supported when the ORS control volume is on a storage system running HYPERMAX OS 5977.</td>
</tr>
<tr>
<td>Donor Update</td>
<td>Create</td>
<td>Causes data written to the control volume during a hot pull to also be written to the remote volume.</td>
</tr>
<tr>
<td>Incremental Restore</td>
<td></td>
<td>Maintains a remote copy of any newly written data while the Open Replicator session is restoring.</td>
</tr>
<tr>
<td>Session Option</td>
<td>Used with Command</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Force</td>
<td>Terminate</td>
<td>Select the <strong>Force</strong> option if the copy session is in progress. This will allow the session to continue to copy in its current mode without donor update.</td>
</tr>
<tr>
<td></td>
<td>Restore</td>
<td></td>
</tr>
<tr>
<td>Donor Update Off</td>
<td></td>
<td>Select the <strong>Force</strong> option if the copy session is in progress. This will allow the session to continue to copy in its current mode without donor update.</td>
</tr>
<tr>
<td>Force Copy</td>
<td>Activate</td>
<td>Overrides any volume restrictions and allows a data copy. For a push operation, remote capacity must be equal to or larger than the control volume extents and vice versa for a pull operation. The exception to this is when you have pushed data to a remote volume that is larger than the control volume, and you want to pull the data back, you can use the <strong>Force_Copy</strong> option.</td>
</tr>
<tr>
<td>Front-End Zero Detection</td>
<td>Create</td>
<td>Enables front end zero detection for thin control volumes in the session. Front end zero detection looks for incoming zero patterns from the remote volume, and instead of writing the incoming data of all zeros to the thin control volume, the group on the thin volume is de-allocated.</td>
</tr>
<tr>
<td>Hot</td>
<td>Create</td>
<td>Hot copying allows the control device to be read/write online to the host while the copy operation is in progress. All directors that have the local devices mapped are required to participate in the session. A hot copy session cannot be created unless all directors can discover the remote device.</td>
</tr>
<tr>
<td>Nocopy</td>
<td>Activate</td>
<td>Temporarily stops the background copying for a session by changing the state to CopyOnAccess or CopyOnWrite from CopyInProg.</td>
</tr>
<tr>
<td>Pull</td>
<td>Create</td>
<td>A pull operation copies data to the control device from the remote device.</td>
</tr>
</tbody>
</table>
### Session Option

<table>
<thead>
<tr>
<th>Session Option</th>
<th>Used with Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Push</td>
<td>Create</td>
<td>A push operation copies data from the control volume to the remote volume. This option is not supported when the ORS control volume is on a storage system running HYPERMAX OS 5977.</td>
</tr>
<tr>
<td></td>
<td>Precopy</td>
<td>For hot push sessions only, begins immediately copying data in the background before the session is activated. This option is not supported when the ORS control volume is on a storage system running HYPERMAX OS 5977.</td>
</tr>
<tr>
<td>SymForce</td>
<td>Terminate</td>
<td>Forces an operation on the volume pair including pairs that would be rejected. Use caution when checking this option because improper use may result in data loss.</td>
</tr>
</tbody>
</table>

### Open Replicator flags

<table>
<thead>
<tr>
<th>Flag</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Background copying</td>
</tr>
<tr>
<td>D</td>
<td>Differential copying</td>
</tr>
<tr>
<td>S</td>
<td>Copy direction</td>
</tr>
<tr>
<td>H</td>
<td>Copy operation</td>
</tr>
<tr>
<td>U</td>
<td>Donor update</td>
</tr>
<tr>
<td>T</td>
<td>Session type</td>
</tr>
<tr>
<td>Z</td>
<td>Front-end zero detection</td>
</tr>
<tr>
<td>*</td>
<td>Failed session can be reactivated.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flag</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X = Enabled</td>
</tr>
<tr>
<td></td>
<td>. = Disabled</td>
</tr>
<tr>
<td></td>
<td>X = Enabled</td>
</tr>
<tr>
<td></td>
<td>. = Disabled</td>
</tr>
<tr>
<td></td>
<td>X = Pushing data to the remote volume(s)</td>
</tr>
<tr>
<td></td>
<td>. = Pulling data from the remote volume(s)</td>
</tr>
<tr>
<td></td>
<td>X = Hot copy session</td>
</tr>
<tr>
<td></td>
<td>. = Cold copy session</td>
</tr>
<tr>
<td></td>
<td>X =Enabled</td>
</tr>
<tr>
<td></td>
<td>. = Disabled</td>
</tr>
<tr>
<td></td>
<td>M = Migration session</td>
</tr>
<tr>
<td></td>
<td>R = RecoverPoint session</td>
</tr>
<tr>
<td></td>
<td>S = Standard ORS session</td>
</tr>
<tr>
<td></td>
<td>X =Enabled</td>
</tr>
<tr>
<td></td>
<td>. = Disabled</td>
</tr>
</tbody>
</table>

* Failed session can be reactivated.
Understanding non-disruptive migration (NDM)

Non-Disruptive Migration (NDM) provides a method for migrating data from a source array to a target array without application host downtime. Click here and search for NDM in order to watch a video that provides an overview of NDM. Additional NDM information is available in the Dell EMC Solutions Enabler Array Controls and Management CLI User Guide and the Non-Disruptive Migration Best Practices and Operational Guide.

NDM allows you to migrate storage group (application) data (the storage groups must have masking views) in a non-disruptive manner with no downtime for the following scenarios:

- from source arrays running Enginuity OS 5876 Q4 2016 and higher to target arrays running HYPERMAX OS 5977 Q4 2016 and higher.
- from source arrays running Enginuity OS 5876 Q4 2016 and higher to target arrays running PowerMax OS 5978.
- from source arrays running HYPERMAX OS 5977 Q3 2016 or higher to target arrays running PowerMax OS 5978.

Source side service levels are automatically mapped to target side service levels.

NDM applies to open systems/FBA devices only.

NDM supports the ability to compress data on all-flash storage systems while migrating.

A NDM session can be created on a storage group containing session target volumes (R2s) where the SRDF mode is synchronous. The target volumes of an NDM session may also have a SRDF/Synchronous session added after the NDM session is in the cutover sync state.

Suggested best practices

- Try to migrate during slow processing times; QoS can be used to throttle copy rate.
- Use more SRDF links, if possible, to minimize impact:
  - 2 is minimum allowed, NDM can use up to 8 SRDF links
  - More links = more IOPS, lower response time
- Use dedicated links as they yield more predictable performance than shared links.

The following NDM tasks can be performed from Unisphere:

- Setting up a migration environment - Configures source and target array infrastructure for the migration process.
- Viewing migration environments
- Optional: Preparing a NDM session and Reading migration target - pre-copies the data to the target array and makes it available to the application host.
- Creating a NDM session - Duplicates the application storage environment from source array to target array.
- Viewing NDM sessions
- Viewing NDM session details
- Cutting over a NDM session - Switches the application data access form the source array to the target array and duplicates the application data on the source array to the target array.
Optional: Stop synchronizing data after NDM cutover and Start synchronizing data after NDM cutover - stop or start the synchronization of writes to the target array back to source array. When stopped, the application runs on the target array only. Used for testing.

Optional: Cancelling a NDM session - cancels a migration that has not yet been committed.

Committing a NDM session - Removes application resources from the source array and releases the resources used for migration. Application permanently runs on the target array.

Optional: Recovering a NDM session - recovers a migration process following an error.

Removing a migration environment - Removes the migration infrastructure created by the environmental setup.

Preparing a non-disruptive migration (NDM) session

Non-disruptive migration of storage groups using SRDF is supported between a source storage system running Enginuity 5876 Q3 2016 or higher and a target storage system running HYPERMAX OS 5977 Q3 2016 or higher.

See Understanding non-disruptive migration (NDM) on page 504 for additional information.

There are two paths through the migration creation wizard. The default flow is for creating a migration session between two arrays (see Creating a non-disruptive migration (NDM) session on page 507). The secondary flow allows the user to prepare for a data migration with recommendations on the ports to be used for an optimal candidate migration result. When the prepare path is run (this is an option that can be run before the create path), you have the option to save your preparation to a Migration report containing zoning information. You need to implement the zoning before running the Create scenario in anticipation of the migration creation. If the plan is changed after running the prepare, these port groups need to be renamed or removed.

If the user chooses the prepare path first, the same Symmetrix and SRP must be selected when running the second path for creating the actual migration session.

Before you begin:

To perform this procedure you must be an Administrator or Storage Admin.

The data migration environment exists between two candidate arrays.

The selected storage group is a masked candidate storage group.

The selected storage group does not contain only gatekeepers.

The local array must have online RDF ports.

Unisphere is registered for performance data processing on the source and target arrays. When you register a storage system for performance data collection it takes at least two intervals (by default, 5 minutes each) before performance data begins to populate in the Unisphere GUI and charts.

To prepare a migration session:

Procedure

1. Select a storage system running Enginuity 5876 Q3 2016 or higher.
2. Select STORAGE > Storage Groups.
3. Select a storage group.
4. Click and click Migrate.

5. Select the target storage system.

   Not specifying an SRP is allowed for data migration creation.

7. Select a port group.

8. Click NEXT.

9. Do the following:
   - Select **Prepare Data Migration**
     If the source or target array is remote to this instance of Unisphere, performance data processing is not registered on the target array, or there has not been sufficient time (at least two intervals (by default, 5 minutes each)) to gather performance data, an error popup informs you of this and the NEXT button is disabled.

If any source port groups do not already exist on the target array, a panel is displayed allowing the user to select ports for any port group(s) to be created.

All port group(s) involved in this migration are displayed. Any port group(s) that need to be created on the target array are at the top and any that already exist are at the bottom. Any existing port group(s) have the text "Already configured" in the title.

Any port group to be created displays a selectable list of ports. This list of ports includes all available ports on the target array, but to avoid overlap, port(s) already in use by any existing target array port group(s) are filtered out of the list.

The port table within the panel contains the following columns:

- **Port**—The port identifier of a target array port in Dir:Port format with a checkbox for selection.

- **Utilization**—a bar indicating a utilization score for the port. A lower score indicates lower utilization. This is the default sort column for the list.

- **Initiators**—a number indicating how many initiators, from the list of all initiators in the corresponding source Masking View associated with the source Storage Group, are present in the Login History Table for the port on the target array.

Ports are selected by default based on the Utilization value. The number of default selected ports is equal to the number of ports in the source port group or the number of ports still available in the original list. You are able to override these selections, but you must select at least one port.

- Click NEXT.

- On the **Summary** page, review the details. The summary includes information any port group(s) and ports that you selected. There is also a suitability score for the entire migration request indicating the expected impact of the migrated application on the target array's front end ports. A message, indicating whether or not the selected front end ports have sufficient performance capacity for the incoming load, is displayed.

Do one of the following:
Optional: Click **Save Migration report** to save the report to your chosen location. You need to implement zoning based on the information in the Migration report. You need to implement zoning before running the Create scenario as well as creating the required port groups on the target array in anticipation of the migration creation. If the plan is changed after running the prepare, these port groups need to be renamed or removed.

- Click **Finish** to perform the port group(s) creation (if any) on the target array depending on your selections.

**Note**

Clicking **Finish** does not create the migration session.

---

Creating a non-disruptive migration (NDM) session

Non-disruptive migration of storage groups using SRDF is supported between a source storage system running Enginuity 5876 Q3 2016 or higher and a target storage system running HYPERMAX OS 5977 Q3 2016 or higher.

When migrating a storage system from HYPERMAX OS 5977 to PowerMaxOS 5978, a create with precopy option is supported by Unisphere. The precopy option allows storage to be provisioned on the target array without making the devices’ host visible. This allows the application to continue running on the source array while data is being copied to the target.

See **Understanding non-disruptive migration (NDM)** on page 504 for additional information.

There are two paths through the migration creation wizard. The default flow is for creating a migration session between two arrays. The secondary flow will allow the user to prepare for a data migration (see **Preparing a non-disruptive migration (NDM) session** on page 505).

**Before you begin:**

To perform this procedure you must be an Administrator or Storage Admin.

The data migration environment exists between two candidate arrays.

The selected storage group is a masked candidate storage group.

The selected storage group does not contain only gatekeepers.

The Initiators in the Storage Groups Masking Views are visible to the target array running HYPERMAX OS 5977 or higher.

The local array must have online SRDF ports.

You are allowed to select a port group name on the target array to use as part of the migrated Masking View. This port group must exist on the target array.

When migrating a storage system from HYPERMAX OS 5977 to PowerMaxOS 5978, a create with precopy option is supported by Unisphere. The precopy option allows storage to be provisioned on the target array without making the devices’ host visible. This allows the application to continue running on the source array while data is being copied to the target.

To create a migration session:

**Procedure**

1. Select a storage system running Enginuity OS 5876 Q3 2016 or higher.
2. Select STORAGE > Storage Groups.
3. Select a storage group.
4. Click and click Migrate.
5. Select the target storage system.
   The default SRP is selected on the SRP combo if it can be calculated. Not specifying an SRP is allowed for data migration creation.
7. Select a port group.
8. Click NEXT.
9. Select Create Data Migration
   • Optional: Uncheck the Compression check box to turn off Compression. Compression is only allowed on All Flash systems running the HYPERMAX OS 5977 Q3 2016 Service Release or higher.
   • Optional: Click Precopy
   • Click NEXT.
   • On the Summary page, review the details. The summary includes information on any Masking View(s) that would be created by this migration and any Port group(s) and Host/Host Group(s) that you selected.
10. Do one of the following:
   • Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   • Expand Add to Job List, and click Run Now to perform the operation now. Review the contents of the feedback dialog. After successful migration, a dialog is displayed. Select Go to Migrations list view, No Further action at this time or Close.

Results
If the host can scan the new paths on its own, the migration moves to the CutoverReady state. If a user rescan is needed, the migration state moves to the Created state.

Viewing the non-disruptive migration (NDM) sessions list
This procedure explains how to view the list of the non-disruptive migration (NDM) sessions.

See Understanding non-disruptive migration (NDM) on page 504 for additional information.

To view the migration sessions list:

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > Migrations
3. Select the Storage Groups tab.
   The following properties display:
• **Storage Group**—Name of the storage group.
• **Capacity (GB)**—Capacity of the storage group in GB.
• **State**—Migration state. An icon representing the state is also displayed. Failed states are represented as red, in progress states are represented using the refresh icon and states after successful completion of actions are green.
• **Done (%)**—Percentage complete.
• **Source**—Source storage system.
• **Target**—Target storage system.
• **Migration Status**—Status of the migration.

The following controls are available:

• ![Viewing migration details](#) — Viewing migration details on page 509
• **Cutover**—Cutting over a migration session on page 511
• **Commit**—Committing a migration session on page 512
• **Ready Target**—Readying the migration target on page 510
• **Recover**—Recovering a migration session on page 513
• **Sync**—Synchronizing data after non-disruptive migration (NDM) cutover on page 511
• **Cancel Migration**—Cancelling a migration session on page 512

### Viewing migration details

This procedure explains how to view the migration details for a specific data migration. See **Understanding non-disruptive migration (NDM)** on page 504 for additional information.

To view the migration details:

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > Migrations**
3. Select the **Storage Groups** tab.
4. Select a storage group and click ![Viewing migration details](#) to view the **Migrations** details view.

The following items are displayed:

• **Storage Group**—Name of the storage group.
• **State**—Migration state.
• **Source**—Source storage system.
• **Target**—Target storage system.
• **Capacity (GB)**—Capacity of the storage group in GB.
• **Synched Capacity (GB)**—Synchronized capacity of the storage group in GB.

A storage group table displaying the source status and target status for each storage group associated with the migration.
- A masking view table displaying the source status and target status for each masking view associated with the migration.
- A Port Group table. Selecting a row in the masking view table populates the Port Group table. The table displays the source status and target status for the selected masking view.
- A Host/Host Group table. Selecting a row in the masking view table populates the Host/Host Group table. The table displays the source status and target status for the selected masking view.

Select an item in the Storage Group table to view the following volume information:
- Source Volume—Identity of source volume.
- Source Status—Status of the source volume.
- Target Volume—Identity of target volume.
- Target Status—Status of the target volume.

Select an item in the Port Group table to view the following port information:
- Symmetrix—Storage system ID.
- Port Name—Identity of port.
- Status—Status.

Select an item in the Host/Host Group table to view the following Initiators information:
- Initiator—Identity of initiator.
- Source Status—Source status.
- Target Status—Target status.

### Readying the migration target

#### Before you begin

The migration must be in the precopy state.

To perform this procedure you must be a Storage Admin.

This operation is used on migrations that are in the Precopy state. When migrating a storage system from HYPERMAX OS 5977 to PowerMaxOS 5978, a create with precopy option is supported by Unisphere. The precopy option allows storage to be provisioned on the target array without making the devices' host visible. This allows the application to continue running on the source array while data is being copied to the target. The Ready Target operation results in the target devices becoming visible to the host and configures the data migration to allow simultaneous access to both the source and target devices.

#### Procedure

1. Select the storage system.
2. Select **DATA PROTECTION > Migrations**
3. Click the **Storage Groups** tab.
4. Select the storage group, click **ready**, and click **Ready Target**.
5. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to *Scheduling jobs* on page 812 and *Previewing jobs* on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**Results**

If the operation is successful, a success message appears indicating the Ready Target operation was successful and that a host discovery needs to be performed. The state at this stage is Migrating. Once the host discovery has been performed and all data synchronized between the source and target arrays, the migration state changes to Synchronized.

If the command was unsuccessful an error message will appear detailing the reason for the command failure. If the Ready Target operation has run to completion with a failed status the migration has a status of ‘Ready Target Failed’.

**Cutting over a migration session**

The cutover operation results in the storage array running HYPERMAX OS 5977 Q3 2016 or higher becoming the active array.

See *Understanding non-disruptive migration (NDM)* on page 504 for additional information.

Before you begin:

To perform this procedure you must be an Administrator or Storage Admin.

The state of the migration session is CutoverReady.

To cutover a migration session:

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > Migrations**
3. Select the **Storage Groups** tab.
4. Select a storage group and click **Cutover**.
5. (Optional) Under the **Advanced Options** link you can select **Force** and/or **SymForce**.
6. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to *Scheduling jobs* on page 812 and *Previewing jobs* on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**Synchronizing data after non-disruptive migration (NDM) cutover**

After cutover, the sync operation allows the synchronization of the data between an array running HYPERMAX OS 5977 Q3 2016 or higher and an array running Enginuity 5876 Q3 2016 or higher.

See *Understanding non-disruptive migration (NDM)* on page 504 for additional information.

Before you begin:

To perform this procedure you must be an Administrator or Storage Admin.
The state of the migration session is CutoverSync, CutoverSyncing or CutoverNoSync.

To start or stop the synchronization of a migration session:

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > Migrations**
3. Select the **Storage Groups** tab.
4. Select the storage group, click **Add to Job List**, and click **Sync**.
5. Click **Stop** to stop a synchronization or **Start** to start a synchronization.
6. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs on page 812** and **Previewing jobs on page 812**.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**Committing a migration session**

This procedure explains how to commit a data migration session.

See **Understanding non-disruptive migration (NDM)** on page 504 for additional information.

Before you begin:

To perform this procedure you must be an Administrator or Storage Admin.

The state of the migration session is CutoverSync or CutoverNoSync.

To commit a migration session:

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > Migrations**
3. Select the **Storage Groups** tab.
4. Select a storage group and click **Commit**.
5. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs on page 812** and **Previewing jobs on page 812**.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

** Cancelling a migration session**

This procedure explains how to cancel a data migration session (from the source or target array).

See **Understanding non-disruptive migration (NDM)** on page 504 for additional information.

Before you begin:

To perform this procedure you must be an Administrator or Storage Admin.
There are two cancel options. One of them is chosen by Unisphere depending on the migration session state.

The "Cancel without the revert flag" set operation requires the state of the migration session to be: Created, CreateFailed or CutoverReady.

The "Cancel with the revert flag" set operation requires the state of the migration session to be: Migrating or CutoverSync.

To cancel a migration session:

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > Migrations**
3. Select the **Storage Groups** tab.
4. Select the storage group, click , and click **Cancel**.

A checkbox is displayed when Revert is being used and a dash is displayed when Revert is not being used.

5. (Optional) Select the **SymForce** check box.
6. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**Recovering a migration session**

This procedure explains how to recover a data migration session from a failed state. See **Understanding non-disruptive migration (NDM)** on page 504 for additional information.

**Before you begin:**

To perform this procedure you must be an Administrator or Storage Admin.

The state of the migration session is CreateFailed, CutoverFailed, CancelFailed, MigrFailed, or RevertFailed.

To recover a migration session:

**Procedure**

1. Select the storage system.
2. Select **DATA PROTECTION > Migrations**
3. Select the **Storage Groups** tab.
4. Select the storage group, click , and click **Recover**.
5. (Optional) Select **Force** in the **Advanced Options** section.

The force flag is meant for cases where the state of the migration session is CreateInProg, CancelInProg, CutoverInProg, RevertInProg, or CommitInProg.

6. (Optional) Select **SymForce** in the **Advanced Options** section.
7. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Viewing migration environments

This procedure explains how to view existing migration environments. You can also use this view to add a new migration environment or delete an existing one:

- Adding a migration environment
- Removing a migration environment

A visual display of the migration environment is available from the Replication dashboard.

The Migrations Environments topology view visually describes the layout of the migration environments of the currently selected storage system.

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > Migrations
3. Select the Environments tab
   The following properties display:
   - Remote Array—Remote storage system.
   - State—Migration state. An icon representing the state is also displayed. Failed states are represented as red, in progress states are represented using the refresh icon and states after successful completion of actions are green.
   - In Use—Provides an icon that indicates whether any objects involved in the migration session are in use

   The following controls are available:
   - Create—Setting up a migration environment on page 514
   - —Removing a migration environment on page 515

Setting up a migration environment

Before you begin

To perform this procedure you must be a Storage Admin.

This procedure explains how to add a new migration environment.

Procedure

1. Select the storage system.
2. Select DATA PROTECTION > Migrations
3. Select the Environments tab and click Create.
4. Select the remote storage system for the environment creation.
5. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Removing a migration environment

Before you begin
To perform this procedure you must be a Storage Admin.
This procedure explains how to remove a migration environment.

Procedure
1. Select the storage system.
2. Select DATA PROTECTION > Migrations
3. Click the Environment tab, select a migration environment in the list view and click .
4. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Viewing the authorized users and groups details

To view the authorized users and groups list:

Procedure
1. Select to open the Settings panel.
2. Select Users and Groups > Authorized Users & Groups.
3. Select your required storage system ID from the drop-down list.
4. To see more information on a user, select the user and on the right-hand side of the row, click the icon.
5. View the following information in the information dialog: name, authority, domain, storage system identity, roles, and component name.

Expanding remote volumes

Before you begin
- Requires HYPERMAX OS 5977 or later (HYPERMAX OS 5977.1125.1125 or later for CKD volumes). Consider consulting with your operating system vendor or cluster vendor for support of online LUN expansion.

Procedure
1. Select a group (one only) to expand remote volume or do not select a group to only expand local volume.
2. Click APPLY.

Setting a device identity

Before you begin

This operation allows the conversion of device IDs between Compatibility IDs and Mobility IDs.

Procedure

1. Select the storage system.
2. Select STORAGE > Volumes
3. Select a FBA volume, click , and click Set Volumes > Mobility ID.
4. Select Mobility ID if you wish to change the device identity type from Compatibility ID (default) to Mobility ID.
5. Do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand Add to Job List, and click Run Now to perform the operation now.

Results

If the operation is successful, a success message appears indicating the Ready Target operation was successful and that a host discovery needs to be performed. The state at this stage is Migrating. Once the host discovery has been performed and all data synchronized between the source and target arrays, the migration state changes to Synchronized.

If the command was unsuccessful an error message will appear detailing the reason for the command failure. If the Ready Target operation has run to completion with a failed status the migration has a status of ‘Ready Target Failed’.

Editing storage group volume details

To edit storage group details for a storage system running Hypermax OS 5977 or higher:

Procedure

1. Click the Volume Config tab.
2. To name the volumes you are adding to the storage group, select one of the following Volume Identifiers and type a Name

   Note

   This option is only available when modifying storage groups with new volumes. Note that when modifying storage groups with some new and some existing volumes, the identifiers will only be applied to the new volumes.

   - None—Allows the system to name the volumes (Default).
   - Name Only—All volumes will have the same name.
• **Name + VolumeID**—All volumes will have the same name with a unique Symmetrix volume ID appended to them. When using this option, the maximum number of characters allowed is 50.

• **Name + Append Number** —All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the **Append Number** and increment by 1 for each additional volume. Valid **Append Numbers** must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.

3. Optional: Click **Enable Compression** checkbox.

4. Optional: Click the **Enable Mobility ID** checkbox to assign Mobility IDs to the volumes in the storage group. If you leave the checkbox unchecked, Compatibility IDs will be assigned to the volumes instead.

5. Optional: Click **Allocate capacity for each volume** checkbox.

6. Optional: Click **Persist preallocated capacity through reclaim or copy** checkbox.

7. Click the **Volume Size** tab.

8. Enter a volume size, capacity and capacity unit.

9. Optional: Add one or more volume sizes by hovering over the area to the right of the volume capacity and selecting .

10. Optional: Click to remove a volume size.

11. Click **APPLY**.

The Storage Group page in the wizard displays **Mixed Capacities** for the row. Click **Mixed Capacities** to reopen this dialog.

---

**Editing storage group details**

To edit storage group details for a storage system running Enginuity 5876:

**Procedure**

1. To name the volumes you are adding to the storage group, select one of the following **Volume Identifiers** and type a **Name**

   **Note**

   This option is only available when expanding storage groups with new volumes. Note that when expanding storage groups with some new and some existing volumes, the identifiers will only be applied to the new volumes.

   • **None**—Allows the system to name the volumes (Default).

   • **Name Only**—All volumes will have the same name.

   • **Name + VolumeID**—All volumes will have the same name with a unique Symmetrix volume ID appended to them. When using this option, the maximum number of characters allowed is 50.

   • **Name + Append Number** —All volumes will have the same name with a unique decimal suffix appended to them. The suffix will start with the value specified for the **Append Number** and increment by 1 for each additional volume. Valid **Append Numbers** must be from 0 to 1000000. When using this option, the maximum number of characters allowed is 50.
To only use BCVs in the storage group, select **Use BCV volumes.**

To only use volumes from a specific disk group, select the Disk Group. (applicable for regular volumes only)

2. Click **OK.**

### Replication state severities

The following are the replication state severities, organized by replication technology:

<table>
<thead>
<tr>
<th>Severity</th>
<th>SRDF State</th>
<th>TimeFinder State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>Synchronized</td>
<td>Copied</td>
</tr>
<tr>
<td></td>
<td>SyncInProg</td>
<td>Created</td>
</tr>
<tr>
<td></td>
<td>Split</td>
<td>Restored</td>
</tr>
<tr>
<td></td>
<td>Failed Over</td>
<td>TerminateInProgress</td>
</tr>
<tr>
<td></td>
<td>R1 UpdInProg</td>
<td>Recreated</td>
</tr>
<tr>
<td></td>
<td>R1 Update</td>
<td>CopyInProgress</td>
</tr>
<tr>
<td></td>
<td>Consistent</td>
<td>CopyOnAccess</td>
</tr>
<tr>
<td></td>
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<td>N/A</td>
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<tr>
<td></td>
<td>Mixed</td>
<td>Invalid</td>
</tr>
<tr>
<td></td>
<td>N/A</td>
<td>Failed</td>
</tr>
<tr>
<td></td>
<td>Invalid</td>
<td></td>
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</tbody>
</table>
Managing space reclamation

Before you begin

- You can only reclaim thin pool capacity from bound thin volumes.
- Thin pool reclamation for individual thin volumes requires Enginuity 5876 or HYPERMAX OS 5977 or higher.
- Thin pool reclamation for thin volumes in a storage group requires Enginuity 5876 or higher.
- This procedure explains how to perform this operation from the Volumes view. You can also perform this operation from storage group views. Depending from where you are performing this procedure, some of the following steps may not apply.

The following describes how to start and stop the space reclamation option, freeing unused pool capacity and reclaiming unwritten tracks from thins volumes. In addition, you can also perform this operation from the following views:

- Storage Groups (HYPERMAX OS 5977 or higher): STORAGE > > Storage Groups
- Storage Groups (Enginuity 5876): STORAGE > Storage Groups
- Device Groups: DATA PROTECTION > Device Groups
- File Storage Groups: SYSTEM > eNAS > File Dashboard > File Storage Groups

For more information about thin pools and thin provisioning concepts, refer to the Product Guide.

Procedure

1. Select the storage system.
2. Select STORAGE > Volumes.
3. Select the volume type by selecting a tab.
4. Do one of the following:
   - To start space reclamation:
     - Select one or more volumes, click , and select Start Allocate/Free/Reclaim to open the Start Allocate/Free/Reclaim dialog box.
     - To start reclaiming unwritten tracks and those written completely with zeros, select Reclaim Volumes. This option is only available on storage systems running Enginuity 5876 or higher, or storage systems running HYPERMAX OS 5977 or higher.
     - Optional: To reclaim tracks that are unwritten or zero-based, even if they are marked as persistent, select Reclaim persistent capacity.
     - To reserve the volumes, select Reserve. In addition you can also type reserve Comments and select an Expiration Date. The default values for Reserve and Comments are set in Symmetrix Preferences for volumes reservations. If the volumes are not automatically reserved you can optionally reserve them here.
   - To stop space reclamation:
Select one or more volumes, click , and select **Stop Allocate/Free/Reclaim** to open the **Stop Allocate/Free/Reclaim** dialog box.

- Select **Stop Reclaim**. In addition, on storage systems running Enginuity 5876, you can optionally specify to free tracks that are unwritten or zero-based, even if they are marked persistent.

- To reserve the volumes, select **Reserve**. In addition you can also type reserve Comments and select an **Expiration Date**. The default values for **Reserve** and **Comments** are set in Symmetrix Preferences for volumes reservations. If the volumes are not automatically reserved you can optionally reserve them here.

5. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to **Scheduling jobs** on page 812 and **Previewing jobs** on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

**Advanced Options dialog**

Refer to the parent help topic for information on the **Advanced Options** dialog.
CHAPTER 7

Performance Management

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Understanding Performance Management

Performance Management covers the following areas:

- **Dashboards** - Display pre-defined, user-defined custom dashboards, and templates.
- **Charts** - Create custom charts across multiple categories/metrics/time intervals.
- **Analyze** - Provide in-depth drill-down on storage system data for various collection ranges.
- **Heatmap** - Display hardware instances represented as colored squares, with the color indicating utilization levels.
- **Reports** - Create, manage and run performance reports.
- **Real Time Traces** - Create, manage and run performance real time traces (see Viewing Real Time traces on page 590).
- **Databases** - Manage Performance database tasks, for example, backup, restore, delete, as well as individual performance database information (see Viewing Performance database backups on page 598).
- **Plan** - Provide performance projection capacity dashboards displaying predicted future data, based on linear projection.

Performance Dashboards

See Understanding Performance Management on page 522 for an overview of Unisphere Performance Management.

The Performance component of Unisphere collects performance data only after you register your storage systems.

A dashboard is a collection of charts that you define (custom), or that Unisphere provides. You can view a set of dashboards for a specific storage system (see Viewing dashboards on page 523), or you can view a set of overview dashboards covering all storage systems (see Using the All Arrays overview dashboard on page 525).

Custom dashboards must have a unique name up to 32 characters. One or more can be marked as a favorite to allow quick and easy access. Custom dashboards can be promoted to being a favorite by hovering over the dashboard in the table and clicking the Add to Favorites button. The chosen dashboard will then appear in the Favorites selection for easy access.

Only applicable dashboards (those defined in the dashboard catalog - refer to Managing dashboard catalog on page 598) are displayed for individual storage systems.

The overview dashboards for all storage systems include the following tabs:

- **All Arrays Overview**
- **All Arrays Thresholds**

When viewing a specific storage system, the following dashboard folders are provided:

- **Favorites**
  - Custom dashboards that have been marked as favorites.
- **Default**
  - Pre-configured dashboards that are created dynamically and provide the following benefits:
• Easy visualization.
• Event correlation between application response time and hardware component utilization taken at a particular point in time.
• Fast problem recognition.

Depending on the configuration of the individual storage system, all default dashboards might not be available. In addition, you can configure which dashboards are listed in the Default folder.

**Custom**
Dashboards that were created by saving a chart or a group of charts as a custom dashboard.

**Templates**
Dashboards that were created by saving a chart or a group of charts as a template.

The specific information displayed in a default dashboard view depends on the selected storage system and Category. Unless the selected category is Array, the information is filtered for the selected category (for example, Database or Storage Group).

Depending on the dashboard displayed, you can perform some of the following tasks:

• Schedule a report to run.
• Navigate directly to the Charts or Analyze view.
• Switch between the use of average and maximum values for the current dashboard.
• Change the number of columns of charts in the current dashboard.
• Change the time frame of the current dashboard.
• Run a PDF report.
• Navigate to the Storage Groups view from the Storage Group dashboard.

To manage dashboards, you can perform the following tasks:

• Creating a template dashboard from an Analyze view on page 539
• Creating a dashboard with charts on page 526
• Copying a dashboard on page 527
• Saving a dashboard as a template on page 528
• Viewing dashboards on page 523
• Using the All Arrays overview dashboard on page 525
• Deleting dashboards on page 527
• Saving dashboards and charts on page 530

**Viewing dashboards**

**Before you begin**
Read Performance Dashboards on page 522.

To view dashboards:
Procedure

1. Do one of the following:

   - View a dashboard:
     a. Select a storage system.
     b. Select **Performance > Dashboards**.
        
        To view one of the pre-configured default dashboards, choose one from the **Default** section of the **Dashboards** panel on the left.

        **Note**
        
        You cannot delete default dashboards.

        To view Custom dashboards, expand the **Custom** dashboards folder.
        To view Template dashboards, expand the **Templates** dashboards folder.

   - View the overview dashboards for all storage systems:
     a. Select **Performance > Dashboard**
        
        By default, the All Arrays Overview dashboard displays.

        Depending on the selected dashboard type, some of the following controls are available:

        - ![Save As](image) — Saving dashboard changes on page 528
        - ![Delete Custom Dashboard](image) or ![Delete Template Dashboard](image)
        - ![Schedule PDF Report](image) — Scheduling a report from the dashboard on page 529
        - ![Run PDF Report now](image)
          - Run PDF Report now
          - Run PDF Report now - with data
        - ![Navigate to](image)
          - Navigate to Charts
          - Navigate to Analyze
          - Navigate to Details — Navigating to the Details view on page 530

Using default dashboards

**Before you begin**

Read **Performance Dashboards** on page 522.

To configure what appears in the dashboard, see **Managing dashboard catalog** on page 598.

The default dashboards require Administrator, Monitor, or Performance Monitor permissions.

The full list of default dashboards is shown below. A subset of these are presented depending on array type and configuration.
- **Array Efficiency** tab is not applicable for storage systems running Enginuity OS 5876 or non-flash storage systems running HYPERMAX OS 5977.

The Array Performance Thresholds dashboard gives a visual overview to indicate if system component utilization thresholds have been broken for hardware components. Individual bar charts can be double clicked to view more information (including threshold information) (see Utilization Threshold charts on page 531).

- BE Directors (DA)
- External Directors
- Database
- Disk Groups
- Disk Technology
- FE Directors
- Hosts
- Port Groups
- RDF Directors
- Storage Containers
- Storage Groups
- Disk Group Tier
- Virtual Pool Tier
- Thin Pools

The FE Directors, BE directors (DA), RDF Directors, Disk Groups, Disk Technology, and External Directors have an **All** tab where you can compare all instances of that type that exist on the storage system.

**Procedure**

1. To save a default dashboard to a PDF file, complete the following steps:
   a. Select a storage system.
   b. Select **Performance > Dashboards**
   c. Expand the **Default** section.
   d. Select a dashboard.
   e. To run a PDF report, click .
      The PDF report is downloaded in the browser.
   f. Alternatively, to schedule a PDF report, click .
      Scheduled reports are listed in the **Performance > Reports** page.
      When a scheduled report completes, it saves to the default location: \install_dir\SMAS\report\SPA\querydata.

**Using the All Arrays overview dashboard**

**Before you begin**

The default dashboards require Administrator, Monitor, or Performance Monitor permissions.
By default, Performance Dashboards across all available arrays are displayed. This allow you to perform top level comparisons across all arrays.

To view the All Arrays overview dashboard, complete the following steps:

**Procedure**

1. Select **Performance > Dashboard**.

   A dashboard displaying aggregated data for all arrays displays. The following tabs are displayed:

   **All Arrays Overview**
   - A dashboard displaying the following charts for all arrays:
     - Host IOs/sec
     - Latency
     - Throughput
     - Capacity

   **All Arrays Thresholds**
   - A dashboard displaying threshold information for all arrays.

   After clicking on an individual array ID, you will be drilled down in context to that's array's full suite of dashboards.

   The following controls are available:

   - ![Schedule PDF Report](image) — *Scheduling a report from the dashboard* on page 529
   - ![Run PDF Report Now](image)
   - ![Navigate to](image)
     - Navigate to Charts
     - Navigate to Analysis

---

### Creating a dashboard with charts

To create a dashboard with charts:

**Procedure**

1. In the **Charts** view, create one or more charts

2. Click ![Save as Dashboard](image).

3. In the **Save as Dashboard** dialog box, specify a dashboard name.

4. Click **OK** to save the dashboard.

**Note**

If a dashboard with the same name already exists, clicking OK will overwrite that dashboard.

The dashboard is saved to the **Custom** dashboard folder.
Editing a template dashboard

To edit a template dashboard:

Procedure

1. Select a storage system.
2. Select Performance > Dashboards.
3. In the Templates list, select the user template dashboard you want to edit.
4. Do one or more of the following:
   • Hover over the template dashboard name in the Templates list and click the star icon to add the template dashboard to the Favorites list.
   • Delete the template dashboard.

Copying a dashboard

You can copy an existing custom or template dashboard and change the name and some characteristics to make a new dashboard. You cannot copy a default dashboard.

To copy a dashboard:

Procedure

1. Select a storage system.
2. Click Performance > Dashboards.
3. Select the dashboard to copy and click to open the Copy Dashboard dialog box.
4. Type a Dashboard Name for the copied dashboard.
5. Click OK.

Editing dashboards

To edit a dashboard:

Procedure

1. Select a storage system.
2. Select Performance > Dashboards to view the list of dashboards.
3. Select the dashboard you want to edit.
4. Do one or more of the following:
   • Hover over the template dashboard name in the Templates list and click the star icon to add the template dashboard to the Favorites list.
   • Delete the template dashboard.

Deleting dashboards

Before you begin

You can delete only dashboards in the Custom or Templates folders. Predefined dashboards cannot be removed.

To delete a dashboard:
Procedure

1. Select a storage system.
2. Select Performance > Dashboards.
3. In the Custom or Templates folder, hover over the dashboard you want to delete and click .
4. Click OK on the delete confirmation message.

Running a report from the dashboard

You can run a PDF report from a performance dashboard.

Procedure

1. Select a storage system.
2. Click Performance > Dashboards.
3. Open an existing dashboard or create a new one.
4. Click to run the report now.

Saving a dashboard as a template

Selected default dashboards can be adjusted and saved as a template for your own dashboard as long as they are for the same storage system, category, and object type as the original.

To save a dashboard as a template:

Procedure

1. Select a storage system.
2. Select Performance > Dashboards.
3. Select one of the default dashboards.
4. Click > Save as Template to open the Save as Template dialog box.
5. Enter a Template Name.
6. The template is saved to the Templates folder.
7. Click OK.

Saving dashboard changes

The Save as option allows you to do the following:

- Save charts created in the chart section as either a Custom Dashboard or a Template.
- Save an existing Default or Custom Dashboard as a Template.
- Save a Template as a Custom Dashboard.

Note

You cannot save a dashboard containing multiple tabs or item lists.

To save dashboard changes:
Procedure

1. Click **Performance > Dashboards** to view the list of dashboards.
2. Open the dashboard chart that you want to change.
3. Update the chart, depending on the options available.
   
   For more information, see Customizing the tabbed Charts view on page 534 and Customizing a chart on page 532.
4. Click > Save as Custom Dashboard.

Scheduling a report from the dashboard

The performance dashboard reports are saved in PDF format. When you schedule a report, it will run on the time/days selected.

To schedule a report from the dashboard:

Procedure

1. Select a storage system.
2. Select **Performance > Dashboards**.
3. Select a default or custom dashboard.
4. Click to open the Create Report dialog box.
5. In the General section, enter a report Name.
6. (Optional) Enter the report description.
7. In the Schedule section, select Schedule.
8. Set First Run Time.
   
   The First Run Time is continually adjusted relative to the current time and the report execution interval. For example, if First Run Time is set to 3am, but the current time is 4am and the Time Range is set to 'Last 4 hours', then the value of First Run Time is changed to 7am.
9. Select the days on which the report will run.
10. From the Retention (Days) menu, select the number of days for which you want the generated reports to be retained.
11. (Optional) In the Email section, do one or more of the following:
   
   - Select the Email report to check box to send an email to a preconfigured email address.
   - Select the Send report to check box and type a valid email address in the field.
12. Click OK.

A confirmation message displays. Scheduled reports are listed under **Performance > Reports**. Changes can be made to scheduled reports from there.

Scheduled reports save to this default location:

```
install_dir\SMAS\report\SPA\querydata\`
```
Navigating to the Details view

From many of the Dashboards you can navigate to the component's details view.

If the icon is dimmed, there is no corresponding detail view.

To navigate to the details view:

Procedure

1. Select a storage system and an existing dashboard.
2. Click

The component's details display. For example, the details view for the storage group, front-end director, or disk group.

You cannot navigate from any of the dashboards for all components (all arrays, all disk groups, and so on.).

Saving dashboards and charts

When viewing a dashboard or chart, you can export it to a PDF file or save it as an image file (JPEG or PNG file format). When exporting to PDF, you can export the chart or dashboard only, or the dashboard or chart with the data also included in a table.

If multiple dashboards are displayed on different tabs, exporting to a PDF saves each chart or dashboard. Saving a dashboard or chart as an image file saves only the currently displayed dashboard or chart.

Saving a dashboard or chart to an image file

Procedure

1. Open the dashboard or chart that you want to save.
2. In the individual chart, click > Save As.
3. Select the image format you want to use. The following choices are available:
   - JPEG
   - PNG
   - CSV

The image is downloaded in the browser.

Saving a dashboard to PDF

Procedure

1. Open the dashboard you want to save.
2. Click .
3. The PDF copy of the dashboard is downloaded in the browser.
Opening a dashboard image in a new browser tab

Note

This functionality is available only when using Firefox or Chrome web browsers.

Procedure

1. Using Firefox or Chrome, open the dashboard or chart that you want to save.
2. In the individual chart, click > Save As > To Clipboard.
3. A JPG image of the current dashboard opens in a new browser tab.

From there, you can copy it to the clipboard and paste it to another application, for example, into a presentation.

Utilization Threshold charts

The Array Performance Thresholds dashboard gives an visual overview to indicate if system component utilization thresholds have been broken for hardware components. Individual bar charts can be double clicked to view more information (including threshold information).

Charts View

See Understanding Performance Management on page 522 for an overview of Unisphere Performance Management.

The All Array Charts view allows you to easily draw charts for any performance registered array without having to drill down to the performance section for an individual array.

The Charts view provides the capability to create user-definable charts. A list of metrics dynamically changes based on your selections in the table. The metrics list can display:

- **KPI Metrics**: Lists the key performance indicators that correspond to the column headings in the current table.

- **All Metrics**: Lists all available metrics for the selected object in the table.

When you select a particular system and/or component for which you want to create a chart, the instances per category are listed in order of how active they are, according to the default KPI displayed in the drop-down menu. The default KPI used depends on the component type but you can select a different KPI, as required.

To maximize chart viewing space the New Chart panel can be collapsed by clicking the Close Sidebar button. To restore the New Chart Panel click the Add New Chart button.

To create a chart:

Procedure

1. Select the storage system.
2. Select **Performance > Charts > New Chart**.
3. (Optional) In the Chart Details section, type a **Chart Title**.
4. Select an appropriate time range for the chart or specify a custom time range.
5. In the Objects section, select the systems and/or component types for which you want to create a chart.
6. (Optional) If required, move the slider from **Avg** to **Max** to use maximum metric values rather than average values, which are used by default.
7. 
   (Optional) If required, click to filter the list of selected components by name.
8. You can sort the list alphabetically by clicking on the object name at the top of the list.
9. Select the component instances. Multi-select is available.
10. (Optional) To sort instances by category by a different metric, select a KPI from the drop-down list of KPI metrics available for that category.
11. Select the one or more metrics from the **Metrics** list or use the slider to display the **All Metrics** list and select metrics from that list. You can filter the list by clicking on and typing a metric name in the search box.
    You can select multiple metrics, however, the more you select, the less readable the chart will be.
12. Click **Create**.
    Depending on the selected options, you might be given a choice between creating different types of charts. The options available are:
    - **One Chart**
    - **One Chart per Instance**
    - **One Chart per Metric**
    Select an appropriate option and click **Create**.
13. (Optional) Customize the chart. For more information about how to do this, refer to **Customizing a chart** on page 532.
14. (Optional) Customize the Chart view in which the chart is displayed. For more information about how to do this, refer to **Customizing the tabbed Charts view** on page 534.

**Customizing a chart**

After you create a chart there several ways to customize that chart. For more information about editing the information displayed on a chart, see **Editing charts** on page 536.

For more information about customizing the tabbed Charts view, see **Customizing the tabbed Charts view** on page 534.

**Procedure**

1. To customize a chart, hover over the chart, and do one or more of the following, depending on the options available:
   - Change the chart type:
a.

Click **Chart Type.** The following options are available:

- Timeline
- Snapshot
- Threshold Table

Save the chart as an image:

a.

Click > **Save as.**

b. Select JPG, PNG or CSV.

c. Specify a file name for the image file.

- Change the style of the chart:

  a.

  Click > **Chart Style.**

  b. Select a chart style.

  The type of chart styles available depend on the metrics selected for the current chart. Some or all of the following chart styles are available:

  - Line
  - Bar
  - Area
  - Table

- Change the data format of the chart:

  a.

  Click **Data Format.** Select one or both of the following:

  - **Average** — Shows the average metric value for each metric in the table rows, for the session (hour). This is the default.
  - **Max** — Shows the maximum metric value—the high water mark—for each metric in the table rows, for the session (hour).

  Selecting both formats on a chart displaying multiple metrics can make the chart less readable.

- Save the chart as a JPEG file:

  a.

  Click > **Save as > JPEG**

  b. Specify a file name for the JPEG file.

- Save the chart as a PNG file:

  a.

  Click > **Save as > PNG**

  b. Specify a file name for the PNG file.

- Save the chart as a CSV file:

  a.

  Click > **Save as > CSV**
b. Specify a file name for the CSV file.

- Display a threshold on the chart (if thresholds have been set for a metric):
  a. 
  
  Click   > Display Thresholds.

**Note**

Threshold values are not displayed in table charts.

- Display service level information on the chart:
  a. 
  
  Click   > Display Service Level.

- Hide the chart legend:
  a. 
  
  Click   > Hide Legend.

- Single Scale
  a. 
  
  Click   > Single Scale.

- Show information about the chart:
  a. 
  
  Click   .
  b. To close the information pane, click  .

- Maximize the chart:
  a. 
  
  Click   .

- Minimize the chart:
  a. 
  
  Click   .

- Restore a maximized chart to the default chart size:
  a. 
  
  Click   .

- Remove the chart:
  a. Click   .

- Change the zoom level of a chart:
  a. Select an area on a chart to zoom into that area.
  b. To reset the zoom level to default, click **Reset zoom**.

**Customizing the tabbed Charts view**

There are several ways to customize the way that charts are displayed on the tabbed Charts view.

For more information about customizing the way that individual charts are displayed, see **Customizing a chart** on page 532.
For more information about editing the information displayed on a chart, see Editing charts on page 536.

Tabs can be closed by selecting the "X" button on the tab. There must be at least one tab available.

**Procedure**

1. When in the tabbed Charts view, and without any individual charts selected, do one, or more, of the following:
   - Add a chart:
     a. If the **New Chart** menu is not already open, in the Charts view click **Add Charts**.
     b. Create a new chart. For more information, refer to Charts View on page 531.
   - Create a new tab for charts:
     a. Click **+**.
   - Save the Charts view as a dashboard:
     a. Click **Save as Dashboard**.
     b. In the **Save as Dashboard** dialog box, type a **Dashboard Name**.
     c. Click OK.
   - Save the Charts view as a template (Note that all Charts in the tab must all be for the same category, Object and time period.):
     a. Click **Save As Template**.
     b. In the **Save as Template** dialog box, type a **Template Name**.
     c. Click OK.
   - Save the Charts view as a PDF:
     a. Click **Save As PDF - Charts**.
   - Save the Charts view as a PDF with data included in an additional table:
     a. Click **Save As PDF - Charts & Data**.
   - Remove all charts from the Charts view:
     a. Click **to select all charts.**
     b. Click **.**
   - Adjust the number of columns displayed in the Chart view:
     a. From the **Chart Column(s)** drop-down menu, select a value.

2. When in the tabbed Charts view, and with an individual chart selected (select the chart by selecting the checkbox in the top left corner of the chart), do one, or more, of the following:
• Copy a chart to another tab:
  a. Click > Copy Charts to tab
  b. In the Copy charts to existing tab dialog box, select a tab.
  c. Click OK.

• Move a chart to another tab:
  a. Click > Move Charts to tab
  b. In the Move charts to existing tab dialog box, select a tab.
  c. Click OK.

• Save the Charts view as a template (Note that all Charts in the tab must all be for the same category, Object and time period.):
  a. Click > Save As Template
  b. In the Save as Template dialog box, type a Template Name.
  c. Click OK.

• Save the Charts view as a PDF:
  a. Click > Save As PDF - Charts .

• Save the Charts view as a PDF with data included in an additional table:
  a. Click > Save As PDF - Charts & Data .

• Remove the chart from the Charts view:
  a. Click .

• Adjust the number of columns displayed in the Chart view:
  a. From the Chart Column(s) drop-down menu, select a value.

Editing charts

You can edit the information displayed on a chart. For more information about customizing the way that individual charts are displayed, see Customizing a chart on page 532.

For more information about customizing the tabbed Charts view, see Customizing the tabbed Charts view on page 534.

Procedure

1. Select the chart using the checkbox in the top left corner.
2. Click to open the Edit Chart pane.
3. Do one of the following:
• Add a metric:
  a. Select objects and apply filters, as appropriate to display the list of metrics.
  b. Select the metric in the KPI Metrics or All Metrics list.
  c. Click Save.

• Remove a metric:
  a. Clear the checkbox alongside the metric you want to remove from the chart.
  b. Click Save.

Copying a chart

To copy a chart:

Procedure
1. Select a storage system.
2. Click Performance > Charts.
3. Select the chart by clicking the checkbox in the top left corner of the chart and then click to create the copy.

Analyze view

See Understanding Performance Management on page 522 for an overview of Unisphere Performance Management.

Only applicable dashboards (those defined in the dashboard catalog - refer to Managing dashboard catalog on page 598) are displayed for individual storage systems.

The All Array Analyze view allows you to easily compare and drill into analyze data for any performance registered array without having to drill down to the performance section for an individual array.

The Analyze view provides three tabbed views into your storage data. You can use the Real Time and Diagnostic tabs to debug and find causes for performance problems. You can use the Historical tab to view historical data, showing long-term trends, to plan for future needs.

Real Time tab
The default range is the previous 1 hour. Real Time view collects data between 2 and 5 seconds for a limited group of metrics. The data is available for the previous hour. Saved Real Time traces can also be viewed here.

Diagnostic tab
The default range is the previous 4 hours. Diagnostic view collects data every 5 minutes (by default, but this can be changed to 10 or 15 minutes) for root cause analysis. The data is available for the previous 15 days (by default, but this can be reduced). A maximum of a 24 hour time period can be viewed at a time.

Historical tab
The default range is the previous 24 hours. Historical view collects data in hourly or daily intervals for trending and planning. The data is available for a maximum of the previous 3 years (18 months by default).
You can use Real Time and Diagnostic information to find the cause of performance problems. Historical information shows long-term trends you can use to plan for future requirements.

**Procedure**

1. Select a storage system.
2. Click **Performance > Analyze**
3. Select a tabbed view. The following tabs are available:
   - Real Time
   - Diagnostic
   - Historical
   The Diagnostic tab is displayed by default.
4. To see more information about a storage system, click the ID of the storage system.
   More detailed data, displayed according to category, is presented.
5. To navigate between the different categories of information for that storage system, select a category from the drop-down menu in the breadcrumb trail.
   Categories for which there is no information available for that storage system are not displayed. The detailed information displayed for each storage system depends on the configuration and version of that storage system.
6. (Optional) To configure the columns presented click `"` and select the columns you want to view. For some analyze views, additional columns can be viewed.
7. To filter a column, click `"` and type letters or numbers in the search box, depending on the data type in the column being searched. For columns with numerical values you can filter for exact values or for ones larger than or equal or smaller than or equal to the value e.g. 100, >100, >=100, <100, <=100. You can also filter for a numerical range e.g. 100-150.
8. (Optional) To return to the top-level, table view of storage systems, click the storage system ID in the breadcrumb trail.
9. (Optional) To take a trace for the last one hour's worth of real time data. click the **Capture Trace** button (available from the **Real Time** tab).

**Creating a dashboard from an Analyze view**

**Before you begin**

You require access to a visible, registered storage system.

You can create a dashboard from the information currently displayed in an Analyze view.

To create a dashboard from an Analyze view:

**Procedure**

1. Select component(s) from the table in an Analyze view.
2. Click `"` **Navigate to Charts**
   The selected components are displayed in a **New Chart** view.
3. Select the metrics to be displayed.
4. Click Create.
5. Click .
   The Save as Dashboard dialog box displays.
6. Specify a dashboard name.
7. Click OK to save the dashboard.

Creating a template dashboard from an Analyze view

To create a dashboard template from an Analyze view:

Procedure
1. Select component(s) from the table in an Analyze view.
2. Click Navigate to Charts
   The selected components are displayed in a New Chart view.
3. Select the metrics to be displayed.
4. Click Create.
5. Click Save as Template.
   The Save as Template dialog box displays.
6. Specify a template name.
7. Click OK to save the template.

Changing the time range

Use the options in the Custom Time Selection dialog to specify a custom time range for performance reports or to specify a data collection time range for an analyze view.

In the Analyze view, there are the following default data collection time ranges:

**Real Time**
The last hour.

**Diagnostic**
The last 4 hours.

**Historical**
The last 24 hours.

For the Real time tab, you can load an existing real-time trace file by selecting Realtime > Trace from the time-selection drop-down menu.

For the Diagnostic and Historical tabs, you can customize the time range by specifying a custom time range from the time-selection drop-down menu.

When specifying a custom Diagnostic time range, you can define a maximum range of 24 hours, specified at five-minute intervals.

When specifying a custom Historical time range, you can define a minimum range of 24 hours, specified at one-hour intervals.
Procedure

1. Complete one of the following:

   • Changing the Real Time time range:
     
     From the time selection menu, which, by default displays Last Hour, select one of the following options:
     
     - Select Last Hour to view the last hour of data collected.
     - Select Trace and choose a saved trace file from the list. This option is available only if a trace file is available for the selected storage system.

   • Changing the Diagnostic time range:
     
     a. From the time selection menu, which by default displays Last 4 Hours, select Diagnostic, and one of the following options:
     
        - Select Last Hour to view the last hour of data collected.
        - Select Last 2 Hours to view the last two hours of data collected.
        - Select Last 4 Hours to view the last four hours of data collected.
        - Select Last 8 Hours to view the last eight hours of data collected.
        - Select Last 24 Hours to view the last 24 hours of data collected.
        - Select Custom to make a custom time selection. To do this, complete the following steps:

          a. In the Custom Time Selection dialog box, specify a start time and end time.
          b. Click OK.

   • Changing the Historical time range:
     
     a. From the time selection menu, which by default displays Last 24 Hours, select one of the following options:
     
        - Select Last 24 Hours to view the last 24 hours of data collected.
        - Select Last Week to view the last week of data collected.
        - Select Last Month to view the last month of data collected.
        - Select Last 6 Months to view the last 6 months of data collected.
        - Select Last 12 Months to view the last 12 months of data collected.
        - Select Custom to make a custom time selection. To do this, complete the following steps:

          a. In the Custom Time Selection dialog box, specify a start time and end time.
          b. Click OK.

Symmetrix systems view (Real Time)

The Real Time view provides high-level data about all storage systems. The specific information displayed depends on the models of the selected storage systems and consists of some or all of the following:

Host IOs/sec

The IOs per second for each front end director.

Host MBs/sec

The MBs per second for each front end director.
FE Reqs/sec
The number of requests per second for each front end director.

System WP Events/sec
The number of write pending events per second for the system.

Device WP Events/sec
The number of write pending events per second for the volume.

FE Director view (Real Time)

The Real Time view provides detailed data about front-end directors. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

Name
The ID of the director.

% Busy
The percent of time the director is busy.

Host IOs/sec
The IOs per second for each front end director.

Host MBs/sec
The MBs per second for each front end director.

Reqs/sec
The number of requests per second for each front end director.

System WP Events/sec
The number of write pending events per second for the system.

Device WP Events/sec
The number of write pending events per second for the volume.

BE Director (DA) view (Real Time)

The Real Time view provides detailed data about back-end directors (DA). The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

Name
The ID of the back-end director.

% Busy
The percent of time the directory is busy.

IOs/sec
The number of IOs to and from the disks that are mapped to this back-end director.

Reqs/sec
The requests per second for each back-end director.
Reads Reqs/sec
The number of read requests to and from the disks that are mapped to this back-end director.

Writes Reqs/sec
The number of write requests to and from the disks that are mapped to this back-end director.

External Director view (Real Time)

The Real Time view provides detailed data about external directors. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

Name
The ID of the external director.

% Busy
The percent of time that the director is busy.

IOs/sec
The number of IOs (per second) handled by the director.

Reqs/sec
The average number of requests performed by the director per second.

Read Reqs/sec
The average number of read requests performed by the director per second.

Write Reqs/sec
The average number of write requests performed by the director per second.

RDF Director view (Real Time)

The Real Time view provides detailed data about RDF directors. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

Name
The ID of the director.

% Busy
The percent of time the director is busy.

IOs/sec
The number of IOs to and from the disks that are mapped to this RDF director.

Tracks Sent/sec
The number of tracks sent to each disk from the RDF director.

Tracks Received/sec
The number of tracks received from each disk mapped to the RDF director.
Array systems view (Diagnostic)

The Diagnostic view provides high-level data about all storage systems. The specific information displayed depends on the models of the selected storage systems and consists of some or all of the following:

Name
The array ID for each supported system in the domain.

Alerts
The number and severity of alerts associated with each Symmetrix system.

Host I/Os/sec
The number of host IO operations performed each second by all Symmetrix volumes, including writes and random and sequential reads.

Host MBs/sec
The number of host MBs written and read by all of the Symmetrix volumes each second.

FE Utilization
The calculated percent of time the front-end directors are busy.

BE Utilization
The calculated percent of time the back-end directors are busy.

RDF Utilization
The calculated percent of time the RDF directors are busy. If the utilization value is not available, the number indicates the MBs per second activity between the local and remote Symmetrix systems, if both systems are in the managed domain. If the remote system is not in the domain, the value for each of the local R1 links displays without a remote identifier.

% Cache WP
The percent of cache that is busy with write pendings.

Disk Utilization
The average utilization across the disk groups. The utilization (time busy) values are 0% to 100%.

Average Fall Thru Time
The average time it takes a cache slot in LRU0 to be freed up. It is the average time from the first use of the contents to its reuse by another address.

Alerts view (Diagnostic)

The Diagnostic view provides detailed data about alerts. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

Created
The time the alert was created.

Severity
The severity of the alert.
- (1) Fatal
- (2) Critical
- (3) Warning
- (4) Information
- (5) Normal

**Category**
The object related to the alert, such as volume group, disk group, and so on.

**Instance**
The specific object on which the alert is generated. For example, if the category listed disk groups, the instance would name the specific disk.

**Metric**
The metric that generated the alert.

**Value**
The specific value of the metric that generated the alert.

**Count**
The number of times the metric exceeded the threshold.

**Acknowledge**
Indicates whether the alert has been acknowledged.

**Type**
Indicates whether the alert is static or dynamic.

**Message**
Describes the cause of the alert.

### FE Directors view (Diagnostic)

The Diagnostic view provides detailed data about RDF directors. The specific information displayed depends on the model of the selected storage system, and consists of some or all of the following:

**Name**
The ID of the director.

**% Busy**
The percent of time the director is busy.

**Host IOs/sec**
The number of host commands for data transfer per second.

**Host MBs/sec**
The size (MBs) of the host throughput per second.

**Reqs/sec**
The number of data transfers between the director and the cache. An IO may require multiple requests depending on IO size, alignment or both. The requests rate should be either equal to or greater than the IO rate.
System WP Events/sec
The number of write misses due to the system write pending limit having been reached.

Device WP Events/sec
The number of write misses due to the volume write pending limit having been reached.

**BE Directors (DA) view (Diagnostic)**

The Diagnostic view provides detailed data about back-end directors (DA). The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

**Name**
The ID of each back end director.

**% Busy**
The percent of time that a director is busy.

**IOs/sec**
The number of IOs (per second) commands to the disk.

**Reqs/sec**
The number of data transfers between the director and the cache. An IO may require multiple requests depending on IO size, alignment or both. For writes the request counter is incremented at the time that the write pending flag is removed from the cache slot. In the event that multiple DAs are involved in the IO operation (such as RAID-1), the request count may not reconcile with the IO count and IO size.

**MBs Read/sec**
The average size of host MBs read (per second) by the director.

**MBs Written/sec**
The average size of host MBs written (per second) by the director.

**External Directors view (Diagnostic)**

The Diagnostic view provides detailed data about external directors. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

**Name**
The ID of each external director.

**% Busy**
The percent of time that the director is busy.

**IOs/sec**
The number of IOs (per second) handled by the director.

**Reqs/sec**
The average number of requests performed by the director per second.
MBs Read/sec
The average number of MBs read by the director per second.

MBs Written/sec
The average number of MBs written by the director per second.

**RDF Directors view (Diagnostic)**

The Diagnostic view provides detailed data about RDF directors. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

**Name**
The ID of each RDF director.

**% Busy**
The percent of time that a director is busy.

**IOs/sec**
The number of IOs (per second) handled by the director.

**MBs Sent/sec**
The average size of MBs sent (per second) by the director.

**MBs Received/sec**
The average size of MBs received (per second) by the director.

**Copy IOs/sec**
The number of copy IOs (per second) by the director. Copy is a generic SRDF term meaning a full track that comes from background data movement. These copies can be generated by a number of different things, including if the RDF device is in adaptive copy mode. Adaptive copy is included in this term, but not exclusively. For example, if SRDF is suspended, hosts continue to write to the R1 and then SRDF is resumed, the resulting R1->R2 copy of tracks (due to invalids) is a “copy.”

**Copy MBs/sec**
The size of copy IOs (per second) by the director.

**% Compressed MBs Sent**
The percent of total MBs sent by the director that were compressed MBs.

**IM Directors view (Diagnostic)**

The Diagnostic view provides detailed data about IM directors. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

**Name**
The ID of the IM director.

**% Busy**
The percent of time that a director is busy.

**% Idle**
The percent of time that a director is idle.
EDS Directors view (Diagnostic)

The Diagnostic view provides detailed data about EDS directors. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

Name
The ID of each EDS director.

% Busy
The percent of the time that a director is busy.

Random Read Misses
The number of random read IOs that were misses.

Random Read Misses Mbytes

Random Write Misses
The number of random write IOs that were misses.

Random Write Misses Mbytes

Cache Partitions view (Diagnostic)

The Diagnostic view provides detailed data about cache partitions. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

Name
The cache partition identifier.

% WP Utilization
The percent of tracks in cache that are write pending. Until the data is destaged to disk, those tracks are not used to serve reads and improve the hit ratio.

% Hit
The Read/Hit and Write/Hit ratio percentage for the cache partition.

% Cache Used
The percent of the cache partition that is used.

Boards view (Diagnostic)

The Diagnostic view provides detailed data about boards. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
The ID of the board.

Utilization
The percent of time the board is busy.
Outbound MBs/sec
-
Inbound MBs/sec
-
Max Speed MBs/sec
-

Disk Technologies view (Diagnostic)

The Diagnostic view provides detailed data about disk technologies. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
The disk technology identifier.

Name
The disk technology name.

% Busy
The percent of time the disk technology group is busy.

Reads/sec
The average number of host reads performed per second.

Read RT (ms)
The average time it took the disk technology group to serve one read command.

Writes/sec
The number of write operations performed by the disk technology group per second.

Write RT (ms)
The average time it took the disk technology group to serve one write command.

Total Capacity (GB)
The total capacity of the disk technology group.

% Used Capacity
The used capacity of the disk technology group.

Members
The number of members in the disk technology group.

Model
The vendor model number of the disk.

Events view (Diagnostic)

The Diagnostic view provides detailed data about events. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:
Storage Groups view (Root Cause Analysis)

The Root Cause Analysis view provides detailed data about storage groups. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

**ID**
The name assigned to this storage group.

**Host I/Os/sec**
The number of host read IO and write IO operations performed each second by the group.

**Host MBs/sec**
The number MBs performed each second by the group.

**Read Response Time (ms)**
The time it takes the group to perform the Reads in milliseconds.

**Write Response Time (ms)**
The time it takes the group to perform the Writes in milliseconds.
% Hit
The percentage of IO operations, performed by the group, that were immediately satisfied by cache.

% Writes
The percent of IO operations that were writes.

% Read Miss
The percent of read miss operations performed each second by the group. A miss occurs when the requested read data is not found in cache or the write operation had to wait while data was destaged from cache to the disks.

Capacity (GB)
The capacity of the storage group in GBs.

Members
The number of volumes that comprise this storage group.

Device Groups view (Diagnostic)
The Diagnostic view provides detailed data about device groups. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
The name assigned to the device group.

Host IOs/sec
The number of host operations performed each second by the group.

Read RT (ms)
The average time it took the storage system to serve one read IO for this group.

Write RT (ms)
The average time that it took the storage system to serve one write IO for this group.

% Hit
The percent of IO operations, performed by the group, that were immediately satisfied by cache.

% Writes
The percent of IO operations that were writes.

% Read Miss
The percent of read miss operations performed each second by the group. A miss occurs when the requested read data is not found in cache.

Allocated Capacity
The total allocated array capacity.

Total Capacity (GB)
The capacity of the device group in GBs.

Members
The number of volumes that comprise this device group.
Databases view (Diagnostic)

The Diagnostic view provides detailed data about databases. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

- **ID**
  The ID of the database.

- **Host**

- **Env Name**

- **Host IOs/sec**
  Host operations performed each second by the group.

- **Read Response Time (ms)**
  The average time that it took the storage system to serve one read IO for this group.

- **Write Response Time (ms)**
  The average time that it took the storage system to serve one write IO for this group.

- **% Hit**
  Percentage of I/O operations for which the read data was in cache and the write operation could be sent directly to cache without having to wait for data to be destaged from cache to the disks.

- **% Writes**
  Percentage of IO operations that were writes.

- **% Read Miss**
  Percentage of read miss operations performed each second by the group. A miss occurs when the requested read data is not found in cache.

- **Allocated Capacity (GB)**

- **Total Capacity (GB)**

- **Members**

Thin Pools view (Diagnostic)

The Diagnostic view provides detailed data about virtual pools. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

- **ID**
  The identifier of the thin pool.
BE Reqs/sec
The number of data transfers between cache and the pool.

BE MBs Transferred/sec
The number of MBs transferred each second between cache and the pool.

BE Response Time (ms)
The average time it takes to transfer IO from pool to cache.

Allocated Pool Capacity (GB)
The allocated capacity for the thin pool in GBs.

Total Capacity
The total capacity of the thin pools in GBs.

Disk Groups view (Diagnostic)

The Diagnostic view provides detailed data about disk groups. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
The disk group ID.

Name
The disk group name.

% Busy
The percent of time the disk group is busy.

Reads/sec
The number of read operations performed by the disk group per second.

MBs Read/sec
The number of read MBs performed by the disk group per second.

Read RT (ms)
The average time it took the disk group to serve one read command.

Writes/sec
The number of write operations performed by the disk group per second.

MBs Written/sec
The number of write MBs performed by the disk group per second.

Write RT (ms)
The average time it took the disk group to serve one write command.

Total Capacity (GB)
The total capacity of the disk group.

Used Capacity (%)
The used capacity of the disk group.

Members
The number of members in the disk group.
Model
The vendor model number of the disk.

**External Disk Groups view (Diagnostic)**

The Diagnostic view provides detailed data about external disk groups. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

- **ID**
  The identifier assigned to this external disk group.

- **Name**
  The name of the external disk group.

- **Reads/sec**
  The average number of host reads performed per second.

- **MBs Read/sec**
  The throughput per second for the disks that comprise this disk group.

- **Read RT (ms)**
  The average time it takes the storage system to perform read operations.

- **Writes/sec**
  The average number of host writes performed per second.

- **MBs Written/sec**
  The number of MBs written per second.

- **Write RT (ms)**
  The average time it takes the storage system to perform write operations.

- **Total Capacity (GB)**
  The total available capacity in GBs for disks in the external disk group.

- **% Used Capacity**
  The total percentage used capacity in GBs for disks in the external disk group.

- **Members**
  The number of members in the external disk group.

**SRPs view (Diagnostic)**

The Diagnostic view provides detailed data about SRPs. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

- **ID**
  The ID of the SRP.

- **Host IOs/sec**
  The number of IOs per second transferred from the host.
Host MBs/sec
The number of host MBs written and read by all of the storage volumes each second.

BE Reqs/sec
The number of read or write requests performed each second between the cache and the director.

BE MBs Transferred/sec
The MBs transferred per second to the disk directors.

Response Time (ms)
The average time it takes the SRP to service IO.

**RDFA Groups view (Diagnostic)**

The Diagnostic view provides detailed data about RDF/A groups. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

- **ID**
  Displays the RDF/A group number.

- **RDFA Group Label**
  Displays the RDF/A group name.

- **RDF Response Time (ms)**

- **Duration of Last Cycle**
  The number of seconds for the last cycle in the session.

- **RDF R1 to R2 MBs/sec**
  The throughput in MB per second from the R1 to the R2 for the RDF/A group.

- **RDFA WP Count**
  The number of cache slots in use by the RDF/A group.

- **Local WP Count**
  The number of write pending slots waiting to be de-staged to disk. The R1 should be less than or equal to the system write pending count.

- **DSE Used Tracks**
  The number of tracks used by DSE for the RDF/A group.

- **% Compressed MBs Sent**
  The percent of total MBs sent by the director that were compressed MBs.

**RDFS Groups view (Diagnostic)**

The Diagnostic view provides detailed data about RDF/S groups. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

- **ID**
  The RDF/S group number.
**RDF/S Group Label**
The RDF/S group label.

**Response Time (ms)**
The average time it took the storage system to serve one IO for the RDF/S group.

**Host Writes/sec**
The total host writes per second for the RDF/S group.

**% Hit**
The percent of read and write operations for this group that were immediately satisfied from cache.

**% Writes**
The percent of IO operations that were writes for the RDF/S group.

---

**Snap Pools view (Diagnostic)**
The Diagnostic view provides detailed data about snap pools. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

**ID**
The identifier of the snap pool.

**BE Reqs/sec**
The number of read/write requests each second performed by the disk directors to the cache.

**BE MBs Read/sec**
The throughput (MBs) that were reads.

**BE MBs Written/sec**
The throughput (MBs) that were writes.

**BE Disk Read RT (ms)**
The calculated back-end disk read response time in milliseconds for the snap pool.

**Allocated Pool Capacity (GB)**
The allocated capacity for the snap pool in GBs.

**Used Pool Capacity (GB)**
The used pool capacity in GBs.

**Members**
The number of volumes in the snap pool.

---

**DSE Pools view (Diagnostic)**
The Diagnostic view provides detailed data about DSE pools. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

**ID**
The identifier of the DSE pool.
**BE Reqs/sec**
The number of read/write requests each second performed by the disk directors to the cache.

**BE MBs Read/sec**
The number of MBs that were read requests to the disk directors from the disk.

**BE MBs Written/sec**
The number of MBs that were written to the disk directors from the disk.

**BE Disk Read RT (ms)**
The calculated response time for read operations on the back end.

**Allocated Pool Capacity (GB)**
The allocated capacity for the DSE pool in GBs.

**Used Pool Capacity (GB)**
The used pool capacity in GBs.

**Members**
The number of volumes in the DSE pool.

**FAST VP Policies view (Diagnostic)**
The Diagnostic view provides detailed data about FAST policies. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

- **ID**
  The policy ID.

- **Allocated SG Capacity (GB)**
  The number of GBs of the storage group that are allocated to the FAST policy.

- **Total SG Capacity (GB)**
  The total capacity of the storage group.

- **Allocated Pool Capacity (GB)**
  The number of GBs of the virtual pool that are allocated to the FAST policy.

- **Total Pool Capacity (GB)**
  The total capacity of the virtual pool.

- **BE Reqs/sec**
  The number of data transfers between cache and the director.

- **BE MBs Transferred/sec**
  The number of MBs transferred each second between cache and the director.

**Disk Group Tiers view (Diagnostic)**
The Diagnostic view provides detailed data about disk group tiers. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:
ID
The name assigned to this storage tier.

% Busy
A high-level overview of the utilization (time busy) for the disks that comprise this storage tier during the selected time range.

Reads/sec
The average number of host reads performed per second.

MBs Read/sec
The throughput in MBs read per second.

Read RT (ms)
The average time it takes the storage system to perform the Reads, in milliseconds.

Writes/sec
The average number of host writes performed per second.

MBs/Written/sec
The throughput in MBs written per second.

Write RT (ms)
The average time it takes the storage system to perform the Writes, in milliseconds.

Total Capacity (GB)
The total available capacity in GBs for disks that comprise this storage tier.

% Used Capacity
The total capacity used in GBs for disks that comprise this storage tier.

Number of Disks
The number of members in the tier.

Technology Protection
The protection type of the tier.

Virtual Pool Tiers view (Diagnostic)
The Diagnostic view provides detailed data about virtual pool tiers. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
The name assigned to this storage tier.

BE Reqs/sec
The number of read/write requests each second performed by the disk directors to the cache.

BE MBs Transferred/sec
The number of MBs per sec + the number of MBs written per second.
BE RT (ms)
The average time it takes to perform IO requests from the disk directors to cache.

Allocated Pool capacity (GB)
The allocated pool capacity.

Total Capacity (GB)
The total pool capacity.

Storage Groups view (Root Cause Analysis)
The Root Cause Analysis view provides detailed data about storage groups. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The name assigned to this storage group.

Host IOs/sec
The number of host read IO and write IO operations performed each second by the group.

Host MBs/sec
The number MBs performed each second by the group.

Read Response Time (ms)
The time it takes the group to perform the Reads in milliseconds.

Write Response Time (ms)
The time it takes the group to perform the Writes in milliseconds.

% Hit
The percentage of IO operations, performed by the group, that were immediately satisfied by cache.

% Writes
The percent of IO operations that were writes.

% Read Miss
The percent of read miss operations performed each second by the group. A miss occurs when the requested read data is not found in cache or the write operation had to wait while data was destaged from cache to the disks.

Capacity (GB)
The capacity of the storage group in GBs.

Members
The number of volumes that comprise this storage group.

Hosts view (Diagnostic)
The Diagnostic view provides detailed data about hosts. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:
The Diagnostic view provides detailed data about initiators. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

**ID**
- The name of the masking group.

**Host IOs/sec**
- The number of host operations performed each second by the initiator.

**Host MBs/sec**
- Number of MBs per second being processed for the initiator.

**Response Time (ms)**
- The overall average response time for reads and writes.

**Read RT (ms)**
- The average time it takes to serve one read IO.

**Write RT (ms)**
- The average time it takes to serve one write IO.

**Host Reads/sec**
- Cumulative number of host MBs read per second.

**Host Writes/sec**
- Cumulative number of host MBs written per second.

**Syscall Count/sec**
- The total number of calls seen by this host.

The Diagnostic view provides detailed data about masking views. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

**ID**
- The name of the masking group.

**Host IOs/sec**
- The number of host operations performed each second by the host.

**Host MBs/sec**
- Number of MBs per second being processed for the host.

**Response Time (ms)**
- The overall average response time for reads and writes.

**Read RT (ms)**
- The average time it takes to serve one read IO.

**Write RT (ms)**
- The average time it takes to serve one write IO.

The Diagnostic view provides detailed data about masking views. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

**ID**
- The name of the masking group.
Host IOs/sec
The number of host operations performed each second by the masking group.

Host MBs/sec
Number of MBs per second being processed for the specific masking group.

Read RT (ms)
The average time it takes to serve one read IO.

Write RT (ms)
The average time it takes to serve one write IO.

Capacity (GB)
The total capacity of the masking group, in GBs.

Port Groups view (Diagnostic)
The Diagnostic view provides detailed data about port groups. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
The ID of the port group.

% Busy
The percent of time the port group is busy.

Host IOs/sec
The number of host IO operations performed each second, including writes and random and sequential reads.

Host MBs/sec
The number of host MBs read each second.

Host IO Limit by SG view (Diagnostic)
The Diagnostic view provides detailed data about host IO limits set for the storage group. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
The name of the storage group.

Host IOs/sec
Number of I/Os the FE port is completing for the storage group.

Read RT (ms)
The average time it takes to serve one read IO for this storage group.

Write RT (ms)
The average time it takes to serve one write IO for this storage group.

Host IO Limit IOs/sec
The number of I/Os the FE port is processing on behalf of the specific storage group.
Host IO Limit Limit MBs/sec
- The number of MBs the FE port is processing on behalf of the specific storage group.

Host IO Limit Exceeded secs
- The number of IOs the FE port is performing on behalf of the specific storage group.

Host IO Limit by FE view (Diagnostic)
The Diagnostic view provides detailed data about host IO limits sorted by the front-end director. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
- The name of the director.

Host IOs/sec
- Number of IOs the FE port is completing for the specific storage group.

Host IO Limit IOs/sec
- Number of IOs the FE port is completing for the specific storage group.

Host MBs/sec
- Number of MBs per second being processed for the specific storage group.

Host IO Limit MBs/sec
- The Host IO delayed IOs divided by the IO count.

Host IO Limit Exceeded Secs
- The number of IOs the FE port is performing on behalf of the specific SG.

Symmetrix systems view (Historical)
The Historical view provides high-level data about all storage systems. The specific information displayed depends on the models of the selected storage systems and consists of some or all of the following:

Symmetrix ID
- The Symmetrix ID for each supported system in the domain.

Alerts
- The number and severity of alerts associated with each storage system.

Host IOs/sec
- The number of host IO operations performed each second by all volumes, including writes and random and sequential reads.

Host MBs/sec
- The number of host MBs written and read by all of the volumes each second.

FE Utilization
- The calculated percent of time the front-end directors are busy.

BE Utilization
- The calculated percent of time the back-end directors are busy.
RDF Utilization
The calculated percent of time the RDF directors are busy. If the utilization value is not available, the number indicates the MBs per second activity between the local and remote storage systems, if both systems are in the managed domain. If the remote system is not in the domain, the value for each of the local R1 links displays without a remote identifier.

% Cache WP
The percent of cache that is busy with write pendings.

Disk Utilization
The average utilization across the disk groups. The utilization (time busy) values are 0% to 100%.

Average Fall Thru Time
The average time it takes a cache slot in LRU0 to be freed up. It is the average time from the first use of the contents to its reuse by another address.

Alerts view (Historical)
The Historical view provides detailed data about alerts. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

Created
The time the alert was created.

Severity
The severity of the alert.
- (1) Fatal
- (2) Critical
- (3) Warning
- (4) Information
- (5) Normal

Category
The object related to the alert, such as volume group, disk group, etc.

Instance
The specific category of the alert. For example, if the category listed disk groups, the instance would name the specific disk.

Metric
The metric that generated the alert.

Value
The specific value of the metric that generated the alert.

Count
The number of times the metric exceeded the threshold.

Acknowledge
Indicates whether the alert has been acknowledged.
Type
Indicates whether the alert is static or dynamic.

Message
Describes the cause of the alert.

**FE Directors view (Historical)**

The Historical view provides detailed data about front-end directors. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

**ID**
The ID of each front end director.

**% Busy**
The percent of time the directory is busy.

**Host IOs/sec**
The number of host commands for data transfer per second.

**Host MBs/sec**
The size (MBs) of the host throughput per second.

**Reqs/sec**
The number of data transfers between the director and the cache. An IO may require multiple requests depending on IO size, alignment or both. The requests rate should be either equal to or greater than the IO rate.

**System WP Events/sec**
The number of write misses due to the system write pending limit having been reached.

**Device WP Events/sec**
The number of write misses due to the volume write pending limit having been reached.

**BE Directors (DA) view (Historical)**

The Historical view provides detailed data about back-end directors. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

**ID**
The ID of each back end director.

**% Busy**
The percent of time that a director is busy.

**IOs/sec**
The number of IOs (per second) commands to the disk.

**Reqs/sec**
The number of data transfers between the director and the cache. An IO may require multiple requests depending on IO size, alignment or both. For writes the request counter is incremented at the time that the write pending flag is removed.
from the cache slot. In the event that multiple DAs are involved in the IO operation (such as RAID-1), the request count may not reconcile with the IO count and IO size.

**MBs Read/sec**
The average size of host MBs read (per second) by the director.

**MBs Written/sec**
The average size of host MBs written (per second) by the director.

### External Directors view (Historical)

The Historical view provides detailed data about external directors. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

**ID**
The ID of each external director.

**% Busy**
The percent of time that the director is busy.

**IOs/sec**
The number of IOs (per second) handled by the director.

**Reqs/sec**
The average number of requests performed by the director per second.

**MBs Read/sec**
The average number of MBs read by the director per second.

**MBs Written/sec**
The average number of MBs written by the director per second.

### RDF Directors view (Historical)

The Historical view provides detailed data about RDF directors. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

**ID**
The ID of each RDF director.

**% Busy**
The percent of time that a director is busy.

**IOs/sec**
The number of IOs (per second) handled by the director.

**MBs Sent/sec**
The average size of MBs sent (per second) by the director.

**MBs Received/sec**
The average size of MBs received (per second) by the director.
Copy IOs/sec
The number of copy IOs (per second) by the director. Copy is a generic SRDF term meaning a full track that comes from background data movement. These copies can be generated by a number of different things, including if the RDF device is in adaptive copy mode. Adaptive copy is included in this term, but not exclusively. For example, if SRDF is suspended, hosts continue to write to the R1 and then SRDF is resumed, the resulting R1->R2 copy of tracks (due to invalids) is a “copy.”

Copy MBs/sec
The size of copy IOs (per second) by the director.

% Compressed MBs Sent
The percent of total MBs sent by the director that were compressed MBs.

IM Directors view (Historical)
The Historical view provides detailed data about IM directors. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
The ID of the IM director.

% Busy
The amount of time that the director is busy.

% idle
The amount of time that the director is idle.

EDS Directors view (Historical)
The Historical view provides information about EDS directors:

ID
The ID of each EDS director.

% Busy
The amount of time that the director is busy.

Random Read Misses
The number of random read I/Os that were misses.

Random Read Misses Mbytes
-

Random Write Misses
The number of random write I/Os that were misses.

Random Write Misses Mbytes
-
Cache Partitions view (Historical)

The Historical view provides detailed data about cache partitions. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
The cache partition identifier.

% WP Utilization
The percent of tracks in cache that are write pending. Until the data is destaged to disk, those tracks are not used to serve reads and improve the hit ratio.

% Hit
The Read/Hit and Write/Hit ratio percentage for the cache partition.

% Cache Used
The percent of the cache partition that is used.

Boards view (Historical)

The Historical view provides detailed data about boards. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
The ID of the board.

Utilization
A measure of how busy the board is calculated as the sum of the input and output transfer rates divided by the maximum transfer rate.

Outbound MBs/sec

Inbound MBs/sec

Max Speed MBs/sec

Disk Technologies view (Historical)

The Historical view provides detailed data about disk technologies. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
The disk technology identifier.

Name
The disk technology name.

% Busy
The percent of time the disk technology group is busy.
Reads/sec
The average number of host reads performed per second.

Read RT (ms)
The average time it took the disk technology group to serve one read command.

Writes/sec
The number of write operations performed by the disk technology group per second.

Write RT (ms)
The average time it took the disk technology group to serve one write command.

Total Capacity (GB)
The total capacity of the disk technology group.

% Used Capacity
The used capacity of the disk technology group.

Members
The number of members in the disk technology group.

Model
The vendor model number of the disk.

Events view (Historical)
The Historical view provides detailed data about events. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

Sequence Number
-

Timestamp
-

Function Class
-

Action Code
-

Activity ID
-

Message
-

Application ID
-

Host ID
-
Storage Groups view (Historical)

The Historical view provides detailed data about storage groups. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

**ID**
The name assigned to this storage group.

**Service Level**
The service level associated with the storage group.

**Host IOs/sec**
The number of host read IO and write IO operations performed each second by the group.

**Host MBs/sec**
The number MBs performed each second by the group.

**Read RT (ms)**
The time it takes the group to perform the Reads in milliseconds.

**Write RT (ms)**
The time it takes the group to perform the Writes in milliseconds.

**% Hit**
The percentage of IO operations, performed by the group, that were immediately satisfied by cache.

**% Writes**
The percent of IO operations that were writes.

**% Read Miss**
The percent of read miss operations performed each second by the group. A miss occurs when the requested read data is not found in cache or the write operation had to wait while data was destaged from cache to the disks.

**Capacity (GB)**
The capacity of the storage group in GBs.

**Members**
The number of volumes that comprise this storage group.
Device Groups view (Historical)

The Historical view provides detailed data about device groups. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

**ID**
- The name assigned to the device group.

**Host IOs/sec**
- The number of host operations performed each second by the group.

**Read RT (ms)**
- The average time it took the storage system to serve one read IO for this group.

**Write RT (ms)**
- The average time that it took the storage system to serve one write IO for this group.

**% Hit**
- The percent of IO operations, performed by the group, that were immediately satisfied by cache.

**% Writes**
- The percent of IO operations that were writes.

**% Read Miss**
- The percent of read miss operations performed each second by the group. A miss occurs when the requested read data is not found in cache.

**Allocated Capacity (GB)**
- The allocated capacity of the device group in GBs.

**Total Capacity (GB)**
- The capacity of the device group in GBs.

**Members**
- The number of volumes that comprise this device group.

Databases view (Historical)

The Historical view provides detailed data about databases. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

**ID**
- The ID of the database.

**Host**
- 

**Env Name**
- 

**Host IOs/sec**
- Host operations performed each second by the group.
Read Response Time (ms)
The average time that it took the storage system to serve one read IO for this group.

Write Response Time (ms)
The average time that it took the storage system to serve one write IO for this group.

% Hit
Percentage of I/O operations for which the read data was in cache and the write operation could be sent directly to cache without having to wait for data to be destaged from cache to the disks.

% Writes
Percentage of IO operations that were writes.

% Read Miss
Percentage of read miss operations performed each second by the group. A miss occurs when the requested read data is not found in cache.

Allocated Capacity (GB)
-

Total Capacity (GB)
-

Members
-

Thin Pools view (Historical)
The Historical view provides detailed data about virtual pools. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
The identifier of the thin pool.

BE Reqs/sec
The number of data transfers between cache and the pool.

BE MBs Transferred/sec
The number of MBs transferred each second between cache and the pool.

BE Response Time (ms)
The average time it takes to transfer IO from pool to cache.

Allocated Pool Capacity (GB)
The allocated capacity for the thin pool in GBs.

Total Capacity (GB)
The total capacity of the thin pool in GBs.
Disk Groups view (Historical)

The Historical view provides detailed data about disk groups. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
The disk group ID.

Name
The disk group name.

% Busy
The percent of time the disk group is busy.

Reads/sec
The number of read operations performed by the disk group per second.

Avg Read Response Time (ms)
The average time it took the disk group to serve one read command.

Writes/sec
The number of write operations performed by the disk group per second.

Avg Write Response Time (ms)
The average time it took the disk group to serve one write command.

Total Capacity (GB)
The total capacity of the disk group.

% Used Capacity
The used capacity of the disk group.

Members
The number of members in the disk group.

Model
The vendor model number of the disk.

External Disk Groups view (Historical)

The Historical view provides detailed data about external disk groups. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
The identifier assigned to this external disk group.

Name
The name of the external disk group.

Reads/sec
The average number of host reads performed per second.

MBs Read/sec
The throughput per second for the disks that comprise this disk group.
Read RT (ms)
The average time it takes the storage system to perform read operations.

Writes/sec
The average number of host writes performed per second.

MBs Written/sec
The number of MBs written per second.

Write RT (msec)
The average time it takes the storage system to perform write operations.

Total Capacity (GB)
The total available capacity in GBs for disks in the external disk group.

% Used Capacity
The total percentage used capacity in GBs for disks in the external disk group.

Members
The number of members in the external disk group.

SRPs view (Historical)
The Historical view provides detailed data about SRPs. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
The ID of the SRP.

Host IOs/sec
The number of IOs per second transferred from the host.

Host MB/sec
The number of host MBs written and read by all of the storage volumes each second.

BE Reqs/sec
The number of read or write requests performed each second between the cache and the director.

BE MBs Transferred/sec
The MBs transferred per second to the disk directors.

Response Time (ms)
The average time it takes the SRP to service IO.

RDFA Groups view (Historical)
The Historical view provides detailed data about RDF/A groups. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
Displays the RDF/A group number.
RDF/A Group Label
Displays the RDF/A group name.

RDF Response Time (ms)
The total writes per second for the RDF/A group.

Duration of Last Cycle
The number of seconds for the last cycle in the session.

RDF R1 to R2 MBs/sec
The throughput in MB per second from the R1 to the R2 for the RDF/A group.

RDF/A WP Count
The number of cache slots in use by the RDF/A group.

Local WP Count
The number of write pending slots waiting to be de-staged to disk. The R1 should be less than or equal to the system write pending count.

DSE Used Tracks
The number of tracks used by DSE for the RDF/A group.

% Compressed MBs Sent
The percent of total MBs sent by the director that were compressed MBs.

RDFS Groups view (Historical)
The Historical view provides detailed data about RDF/S groups. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
The RDF/S group number.

RDF/S Group Label
The RDF/S group name.

Response Time (ms)
The average time it took the storage system to serve one IO for the RDF/S group.

Host Writes per second
The total host writes per second for the RDF/S group.

% Hit
The percent of read and write operations for this group that were immediately satisfied from cache.

% Writes
The percent of IO operations that were writes for the RDF/S group.

Snap Pools view (Historical)
The Historical view provides detailed data about snap pools. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:
ID
The identifier of the snap pool.

BE Reqs/sec
The number of read/write requests each second performed by the disk directors to the cache.

BE MBs Read/sec
The throughput (MBs) that were reads.

BE MBs Written/sec
The throughput (MBs) that were writes.

BE Disk Read RT (ms)
The calculated back-end disk read response time in milliseconds for the snap pool.

Allocated Pool Capacity (GB)
The allocated capacity for the snap pool in GBs.

Used Pool Capacity (GB)
The used pool capacity in GBs.

Members
The number of volumes in the snap pool.

DSE Pools view (Historical)
The Historical view provides detailed data about DSE pools. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
The identifier of the DSE pool.

BE Reqs/sec
The number of read/write requests each second performed by the disk directors to the cache.

BE MBs Read/sec
The number of MBs that were read requests to the disk directors from the disk.

BE MBs Written/sec
The number of MBs that were written to the disk directors from the disk.

BE Disk Read RT (ms)
The calculated response time for read operations on the back end.

Allocated Pool Capacity (GB)
The allocated capacity for the DSE pool in GBs.

Used Pool Capacity (GB)
The used pool capacity in GBs.

Members
The number of volumes in the DSE pool.
FAST VP Policies view (Historical)

The Historical view provides detailed data about FAST policies. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

- **ID**
  - The policy ID.

- **Allocated SG Capacity (GB)**
  - The number of GBs of the storage group that are allocated to the FAST policy.

- **Total SG Capacity (GB)**
  - The total capacity of the storage group.

- **Allocated Pool Capacity (GB)**
  - The number of GBs of the virtual pool that are allocated to the FAST policy.

- **Total Pool Capacity (GB)**
  - The total capacity of the virtual pool.

- **BE Reqs/sec**
  - The number of data transfers between cache and the director.

- **BE MBs Transferred/sec**
  - The number of MBs transferred each second between cache and the director.

Disk Group Tiers view (Historical)

The Historical view provides detailed data about disk group tiers. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

- **ID**
  - The name assigned to this storage tier.

- **% Busy**
  - A high-level overview of the utilization (time busy) for the disks that comprise this storage tier during the selected time range.

- **Reads/sec**
  - The average number of host reads performed per second.

- **MBs Read/sec**
  - The throughput in MBs read per second.

- **Read RT (ms)**
  - The average time it takes the storage system to perform the Reads, in milliseconds.

- **Writes/sec**
  - The average number of host writes performed per second.

- **MBs/Written/sec**
  - The throughput in MBs written per second.
Write RT (ms)
The average time it takes the storage system to perform the Writes, in milliseconds.

Total Capacity (GB)
The total available capacity in GBs for disks that comprise this storage tier.

% Used Capacity
The total capacity used in GBs for disks that comprise this storage tier.

Number of Disks
The number of members in the tier.

Technology Protection
The protection type of the tier.

Virtual Pool Tiers view (Historical)
The Historical view provides detailed data about virtual pool tiers. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
The name assigned to this storage tier.

BE Reqs/sec
The number of read/write requests each second performed by the disk directors to the cache.

BE MBs Transferred/sec
The number of MBs per sec + the number of MBs written per second.

BE Response Time (ms)
The average time it takes to perform IO requests from the disk directors to cache.

Allocated Capacity (GB)
The allocated pool capacity.

Total Capacity (GB)
The total pool capacity.

Storage Groups view (Historical)
The Historical view provides detailed data about storage groups. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
The storage group tier ID.

BE Read Reqs/sec
The number of read requests each second performed by the disk director to cache.

Destage Writes/sec
The number of writes per second that were destaged to disk.
IOs/sec
The number of IOs per second for data transfer.

BE MBs Read/sec
The number of host read IOs performed by the disk group per second.

Destage Write MBs/sec
The size (MBs) of writes per second that were destaged to disk.

MBs/sec
The total MBs read and written per second.

Capacity
The allocated capacity. For example, if SG1 is 100 GB on Tier1 and 50 GB on Tier2, then the SG capacity is 100 GB for Tier1 and 50 GB for Tier2.

IO Density
The number of BE requests per GB of disk. (BE Reads + destaged writes) / capacity.

Hosts view (Historical)
The Historical view provides detailed data about hosts. The specific information displayed depends on the model of the selected storage system. Some or all of the following information is displayed:

ID
The name of the masking group.

Host IOs/sec
The number of host operations performed each second by the host.

Host MBs/sec
Number of MBs per second being processed for the host.

Read RT (ms)
The average time it takes to serve one read IO.

Write RT (ms)
The average time it takes to serve one write IO.

Masking Views view (Historical)
The Historical view provides detailed data about masking views. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
The name of the masking group.

Host IOs/sec
The number of host operations performed each second by the masking group.

Host MBs/sec
Number of MBs per second being processed for the specific masking group.
Read RT (ms)
The average time it takes to serve one read IO.

Write RT (ms)
The average time it takes to serve one write IO.

Capacity (GB)
The total capacity of the masking group, in GBs.

Port Groups view (Historical)
The Historical view provides detailed data about port groups. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
The ID of the port group.

% Busy
The percent of time the port group is busy.

Host IOs/sec
The number of host IO operations performed each second, including writes and random and sequential reads.

Host MBs/sec
The number of host MBs read each second.

Host IO Limit by SG view (Historical)
The Historical view provides detailed data about host IO limits set for the storage group (SG). The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

ID
The name of the storage group.

Host IOs/sec
Number of IOs the FE port is completing for the storage group.

Read RT (ms)
The average time it takes to serve one read IO for this storage group.

Write RT (ms)
The average time it takes to serve one write IO for this storage group.

Host IO Limit IOs/sec
The number of IOs that the FE port is processing on behalf of the SG.

Host IO Limit MBs/sec
The number of MBs that the FE port is processing on behalf of the SG.

Host IO Limit % Time Exceeded
Host IO Limit by FE view (Historical)

The Historical view provides detailed data about host IO limits sorted by the front-end director. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

- **ID**
  - The name of the director.

- **Host IOs/sec**
  - Number of IOs the FE port is completing for the specific storage group.

- **Host IO Limit IOs/sec**
  - Number of IOs the FE port is completing for the specific storage group.

- **Host MBs/sec**
  - Number of MBs per second being processed for the specific storage group.

- **Host IO Limit MBs/sec**
  - The Host IO delayed IOs divided by the IO count.

- **Host IO Limit Exceeded Secs**

Initiators view (Historical)

The Historical view provides detailed data about initiators. The specific information displayed depends on the model of the selected storage system and consists of some or all of the following:

- **ID**
  - The name of the masking group.

- **Host IOs/sec**
  - The number of host operations performed each second by the initiator.

- **Host MBs/sec**
  - Number of MBs per second being processed for the initiator.

- **Read RT (ms)**
  - The average time it takes to serve one read IO.

- **Write RT (ms)**
  - The average time it takes to serve one write IO.

Heatmap

See [Understanding Performance Management](#) on page 522 for an overview of Unisphere Performance Management.

The heatmap displays hardware instances of the selected array represented as colored tiles, with the color indicating utilization levels.

The specific information displayed in a heatmap depends on the model of the selected storage system and whether any filters have been applied. Gray tiles denote components that are not in use.
A graphic indicating the colors used to denote utilization levels is displayed beneath the heatmap.

**Procedure**

1. Select the storage system.
2. Select **Performance > Heatmap**.
3. Do one of the following:
   - Hover over a colored tile to instance to view popup utilization information for that hardware instance.
   - Click on a colored tile to open the **Heatmap Metrics Chart(s)** for the hardware instance (see Viewing Heatmap Metrics Charts on page 580).
   - If the array has multiple engines, scroll through the heatmaps for them using the chevrons on the left and right.
   - Click to export the heatmap to a PDF file that is downloaded by your browser.
   - Click to create a report based on the heatmap. For more information, see Creating performance reports on page 583.
   - Click to Navigate to Charts, Navigate to Analyze, or Navigate to Details, depending on availability. For more information, see Navigating from Heatmap to Analyze or Charts on page 581.
   - Click the slider to choose between average and maximum metric values when drawing the heatmap.
   - Select a time period from the drop-down list to redraw the heatmap for a different time period.

**Note**

To produce a future projection heatmap, you need a minimum of ten days of data.

- Apply a filter. For more information, see Filtering heatmaps on page 581.

**Viewing Heatmap Metrics Charts**

The heatmap displays hardware instances of the selected array represented as colored tiles, with the color indicating utilization levels.

**Procedure**

1. Select the storage system.
2. Select **Performance > Heatmap**.
3. Click on a colored tile to open the **Heatmap Metrics Chart(s)** for the hardware instance.
4. Optional : Click **NAVIGATE TO ANALYZE**.
5. Optional : Click **NAVIGATE TO CHARTS**.
6. Click **OK**.
Navigating from Heatmap to Analyze or Charts

You can navigate from the heatmap object to a charts or analyze view.

To navigate from Heatmap to Analyze or Charts:

**Procedure**

1. Select the storage system.
2. Select **Performance > Heatmap**.
3. Do one of the following:
   - a. Click ![heatmap](image)
   - b. From the drop-down menu, select one of the following:
     - Navigate to Charts
     - Navigate to Analyze
   - a. Click on any object in the heatmap to open its corresponding metric chart.
   - b. Click **Navigate to Analyze or Navigate to Charts**.

Filtering heatmaps

**Procedure**

1. Click the filter icon ![filter](image) to open the filter dialog box.
2. From the **Context** menu, select an object type. The instances list updates to show the objects of that type.
3. Select an object from the instances list. You can filter the instances list by typing all or part of the object's name in the search field.
4. Click **OK**.

Reports

See [Understanding Performance Management](#) on page 522 for an overview of Unisphere Performance Management.

To view performance reports:

**Procedure**

1. Select the storage array.
2. Select **Performance > Reports**.

Use the Reports list to display and manage reports. The following properties display:

- **Name**
  - The user-defined report name.

- **Array**
  - The storage system identifier.
Format

The report format (XML, CSV, BTP, UPV).

Recurring

Indicates whether the report will run automatically.

Run Date

The date of the report.

Email Enabled

Indicates if email notifications are enabled.

Description

The user-defined description.

The following controls are available:

- **Create** — Creating performance reports on page 583
- **Modify** — Modifying performance reports on page 587
- **Delete** — Deleting performance reports on page 588
- **Run Now** — Running performance reports on page 588
- **Schedule** — Scheduling performance reports on page 588
- **Cancel Schedule** — Cancelling a scheduled report on page 589
- **Copy** — Copying performance reports on page 584

When you click **Run Now**, you are prompted to choose the location for the generated reports.

Scheduled XML, CSV, and BTP reports are saved to this location:

`install_dir\SMAS\report\SPA\querydata`

---

**Note**

If the report contains multiple queries involving volumes and disks the report is saved to this location:

```plaintext
/SMAS/report/SPA/runnow
```

Scheduled UPV reports are saved to this location:

`SMAS\backup\SPA`

---

**Report operations**

The following report operations are available:

- Create Compliance reports (see Creating Compliance Reports on page 159).
- Create performance reports (see Creating performance reports on page 583).
- Modify performance reports (see Modifying performance reports on page 587).
Creating performance reports

To create a performance report:

**Procedure**

1. Select a storage array.
2. Select **Performance > Reports**.
3. Click **Create**.
4. In the **General** tab, enter a report **Name**.
5. (Optional) Enter a report **Description**.
6. Select the array.
7. Select the **Time Frame**.
   - If you select **Custom**, the **Custom Time Selection** dialog box displays for custom start and end times.
   - The **Last Interval** option is available only for the **Diagnostic** type. This option executes a report on the array and director categories at each Diagnostic interval. In addition, every hour the system runs a cleanup job to remove Last Interval reports that are older than one hour.
8. Select a **Format**
   - XML, CSV, BTP and UPV formats are supported. If you choose **Last Hour (Realtime)** as the time frame the only format available is CSV. BTP reports are not available for storage systems running HYPERMAX OS 5977 or higher. The BTP format is also not available for Last Interval reports.
9. From the **Generated Time Zone** menu, select the time zone to apply to times in the report. (Not applicable to BTP reports).
10. (Optional) For UPV reports, specify whether to include RT traces.
11. For XML or CSV reports, add one or more queries to the report. Each of these reports must have at least one query.
   - For more information about creating queries see **Creating queries using the Create Query wizard** on page 584. Queries can also be edited (see **Editing queries using the Edit Query wizard** on page 586) or deleted.

**Note**

If the report contains multiple queries involving volumes and disks the report is saved to this location:

```
/SMAS/report/SPA/runnow
```

12. (Optional) In the **Schedule** tab, select the **Schedule** check box and configure values for each of the following options:

   - **First Run Time**
     - The **First Run Time** is continually adjusted relative to the current time and the report execution interval. For example, if **First Run Time** is set to 3am, but the current time is 4am and the **Time Range** is set to ‘Last 4 hours’, then the value of **First Run Time** is changed to 7am.

   - **Day(s) to run**
Copying performance reports

Before you begin

Before copying a performance report, you require an existing report in the Reports list view.

To copy a performance report:

Procedure

1. Select the storage array.
2. Select Performance > Reports to open the Reports list view.
3. Select a report and click Copy.
4. Update the report settings, as appropriate. You can edit the following data:
   - Name
   - Description
   - Symmetrix ID
   - Format
   - Generated Time Zone
   - TimeFrame

5. In the Queries section, do one of the following:
   - Click Add to open the Create Query wizard and create a query.
   - Select a query and click Delete. Click OK on the confirmation message.
   - Select a query and click Edit to open the Edit Query wizard. A report must have at least one query.

6. (Optional) In the Schedule tab, configure the schedule settings for the report.
7. (Optional) In the Email tab, configure the email settings for the report.
8. Click OK.

For more information about reports, see Creating performance reports on page 583

Creating queries using the Create Query wizard

Before you begin

The Create Query wizard is launched from the Create Report dialog box. For more information about creating a report, see Creating performance reports on page 583.

For some categories, you can configure the query to return the \( n \) most active instances. This feature is available for the following categories:
<table>
<thead>
<tr>
<th>Category</th>
<th>Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Group</td>
<td>Host IOs/sec (default)</td>
</tr>
<tr>
<td></td>
<td>Host MBs/sec</td>
</tr>
<tr>
<td></td>
<td>Response Time</td>
</tr>
<tr>
<td>Storage Group Volumes</td>
<td>Host IOs/sec (default)</td>
</tr>
<tr>
<td></td>
<td>Host MBs/sec</td>
</tr>
<tr>
<td></td>
<td>Response Time</td>
</tr>
<tr>
<td>RFDS Group</td>
<td>Host IOs/sec (default)</td>
</tr>
<tr>
<td></td>
<td>Host MB/Sec</td>
</tr>
<tr>
<td></td>
<td>Response Time</td>
</tr>
<tr>
<td>RFDA Group</td>
<td>RDF R1 to R2 IOs/sec (default)</td>
</tr>
<tr>
<td></td>
<td>RDF R1 to R2 MBs/sec</td>
</tr>
<tr>
<td></td>
<td>RDF Response Time</td>
</tr>
<tr>
<td></td>
<td>Host Writes/sec</td>
</tr>
<tr>
<td></td>
<td>Host MBs Written/sec</td>
</tr>
</tbody>
</table>

To create a query using the Create Query wizard:

**Procedure**

1. When creating a report, in the Create Report dialog box, click Add to open the Create Query wizard.
2. In the Query Name & Description page, enter a query Name.
3. (Optional) Enter a query Description.
4. Click Next.
5. In the Category & Instance page, select a Category. Depending on the category type you select, different options are presented.
6. Specify appropriate Instances.
   Some or all of the following options are available:
   All
   Displays all instances.
   Specific instances
   Displays the specific instances you select. Select them in the Available Instances list and click > to move them to the Selected Instances list. You can use multi-select for multiple instances. If required, you can filter the instances by name.
   Most Active
   Displays the top n most active instances. You can specify a value for n and the metric by which you want to sort the displayed instances.
7. Click Next.
8. In the Metrics page, select a Data Format. The available options are Average and Maximum.
9. Select the **Metrics** (for the category and data format you selected on the **Category & Instance** page of the wizard). You can use multi-select for multiple metrics. If required, you can filter the metrics by name.

10. Click **OK**.

**Performance report query operations**

- Create query (see Creating queries using the Create Query wizard on page 584).
- Edit query (see Editing queries using the Edit Query wizard on page 586).

### Editing queries using the Edit Query wizard

**Before you begin**

The **Edit Query** wizard is launched from the **Create Report** dialog box. For more information about creating a report, see Creating performance reports on page 583.

For some categories, you can configure the query to return the $n$ most active instances. This feature is available for the following categories:

<table>
<thead>
<tr>
<th>Category</th>
<th>Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Group</td>
<td>Host IOs/sec (default)</td>
</tr>
<tr>
<td></td>
<td>Host MBs/sec</td>
</tr>
<tr>
<td></td>
<td>Response Time</td>
</tr>
<tr>
<td>Storage Group Volumes</td>
<td>Host IOs/sec (default)</td>
</tr>
<tr>
<td></td>
<td>Host MBs/sec</td>
</tr>
<tr>
<td></td>
<td>Response Time</td>
</tr>
<tr>
<td>RFDS Group</td>
<td>Host IOs/sec (default)</td>
</tr>
<tr>
<td></td>
<td>Host MB/Sec</td>
</tr>
<tr>
<td></td>
<td>Response Time</td>
</tr>
<tr>
<td>RFDA Group</td>
<td>RDF R1 to R2 IOs/sec (default)</td>
</tr>
<tr>
<td></td>
<td>RDF R1 to R2 MBs/sec</td>
</tr>
<tr>
<td></td>
<td>RDF Response Time</td>
</tr>
<tr>
<td></td>
<td>Host Writes/sec</td>
</tr>
<tr>
<td></td>
<td>Host MBs Written/sec</td>
</tr>
</tbody>
</table>

To edit a query using the Create Query wizard:

**Procedure**

1. When creating a report, in the **Create Report** dialog box, click **Edit** to open the **Edit Query** wizard.
2. In the **Query Name & Description** page, modify the query **Name**.
3. (Optional) Modify the query **Description**.
4. Click **Next**.
5. In the **Category & Instance** page, select a **Category**.
   
   Depending on the category type you select, different options are presented.
6. Specify appropriate **Instances**.
   Some or all of the following options are available:
   - **All**
     Displays all instances.
   - **Specific instances**
     Displays the specific instances you select. Select them in the **Available Instances** list and click >> to move them to the **Selected Instances** list. You can use multi-select for multiple instances. If required, you can filter the instances by name.
   - **Most Active**
     Displays the top n most active instances. You can specify a value for n and the metric by which you want to sort the displayed instances.

7. Click **Next**.

8. In the **Metrics** page, select a **Data Format**. The available options are **Average** and **Maximum**.

9. Select the **Metrics** (for the category and data format you selected on the **Category & Instance** page of the wizard). You can use multi-select for multiple metrics. If required, you can filter the metrics by name.

10. Click **OK**.

### Modifying performance reports

**Before you begin**

Before modifying a performance report, you require an existing report in the **Reports** list view.

To modify a performance report:

**Procedure**

1. Select a storage system.
2. Select **Performance > Reports**.
3. Select a report and click **Modify**.
4. Make your changes to the report **Description**, **Symmetrix ID**, **Format**, **Generated Time Zone**, and **TimeFrame**.
   You cannot change the report name.

5. Select one of the following actions in the **Queries** section:
   - Click **Add** to open the Create Query Wizard and create a new query.
   - Select a query and click **Delete**. Click **OK** in the confirmation dialog box.
   - Edit the query. Complete the following steps:

   **Note**
   Reports must have at least one query.

   a. Select a query and click **Edit** to open the Edit Query wizard.
   b. Make your changes in each page of the wizard.
c. Click OK to close the wizard.

6. (Optional) If required, modify the schedule settings for the report.

7. If required, modify the email settings for the report.

8. Click OK.

For more information about reports, refer to Creating performance reports on page 583.

Deleting performance reports

Before you begin

You require an existing report in the Reports list view.

To delete performance reports:

Procedure

1. Select a storage system.
2. Select Performance > Reports.
3. Select the report you want to delete and click Delete.
4. Click OK.

Running performance reports

Before you begin

You require a configured performance report in the Reports list.

To run a performance report:

Procedure

1. Select a storage system.
2. Select Performance > Reports.
3. Select one or more reports and click Run Now.
4. Click OK on the Save Report Results dialog box.
5. Enter a location in the Save As dialog box, enter a file name and extension (if necessary), and click Save.

The report is saved to the selected location.

Note

If the report contains multiple queries involving volumes and disks the report is saved to this location:

/SMAS/report/SPA/runnow

Scheduling performance reports

Before you begin

You must have a configured performance report in the Reports list.

To run a performance report:
Procedure

1. Select a storage system.
2. Select Performance > Reports.
3. Select one or more reports and click Schedule.
4. Select the Schedule check box.
5. Configure values for each of the following options:
   - First Run Time
     The First Run Time is continually adjusted relative to the current time and the report execution interval. For example, if First Run Time is set to 3am, but the current time is 4am and the Time Range is set to 'Last 4 hours', then the value of First Run Time is changed to 7am.
   - Day(s) to run
   - Retention
6. Click OK.

Scheduled XML, CSV, and BTP reports are saved to this location:

\texttt{SMAS/report\SPA/querydata}

\underline{Note}

If the report contains multiple queries involving volumes and disks the report is saved to this location:

\texttt{/SMAS/report/SPA/runnow}

Scheduled UPV reports are saved to this location:

\texttt{SMAS\backup\SPA}

Cancelling a scheduled report

\textbf{Before you begin}

You must have a scheduled performance report in the Reports list view.

To cancel a scheduled report:

\textbf{Procedure}

1. Select a storage system.
2. Select Performance > Reports.
3. Select one or more reports and click Schedule.
4. Click OK.
Copying performance reports

**Before you begin**

Before copying a performance report, you require an existing report in the **Reports** list view.

To copy a performance report:

**Procedure**

1. Select the storage array.
2. Select **Performance > Reports** to open the **Reports** list view.
3. Select a report and click > **Copy**.
4. Update the report settings, as appropriate. You can edit the following data:
   - Name
   - Description
   - Symmetrix ID
   - Format
   - Generated Time Zone
   - TimeFrame
5. In the **Queries** section, do one of the following:
   - Click **Add** to open the **Create Query** wizard and create a query.
   - Select a query and click **Delete**. Click **OK** on the confirmation message.
   - Select a query and click **Edit** to open the **Edit Query** wizard. A report must have at least one query.
6. (Optional) In the **Schedule** tab, configure the schedule settings for the report.
7. (Optional) In the **Email** tab, configure the email settings for the report.
8. Click **OK**.

For more information about reports, see **Creating performance reports** on page 583

---

Viewing Real Time traces

See **Understanding Performance Management** on page 522 for an overview of Unisphere Performance Management.

A trace is a linear map; in Performance, a trace is one to four hours of real time data that is captured and saved.

A trace can be configured in advance. Trace files can be retained up to 30 days.

To view a Real Time trace:

**Procedure**

1. Select **Settings** to open the **Settings** panel.
2. Select Performance > Real Time Traces.

Use the Real Time Traces list view to display and manage Real Time traces.

The following properties display:

Array
   The storage system identifier.

Start Time
   The start time and date of the scheduled trace.

Status
   The status of the scheduled trace. Possible values are:
   
   New
      The status assigned during creation.
   
   Scheduled
      The trace has been configured and scheduled to run at a specific time.
   
   Completed
      The scheduled trace has completed successfully.
   
   No Data
      No data was available for the scheduled trace at the time of execution.
   
   Failed
      Execution of the trace failed.

Retention (Days)
   The number of days for which the trace is saved.

Description
   A user-defined description of the trace.

The following controls are available:

- Create — Creating a Real Time trace on page 591
- Modify — Modifying a Real Time Trace on page 592

Creating a Real Time trace

Before you begin
You must have access to one or more storage systems with Real Time registrations.

To create a Real Time trace:

Procedure

1. Select a storage system.
2. Select Performance > Real Time Traces.
3. Click Create.
4. Select the Symmetrix ID.
5. Select the **Date** and **Trace Start Time**. Click the calendar icon for the date selection and use the up and down arrows for setting the specific start time.

6. Select the **Number of Hourly Traces**. You can save up to 4 hours of data in four 1-hour files.
   When configuring a new trace, the **Status** field displays the value **New**.

7. Select the **Retention** number of days.
   Values are 1–30.

8. (Optional) Enter a **Description** of this trace.

9. Click **OK**.

### Modifying a Real Time Trace

**Before you begin**
You must have access to licensed storage systems.

A trace is 1 to 4 hours of real time data that is captured and saved. A trace can be configured in advance. Trace files can be retained up to thirty days.

To edit a trace:

**Procedure**

1. Select a storage system.
2. Select **Performance > Real Time Traces**.
3. Select a trace from the list and click **Modify**.
4. Update the **Trace Start Time**, **Retention** and/or **Description** values.
5. Click **OK**.

### Deleting a Real Time trace

**Before you begin**
You require one or more configured traces in the Real Time Traces list view.

To delete a Real Time trace:

**Procedure**

1. Select a storage system.
2. Select **Performance > Real Time Traces**.
3. Select a trace from the list and click **Delete**.
4. Click **OK**.

### Plan View

See [Understanding Performance Management](#) on page 522 for an overview of Unisphere Performance Management.

The Plan view displays predicted future data, based on linear projection. You can use the projection dashboards contained in the Plan view to assist when planning and to avoid potential problems.

The following projection dashboards are available from the drop-down menu:
You need a minimum of 10 days of data to produce a projection dashboard. If insufficient data is available, a message stating the number of remaining days before the projection dashboard can be produced is displayed.

To save the current Plan view as a PDF, click and select one of the following options:
• Save as PDF - Charts
• Save as PDF - Charts & Data

To schedule a report, click . For more information, see Scheduling performance reports on page 588.

SRP projection dashboard

The SRP protection dashboard displays utilization data based on projections calculated over the selected time range.

SRP - Capacity Status
This chart displays a table containing current information for all SRPs in the array. The table contains the following columns:

ID
The ID of the SRP.

Days to Full
The number of days until the capacity of the SRP will be fully utilized. The maximum calculated value is 180 days. One of the following status icons is displayed according to the Days to Full value: - < 7 days utilization remaining; - < 30 days utilization remaining; - < 180 days utilization remaining; - > 180 days utilization remaining.

Capacity Trend/Month
The capacity growth rate of the SRP per month. Arrow icons indicate if it's going up, down, or remaining stable.

Capacity
The total capacity of the SRP and the percentage currently being used. By default, the table is sorted by the Days to Full column.

% Used Capacity Projections
This chart displays the current and projected % used capacities for the currently selected SRP. When the chart is initially opened, the first SRP is displayed, by default.

You can configure the time ranges for this chart by selecting an alternative time range. The following time ranges are available:
• 1 week
• 1 Month
• 3 Months
• 6 Months
By default, when initially opened, the % Used Capacity Projections chart displays data for one week.

**Thin pool projection dashboard**

The thin pool protection dashboard displays utilization data based on projections calculated over the selected time range.

**Thin Pool - Capacity Status**

This chart displays a table containing current information for all thin pools in the array. The table contains the following columns:

1. **ID**
   - The ID of the Thin pool.

2. **Days to Full**
   - The number of days until the capacity of the pool will be fully utilized. The maximum calculated value is 180 days. One of the following status icons is displayed according to the Days to Full value:
     - < 7 days utilization remaining;
     - < 30 days utilization remaining;  
     - < 180 days utilization remaining;  
     - > 180 days utilization remaining.

3. **Capacity Trend/Month**
   - The capacity growth rate of the thin pool per month. Arrow icons indicate if it's going up, down, or remaining stable.

4. **Capacity**
   - The total capacity of the thin pool and the percentage currently being used. By default, the table is sorted by the Days to Full column.

**% Used Capacity Projections**

This chart displays the current and projected % used capacities for the currently selected thin pool. When the chart is initially opened, the first thin pool is displayed, by default.

You can configure the time ranges for this chart by selecting an alternative time range. The following time ranges are available:

- 1 week
- 1 Month
- 3 Months
- 6 Months

By default, when initially opened, the % Used Capacity Projections chart displays data for one week.

Changing the time range for the dashboard changes the time range for this chart only. The % Used Capacity Projections chart always displays current data.

**Viewing system registrations**

See Understanding Performance Management on page 522 for an overview of Unisphere Performance Management.

To view system registrations:
Procedure

1. Select  to open the **Settings** panel.

2. Select **Performance > System Registrations** to open the Registrations list view.

Use the Registrations list view to view and manage storage system performance registration and data collection policies.

The following properties display:

- **Array** — The ID of the registered storage system.
- **Diagnostic** — A check box that indicates if the storage system is registered for Diagnostic data. The check box can be selected or cleared.
- **Real Time** — A check box that indicates if the storage system is registered for Real Time data. The check box can be selected or cleared.
- **Storage Group Real Time** — Applicable only to storage systems running PowerMaxOS 5978. A check box indicates if the storage system is registered for Storage Group Real Time data. The check box can be selected or cleared.

The overall status is captured in the All row. In this row:

- The **Diagnostic** checkbox is selected/cleared if all of the array diagnostics checkboxes are selected/cleared.
- The **Real Time** checkbox is selected/cleared if all of the array real time checkboxes are selected/cleared.
- The **Storage Group Real Time** checkbox is selected or cleared if all of the array storage group real time check boxes are selected or cleared.

Note

In cases where there are a mixture of selected and cleared check boxes for items in a column, the overall status is indeterminate (denoted for the appropriate column by the 📝 symbol).

3. Hover over a row and click 📊 (see Changing registration details on page 597).

4. Hover over a row and select 📊 (see Viewing system registration details on page 595).

5. For arrays running PowerMaxOS 5978 or later, hover over a row and select 📊 (see Registering storage systems on page 596).

**Viewing system registration details**

The system registration details view shows the default values for storage system registrations and data collection settings.

To view system registration details:

**Procedure**

1. Select 📊.
2. Select **Performance > Settings > System Registrations**.
3. Expand the **All** list.
4. Select an array and click ![Information](image) to open the **Information** dialog box.

The following properties display:

- **Array** — The ID of the registered storage system.
- **Diagnostic** — Indicates if the storage system is registered for Diagnostic data.
- **Real Time** — Indicates if the storage system is registered for Real Time data.
- **Real Time Storage Groups** — Indicates if selected storage groups in the storage system are registered for real time data collection.
- **Collection Recovery (Hours)** — The amount of data that the `storstpd` daemon will save if the Performance server or the Performance database is not ready to accept new data points. The default is 24 hours.
- **Diagnostic Interval (Minutes)** — The frequency of polling in the Diagnostic view. The default 5 minutes is recommended.
- **Server IP** — The IP address of the Unisphere server.
- **SE Server IP** — The IP address of the Solutions Enabler server.

**Registering storage systems**

The Performance component of Unisphere collects performance data only after you register your storage systems.

Only local storage systems can be registered for performance data collection.

When you register a storage system for performance data collection it takes at least two intervals (by default, 5 minutes each) before performance data begins to populate in the GUI and charts. Before this, the GUI and charts might display "NA" or remain blank. The collection of real time data is performed at 5 second intervals.

If a storage system is registered for real time data collection, then by selecting a storage group, all devices in the storage group are also registered for the collection of real time data. Only one storage system can be enabled for real time storage group data collection at any given time, and a maximum of five storage groups in this array can be selected for collection.

Storage group real time data collection is available only for storage systems running PowerMaxOS 5978, or later.

To register a storage system:

**Procedure**

1. Select ![Settings](image)
2. Select **Performance > System Registrations**.
3. Select the storage systems to register for performance data collection.
4. Select the type of performance data to collect: **Diagnostic** only, or both **Real Time** and **Diagnostic**.
5. (Optional) If **Real Time** data collection has been enabled, **Storage Group Real Time** data can also been enabled. To do this, complete the following steps:
Click . The Storage Groups for Real Time Collection dialog box displays.

b. Select storage groups in the Available Storage Groups list and click to move them to the Selected Storage Groups list. A maximum of five storage groups can be selected.

c. Click OK.

The Storage Group Real Time column displays a green icon for the selected storage system.

6. Click Apply.

Removing a system registration

To remove a system registration:

Procedure

1. Select .
2. Select Performance > System Registrations.
3. Clear the registration for Diagnostic, Real Time, or both.
4. Click Apply.

Viewing registered storage systems information

To view registered storage systems information:

Procedure

1. Select .
2. Select Performance > System Registrations.
3. Hover over the storage system and click to view the registration information.

Changing registration details

Procedure

1. Select .
2. Select Performance > System Registrations to open the Registrations list view.
3. Hover over the storage system name or All.
4. Click .
5. In the Registration Details dialog box, update one or both of the following fields:
• **Collection Recovery (Hours)** — The amount of data that the `storstpd` daemon will save if the Performance server or the Performance database is not ready to accept new data points. The default is 24 hours.

• **Diagnostic Interval (Minutes)** — The frequency of polling in the Diagnostic view. The default 5 minutes is recommended.

6. Click **OK**.

**Managing dashboard catalog**

To view and edit the catalog of items displayable on the Performance dashboard:

**Procedure**

1. Select.
2. Select **Performance > Dashboard Catalog**.
   
   A list of categories is displayed.
3. Select the checkbox for a category to make it visible and clear a checkbox for a category to make it invisible.
4. Click **APPLY**.

**Viewing Performance database backups**

See [Understanding Performance Management](#) on page 522 for an overview of Unisphere Performance Management.

**Procedure**

1. Select to open the **Settings** panel.
2. In the **Settings** dialog box, select **Unisphere Databases > Performance Databases**.

   Use the Performance Databases list view to view and manage databases.

   The following properties display:

   - **Array ID**
     
     The storage system identifier.

   - **Status**
     
     The status of the performance database.

   - **Load Status**
     
     The status of a database action (backup, restore).

   - **Backup Scheduled**
     
     Time of the scheduled backup.

   The following controls are available:

   - **Backup**—[Backing up a performance database](#) on page 601
   - **Restore**—[Restoring a performance database](#) on page 600
   - **View Details**—[Viewing performance database details](#) on page 599
Viewing performance database details

To view performance database details:

Procedure

1. Select .

2. In the Settings dialog box, select Unisphere Databases > Performance Databases.

3. Select a database and click View Details.

The following details display:

  **Array ID**
  The storage system identifier.

  **Registered to collection**
  Shows the performance views available. Possible values are Real Time and Diagnostic, or Not Registered.

  **Database administration**

    **Last backup time**
    Date and time of last backup.

    **Last restore time**
    Date and time of last restore.

    **Last aggregation time**
    Last date and time that Trending & Planning data was derived from Diagnostic data.

    **Last retention time**
    Date and time of last retention.

    **Last real time retention time**
    Date and time of last Real Time retention.

  **Database size**
  Size of the database.

  **Historical**

    **Oldest available data**
    Date and time of first available Historical data.
**Latest available data**
Date and time of latest Historical data.

**Current historical data retention (months)**
Number of months to save Historical data.

**Diagnostic**

**Oldest available data**
Date and time of first available Diagnostic data.

**Latest available data**
Date and time of latest Diagnostic data.

**Current diagnostic data retention (days)**
Number of days to save Diagnostic data.

**Real Time**

**Current real time data retention (hours)**
Number hours to save real time data.

**Backup Files**

**Current backup file retention (number of days)**
Number days to save backup files.

**Number of existing backup files**
Number of existing backup files for this database.

**Scheduled Backup Execution Options**

**Next Backup**
Displays the date/time for the next scheduled backup (if any).

**Recurring**
Displays the days (Monday, Tuesday, etc) set for a recurring backup.

**Last Day of historical**
Indicates whether the last day of historical statistics will be included in the next database backup.

**Named real time traces**
Indicates whether any named real time traces will be included in the next database backup.

---

**Restoring a performance database**

**Before you begin**
There must be an existing performance database file.
Restoring a performance database will result in the contents of the current performance database being overwritten. Ensure that you make a backup of the
current database (see Backing up a performance database on page 601), if appropriate to do so.

Do not attempt to restore a performance database while another restore operation is in progress.

You can restore the performance database of a storage system regardless of whether it is registered.

Procedure

1. In the Settings dialog box, select Unisphere Databases > Performance Databases.
2. Select a storage system.
3. Click Restore.
4. Select a backup file.
5. Do one or more of the following:
   - Select Restore diagnostic data if available if you want to restore Diagnostic data.
   - Select Restore Real Time traces if available if you want to restore Real Time traces.
6. Click OK.

Backing up a performance database

This procedure is a recommended practice. The backup performance database option is available for one or more storage systems, regardless of their registration status. By default, only Trending & Planning (Historical) data is backed up. The performance databases backups should be stored in a safe location. Performance database backups can be restored (see Restoring a performance database on page 600).

To back up the performance database:

Procedure

1. Select to open the Settings panel.
2. In the Settings dialog box, select Unisphere Databases > Performance Databases.
3. Select a database from the list and click Backup.
4. Enter a backup File Name(s)
5. (Optional) Select any of the following Data to Save:
   - Last day of Diagnostics
   - Named Real Time Traces
6. Set the Execution Time.
   Possible values are Now and Schedule (specific date and time)
   - Now—Go to step 7.
• **Schedule**—Complete the following steps:
  a. Click **Next**.
  b. Select the **Start Date** and time.
  c. Select if you want this to be a **Recurring** database backup.
     If **Yes**, select the days on which the database backups should occur.

7. Click **OK**.

A database backup can take some time.

**Canceling a scheduled performance database backup**

**Before you begin**

There must be one or more performance database backups that are scheduled for a future time.

To cancel a scheduled performance database backup:

**Procedure**

1. Click 📋
2. In the **Settings** dialog box, select **Unisphere Databases > Performance Databases**.
3. Select a database, click 🔄, and click **Cancel Scheduled Backup**.
4. Click **OK**.

**Editing a scheduled performance database backup**

**Before you begin**

There must be one or more performance database backups scheduled for a future time.

To edit a scheduled performance database backup:

**Procedure**

1. Select 📋 to open the **Settings** panel.
2. In the **Settings** dialog box, select **Unisphere Databases > Performance Databases**.
3. Select a database, click 🔄, and click **Edit Scheduled Backup**.
4. Change the start date, time, or reoccurrence of the backup.
5. Click **OK**.

**Editing performance database retention settings**

To edit performance database retention settings:
Procedure

1. Select to open the Settings panel.
2. In the Settings dialog box, select Unisphere Databases > Performance Databases.
3. Select a database, click , and click Edit Retention Settings.
4. In the Retention Settings dialog box, edit one or more of the following settings:
   - Set historical data retention (months)
   - Set diagnostic data retention (days)
   - Set real time data retention (hours)
   - Set backup file retention (number of files)
5. Click OK.

Deleting performance databases

Before you begin
You require one or more storage systems that are no longer registered and have a performance database.

The performance database delete operation can be performed only on storage systems that are not registered. The delete action removes all references to the storage systems in the master database and removes the data.

To delete a performance database:

Procedure

1. Select to open the Settings panel.
2. In the Settings dialog box, select Unisphere Databases > Performance Databases.
3. Select a database from the list, click , and click Delete.
4. Select the data you want to delete.
   The following options are available:
   - Delete database only
   - Delete database & backup files
   - Delete database & backup files and cancel scheduled tasks
5. Click OK.

Removing performance database backup files

This procedure is for removing unneeded performance database backup files.

To delete performance database backup files:
Procedure

1. Select \(\) to open the **Settings** panel.

2. In the **Settings** dialog box, select **Unisphere Databases > Performance Databases**.

3. Select a database, click \(\) , and click **Remove Backup Files**.

4. Select the file(s) to delete from the list of backup files and click **OK**.

Viewing Performance thresholds and alerts

You can configure a warning threshold and a critical threshold value for each metric.

Procedure

1. Select \(\) to open the **Settings** panel.

2. Select **Alerts > Performance Thresholds and Alerts**.

3. Select All or a storage system.

4. Select the category for which you want to view the configured thresholds and alerts.

   The thresholds and alerts configured for that category are displayed, according to metric.

   Any metrics that include a custom threshold or alert are highlighted with a tick mark in the **Custom** column.

   The following properties display:

   - **Name**—The metric name.
   - **Warning**—The warning threshold.
   - **Alert**—Indicates if a warning alert has been generated. The icon displayed corresponds to the alert type.
   - **Critical**—The critical threshold.
   - **Alert**—Indicates if a critical alert has been generated. The icon displayed corresponds to the alert type.
   - **KPI**—Indicates if the metric is a KPI.
   - **Custom**—Indicates if a custom threshold or alert has been generated.

5. Click **APPLY**.

   The following controls are available:

   - **Create** - Creating a performance threshold alert on page 60
   - **Delete** - Deleting performance thresholds and alerts on page 62.
Performance Threshold Alert operations

- Creating a Performance Threshold Alert (see Creating a performance threshold alert on page 60).
- Editing a Performance Threshold Alert (see Editing a performance threshold alert on page 61).

Creating a performance threshold alert

You can use the default system values for thresholds and alerts, or create your own. When you set threshold values, you can optionally view them when you create charts for performance metrics in the Diagnostic view.

To create performance threshold alerts:

Procedure

1. Select to open the Settings panel.
2. Select Alerts > Performance Thresholds and Alerts.
3. Select a storage system.
4. Select the category for which you want to create a threshold or alert.
5. Click Create.
   The Create Threshold and Alert wizard displays.
6. Select the Array, Category, and Metrics.
7. Select Instances from the Available Instances list and click to move them to the Instances to Enable list.
8. Add a value for Warning Threshold or Warning Threshold and Critical Threshold.
9. Click NEXT.
10. To add an alert for each configured threshold, complete the following steps:
   a. Select Enable Alert.
   b. For each threshold you are configuring, specify values for the following fields:
      Severity
      The following values are available:
      - Information
      - Warning
      - Critical
      Occurrence
      The number of occurrences in the data samples which must happen before the alert is triggered. For example, if the threshold is breached 3 times out of 5 samples, an alert is initiated.
Samples
The number of occurrences in the data samples which must happen before the alert is triggered. For example, if the threshold is breached 3 times out of 5 samples, an alert is initiated.

c. (Optional) If required, select any additional configuration options.
For some group categories, you can choose to enable for the alert for the individual components of the group, for example, when the Disk Group category is selected, you have the option to enable the alert for the disk.

11. Click OK.

Editing a performance threshold alert
When you edit a threshold and alert setting, a symbol displays in the Custom column of the alerts list to indicate that the value has changed from the default.

To edit performance threshold alerts:
Procedure
1. Select to open the Settings panel.
2. Select Alerts > Performance Thresholds and Alerts.
3. Navigate to the threshold alert to be edited by selecting the appropriate storage system and category.
4. Hover over an item from the table and click .
5. Edit the settings.
6. Click OK.

Deleting performance thresholds and alerts
Before you begin
You can delete only custom values. You cannot delete default thresholds.

To delete a performance threshold and alert:
Procedure
1. Select to open the Settings panel.
2. Select Alerts > Performance Thresholds and Alerts.
3. Navigate to the threshold or alert to be edited by selecting the appropriate category in the Category section.
4. Select one or more rows and click .
5. Click OK.

Configuring SNMP notifications
To set up SNMP notifications:
Procedure

1. Select to open the Settings
2. Select Alerts > Notifications to open the Notifications page.
3. In the SNMP part of the panel, click Configure.
4. Click Create.
5. Enter an IP Address or Host Name.
6. Enter a port number.
7. To test the SNMP configuration, click TEST.

Managing dashboard catalog

To view and edit the catalog of items displayable on the Performance dashboard:

Procedure

1. Select
2. Select Performance > Dashboard Catalog.
   A list of categories is displayed.
3. Select the checkbox for a category to make it visible and clear a checkbox for a category to make it invisible.
4. Click APPLY.

Configuring email notifications

You can configure email addresses to which notifications, alerts, and reports are sent. You can configure a single email address for all notification instances, or you can use different email addresses for different notifications on different storage systems.

To set up email notifications:

Procedure

1. To set up email notification:
   a. Select to open the Settings panel.
   b. Click Alerts > Notifications.
   c. In the Email section, click Configure.
   d. In the Outgoing Mail Server (SMTP) section specify the following details:
      - IP Address/Host
      - Server Port
   e. In the User Information section, specify the Sender E-mail Address.
   f. In the Recipients section, click Create and specify the address you want to add.
   g. Select one or more system or performance level indicators or reports to enable email notifications for the relevant level of system or performance notifications.
Click APPLY.

### About exporting and importing performance settings

See **Understanding Performance Management** on page 522 for an overview of Unisphere Performance Management.

In large environments, it can be very time consuming to setup and configure multiple instances. Storage systems may have very similar configuration and implementations across the environment. To assist with the implementation process, the following settings can be exported and imported:

- Performance metrics (KPIs) definitions with their default (not instance-specific) settings
- Global alert definitions
- User template dashboards

The settings are saved to an XML file. You can select the client-side directory in which the file is saved. When importing a metrics definition file, it replaces any existing metrics definition file. When importing a user template dashboard, any existing templates remain intact; only non-conflicting templates are imported.

### Importing Performance settings

**Before you begin**

For security compliance, a password must be supplied upon exporting and importing a performance settings file. If you pass the settings file to another administrator, ensure that you also provide the password.

---

**Note**

An imported metrics definition overrides server settings. User templates are merged.

To import Performance settings:

You can import the following items:

- Performance metrics (KPIs) definitions with their default (not instance-specific) settings
- Global alert definitions
- User template dashboards

For more information about exporting and importing Performance settings, see **About exporting and importing performance settings** on page 608.

**Procedure**

1. Select ☰ to open the **Settings** panel.
2. Click **Performance > Import Settings**.
3. Select the settings to import: **Metrics and Alert Definitions**, **User Templates**, or both.
4. Click **Choose file** to select the settings file to import.
5. Enter the file password (which was set during the export process).
6. Click APPLY.

Exporting Performance settings

Before you begin

For security compliance, a password must be supplied upon exporting and importing a performance settings file. If you pass the settings file to another administrator, ensure that you also provide the password.

You can import the following items:

- Performance metrics (KPIs) definitions with their default (not instance-specific) settings
- Global alert definitions
- User template dashboards

For more information about exporting and importing Performance settings, see About exporting and importing performance settings on page 608.

To export Performance settings:

Procedure

1. Select " to open the Settings panel.
2. Click Performance > Export Settings.
3. Select the settings to export: Metric and Alert Definitions, User Templates, or both.
4. Enter and confirm a file password.
   The settings file cannot be imported to another Unisphere environment without supplying the password set in this step.
5. Click APPLY.
   The configuration ZIP file is downloaded in your browser.
6. In the confirmation dialog box, click OK.

Exporting Performance Viewer settings

If you are using the offline Performance Viewer, you can export databases, thresholds, reports, user dashboards, and template dashboards.

To export Performance Viewer settings:

Procedure

1. In the online Unisphere for PowerMax client, select " to open the Settings panel.
2. Click Performance > Export PV Settings
3. Select the settings to export: SYMAPI Database, Settings, or both.
   If you select SYMAPI Database, specify a file name for the BIN file.
   If you select Settings, specify a file name for the ZIP file. In addition, select the types of settings you want to export. The following settings are available:
   - Metrics and Thresholds (default and custom)
4. Click APPLY.

The exported files are automatically saved in the following directories:

- SYMAPI Database: `install_dir\SMAS\backup\SPA\SE`
- Settings: `install_dir\SMAS\backup\SPA\settings`

## Viewing and managing metrics

See [Understanding Performance Management](#) on page 522 for an overview of Unisphere Performance Management.

To view and manage metrics:

### Procedure

1. Select ![Settings](Settings.png) to open the **Settings** panel.
2. In the **Settings** dialog box, select **Performance > Metrics**.
3. Select a metric category from the **Category** menu.
   - You can filter the list of displayed metrics. For more information about filtering, refer to [Filtering performance data](#) on page 724.
   - The following properties display:
     - **Metrics**: The ID of the performance metric.
     - **KPI**: An indicator that shows if the metric is a KPI.
4. Select the checkbox for a metric to add it as a KPI or clear the metric's KPI checkbox to no longer have the metric as a KPI.
5. Optional: Click **RESTORE CATEGORY DEFAULTS** to restore the defaults.
6. Click **APPLY**.

## Editing metrics

You can edit metrics to set, or unset, them as KPIs. When a metric is not set as a KPI, it can be viewed under **All** in the Charts view.

To edit metrics:

### Procedure

1. Select ![Settings](Settings.png).
2. Select **Performance > Settings > Metrics**.
3. Select a metric category from the **Category** menu.
4. Do one of the following:
Performance Management Metrics

Unisphere supports the display of performance metrics (listed in the online help) that you can use to monitor and manage your network effectively and efficiently.

For the vast majority of 5 min diagnostic/root cause analysis metrics, Max and Avg are the same.

If real-time data collection is enabled (5 second collection on a reduced set of categories/metrics) Unisphere gathers the maximum real-time values for any real-time metrics and saves them as the maximum value as part of the corresponding 5 min interval save. Unisphere does this to capture any spikes that would otherwise be averaged out as part of the 5 min collection.

Max and Avg are different for historical data. Unisphere performs an hourly aggregation rolling the 5 min diagnostic data into historical tables, for example, hourly, daily, monthly. For example, for hourly data, Avg is the average across the 12 intervals in the hour and Max is the highest value in the 12 intervals for that hour.

Array Metrics

The following table lists all metrics that are available for arrays.

Table 8 Array metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The number of host IO operations performed each second by all volumes, including writes and random and sequential reads.</td>
</tr>
<tr>
<td>Version WP Count</td>
<td></td>
</tr>
<tr>
<td>Total Number of R1 Sessions</td>
<td></td>
</tr>
<tr>
<td>Number of R1 Msc Active Sessions</td>
<td></td>
</tr>
<tr>
<td>Number of R2 Cache Slots in Use</td>
<td></td>
</tr>
<tr>
<td>Total Number of R2 Sessions</td>
<td></td>
</tr>
<tr>
<td>Number of R1 Msc Sessions</td>
<td></td>
</tr>
<tr>
<td>Number of R2 Msc Active Sessions</td>
<td></td>
</tr>
<tr>
<td>Number of R1 Cache Slots in Use</td>
<td></td>
</tr>
<tr>
<td>Number of R2 Msc Sessions</td>
<td></td>
</tr>
<tr>
<td>RDF/A WP Count</td>
<td>The number of RDF/A writes pending.</td>
</tr>
<tr>
<td>Number of R2 Active Sessions</td>
<td></td>
</tr>
<tr>
<td>Total Number of RDF Sessions</td>
<td></td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>The number of host read operations performed each second by all volumes.</td>
</tr>
<tr>
<td>Number of R1 Active Sessions</td>
<td></td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>The number of host write operations performed each second by all volumes.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The number of host MBs written and read by all of the volumes each second.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>The number of host MBs written and read by all of the volumes each second.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>The number of host MBs written by all of the volumes each second.</td>
</tr>
<tr>
<td>FE Reqs/sec</td>
<td>A data transfer between the director and the cache. An IO may require multiple requests depending on IO size, alignment, or both. The requests rate should be either equal to or greater than the IO rate.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the disk to serve one read command.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the disk to serve one write command.</td>
</tr>
<tr>
<td>% Reads</td>
<td>The percent of total read IO operations performed each second by all of the volumes.</td>
</tr>
<tr>
<td>% Writes</td>
<td>The percent of total write IO operations performed by all of the volumes.</td>
</tr>
<tr>
<td>% Hit</td>
<td>The percent of IO operations performed by all of the volumes, for which the read data was in cache and the write operation could be sent directly to cache without having to wait for data to be destaged from cache to the disks.</td>
</tr>
<tr>
<td>FE Read Reqs/sec</td>
<td>A read data transfer between the director and the cache. An IO may require multiple requests depending on IO size, alignment, or both. The requests rate should be either equal to or greater than the IO rate.</td>
</tr>
<tr>
<td>FE Write Reqs/sec</td>
<td>A write data transfer between the director and the cache. An IO may require multiple requests depending on IO size, alignment, or both. The requests rate should be either equal to or greater than the IO rate.</td>
</tr>
<tr>
<td>BE IOs/sec</td>
<td>The total IO from all BE directors to the disks per second.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>A data transfer of a read or write between the cache and the director.</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>A data transfer of a read between the cache and the director.</td>
</tr>
</tbody>
</table>
### Table 8 Array metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Write Reqs/sec</td>
<td>A data transfer of a write between the cache and the director.</td>
</tr>
<tr>
<td>System WP Events/sec</td>
<td>The number of times each second that write activity was heavy enough to use up the system limit set for write tracks occupying cache. When the limit is reached, writes are deferred until data in cache is written to disk.</td>
</tr>
<tr>
<td>Device WP Events/sec</td>
<td>The number of times each second that the write-pending limit for a specific volume was reached.</td>
</tr>
<tr>
<td>System WP Count</td>
<td>The number of system cache slots that are write pending.</td>
</tr>
<tr>
<td>System Max WP Limit</td>
<td>The percent of the target % at which writes are delayed. The range is from 40% to 80%.</td>
</tr>
<tr>
<td>% Cache WP</td>
<td>The percent of system cache that is write pending.</td>
</tr>
<tr>
<td>Avg Fall Thru Time</td>
<td>The average time it takes a cache slot in LRU0 to be freed up. It is the average time from the first use of the contents to its reuse by another address.</td>
</tr>
<tr>
<td>FE Hit Reqs/sec</td>
<td>The total requests from all front-end directors per second that were satisfied from cache.</td>
</tr>
<tr>
<td>FE Read Hit Reqs/sec</td>
<td>The total read requests from all front-end directors per second that were satisfied from cache.</td>
</tr>
<tr>
<td>FE Write Hit Reqs/sec</td>
<td>The total write requests from all front-end directors per second that were satisfied from cache.</td>
</tr>
<tr>
<td>Prefetched Tracks/sec</td>
<td>The number of tracks per second prefetched from disk to cache upon detection of a sequential read stream.</td>
</tr>
<tr>
<td>FE Read Miss Reqs/sec</td>
<td>The total read requests from all front-end directors per second that were misses. A miss occurs when the requested data is not in cache.</td>
</tr>
<tr>
<td>FE Write Miss Reqs/sec</td>
<td>The total write requests from all front-end directors per second that were misses. A miss occurs when the write had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>Optimized Read Misses/sec</td>
<td>Number of read requests each second performed directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Optimized MBs Read Miss/sec</td>
<td>Number of host MBs read each second directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Avg Optimized Read Miss Size (KB)</td>
<td></td>
</tr>
<tr>
<td>FE Balance</td>
<td>Balance information for FE. Balance metrics measure hardware components balance. It is calculated as the difference between the maximum and minimum values for &quot;% Busy&quot; for the component instances. In a balanced system the balance metrics should be relatively low.</td>
</tr>
<tr>
<td><strong>Metric</strong></td>
<td><strong>Description</strong></td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Cache Balance</td>
<td>Balance information for cache. Balance metrics measure hardware components balance. It is calculated as the difference between the maximum and minimum values for &quot;% Busy&quot; for the component instances. In a balanced system the balance metrics should be relatively low.</td>
</tr>
<tr>
<td>SATA Balance</td>
<td>Balance information for SATA. Balance metrics measure hardware components balance. It is calculated as the difference between the maximum and minimum values for &quot;% Busy&quot; for the component instances. In a balanced system the balance metrics should be relatively low.</td>
</tr>
<tr>
<td>FC Balance</td>
<td>Balance information for FC. Balance metrics measure hardware components balance. It is calculated as the difference between the maximum and minimum values for &quot;% Busy&quot; for the component instances. In a balanced system the balance metrics should be relatively low.</td>
</tr>
<tr>
<td>EFD Balance</td>
<td>Balance information for EFD. Balance metrics measure hardware components balance. It is calculated as the difference between the maximum and minimum values for &quot;% Busy&quot; for the component instances. In a balanced system the balance metrics should be relatively low.</td>
</tr>
<tr>
<td>DX Balance</td>
<td>Balance information for DX. Balance metrics measure hardware components balance. It is calculated as the difference between the maximum and minimum values for &quot;% Busy&quot; for the component instances. In a balanced system the balance metrics should be relatively low.</td>
</tr>
<tr>
<td>Queue Depth Utilization</td>
<td>A weighted sum of the utilizations according to the number of IOs in each bucket. Queue depth range metrics are used in the calculation. Calculation: Sx=1..9 [\frac{\text{Avg Queue Depth Range X} - 1}{\text{Avg Queue Depth Range X}} \times \frac{\text{Queue Depth Count Range X}}{\text{Queue Depth Count Total}} \times 100]</td>
</tr>
<tr>
<td>DA Balance</td>
<td>Balance information for DA. Balance metrics measure hardware components balance. It is calculated as the difference between the maximum and minimum values for &quot;% Busy&quot; for the component instances. In a balanced system the balance metrics should be relatively low.</td>
</tr>
<tr>
<td>Allocated Capacity</td>
<td>The total allocated array capacity.</td>
</tr>
<tr>
<td>Critical Alert Count</td>
<td>Number of critical alerts.</td>
</tr>
<tr>
<td>Warning Alert Count</td>
<td>Number of warning alerts.</td>
</tr>
<tr>
<td>Information Alert Count</td>
<td>Number of information alerts.</td>
</tr>
<tr>
<td>Disk Utilization</td>
<td>Percentage of time the disk is busy.</td>
</tr>
<tr>
<td>RDF Utilization</td>
<td>Percentage of time RDF is busy.</td>
</tr>
<tr>
<td>BE Utilization</td>
<td>Percentage of time the BE is busy.</td>
</tr>
</tbody>
</table>
### Table 8 Array metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FE Utilization</td>
<td>Percentage of time the FE is busy.</td>
</tr>
<tr>
<td>Copy Slot Count</td>
<td></td>
</tr>
<tr>
<td>Overall Efficiency Ratio</td>
<td>Ratio of the sum of all TDEVs + snapshot sizes (calculated based on the 128K track size) and the Physical Used Storage (calculated based on the compressed pool track size).</td>
</tr>
<tr>
<td>RDF Balance</td>
<td>Balance information for RDF. Balance metrics measure hardware components balance. It is calculated as the difference between the maximum and minimum values for &quot;% Busy&quot; for the component instances. In a balanced system the balance metrics should be relatively low.</td>
</tr>
<tr>
<td>% Snapshot Saved</td>
<td>Percentage savings of the sum of all TDEV Snapshot sizes (at the time of Snapshot creation) and the TDEV Snapshot Allocated Storage.</td>
</tr>
<tr>
<td>% Virtual Provisioning Saved</td>
<td>Percentage savings of the TDEV configured storage presented to the hosts and the TDEV Allocated Storage.</td>
</tr>
<tr>
<td>Snapshot Compression Ratio</td>
<td>Ratio of the RDP Logical Backend Storage (calculated based on the 128K track size) and the RDP Physical Used Storage of the RDP space (calculated based on the compressed pool track size).</td>
</tr>
<tr>
<td><strong>Note</strong></td>
<td>Compression ratio metrics are supported only on systems capable of compression. Any value reported on a system that is not capable of compression should be disregarded.</td>
</tr>
<tr>
<td>Snapshot Efficiency Ratio</td>
<td>Ratio of the sum of all snapshot sizes and the RDP Logical Backend Storage.</td>
</tr>
<tr>
<td>Snapshot Shared Ratio</td>
<td>Ratio of the Snapshot Allocated Storage and the RDP Logical Backend Storage. Sum of all modified tracks on all snapshots / Sum of the RDP size for all snapshot.</td>
</tr>
<tr>
<td>Virtual Provisioning Compression Ratio</td>
<td>Ratio of the TDEV Logical Backend Storage (calculated based on the 128K track size) and the TDEV Physical Used Storage (calculated based on the compressed pool track size).</td>
</tr>
<tr>
<td><strong>Note</strong></td>
<td>Compression ratio metrics are supported only on systems capable of compression. Any value reported on a system that is not capable of compression should be disregarded.</td>
</tr>
<tr>
<td>Virtual Provisioning Efficiency Ratio</td>
<td>Ratio of the TDEV configured storage and the TDEV Logical Backend Storage (calculated based on TDEV allocated tracks without shared unowned).</td>
</tr>
</tbody>
</table>
Table 8 Array metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Provisioning Shared Ratio</td>
<td>Ratio of the TDEV allocated storage and the TDEV Logical Backend Storage. Backend Storage is the sum of TDEV allocated tracks without counting the TDEV shared unowned tracks.</td>
</tr>
<tr>
<td>Overall Compression Ratio</td>
<td>Ratio of the sum of all TDEVs + snapshot sizes (calculated based on the 128K track size) and the Physical Used Storage (calculated based on the compressed pool track size).</td>
</tr>
</tbody>
</table>

**Note**
Compression ratio metrics are supported only on systems capable of compression. Any value reported on a system that is not capable of compression should be disregarded.

| % Subscribed Capacity                        | The subscribed capacity as a percentage of the usable capacity.                                                                                       |
| % Effective Used Capacity                   | The percentage of usable capacity that would be used if all compressible data was compressed.                                                            |
| Usable Capacity GB                          | The total capacity of all Storage Resource Pools (SRP) in GB.                                                                                          |
| % Metadata Replication Used                 | The percentage of metadata used for replication.                                                                                                       |
| % Metadata System Used                      | The percentage of metadata used for the system.                                                                                                        |
| Glacial Track Count                         | The number of tracks currently in glacially compressed state.                                                                                           |
| % Meta Data Backend Used                    | BE TID used percent.                                                                                                                                  |
| % Meta Data Frontend Used                   | FE TID used percent.                                                                                                                                 |
| Snapshot Capacity (GB) + (TB)               | Total snapshot capacity for system data.                                                                                                               |
| Snapshot Modified Capacity (GB) + (TB)      | Total snapshot modified capacity for system data.                                                                                                      |
| Used Usable Capacity (GB) + (TB)            | Total user used capacity.                                                                                                                               |
| Capacity Health Score                       | Capacity Health Score.                                                                                                                                  |
| Hardware Config Health Score                | Hardware Config Health Score.                                                                                                                           |

**BE Director (DA) metrics**

The following table lists all metrics that are available for back-end directors.

Table 9 BE director (DA) metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time that a director is busy.</td>
</tr>
</tbody>
</table>
Table 9 BE director (DA) metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOs/sec</td>
<td>The number of IOs performed each second by the director.</td>
</tr>
<tr>
<td>Reqs/sec</td>
<td>A data transfer between the director and the cache. An IO may require multiple requests depending on IO size, alignment or both. For writes, the request counter increments at the time that the write pending flag is removed from the cache slot. In the event that multiple DAs are involved in the IO operation (such as RAID-1), the request count may not reconcile with the IO count and IO size.</td>
</tr>
<tr>
<td>Read Reqs/sec</td>
<td>A data transfer of a read between the director and the cache.</td>
</tr>
<tr>
<td>Write Reqs/sec</td>
<td>A data transfer of a write between the cache and the director.</td>
</tr>
<tr>
<td>MBs/sec</td>
<td>The total IO (reads and writes) per second in MBs.</td>
</tr>
<tr>
<td>% Read Reqs</td>
<td>The percent of read requests out of the total requests.</td>
</tr>
<tr>
<td>% Write Reqs</td>
<td>The percent of write requests out of the total requests.</td>
</tr>
<tr>
<td>Syscall Count/sec</td>
<td>The total number of calls seen by this director.</td>
</tr>
<tr>
<td>Avg Time per Syscall</td>
<td>The average time spent processing all system calls.</td>
</tr>
<tr>
<td>Syscall Remote Dir Count/sec</td>
<td>The number of calls sent from the local director to another director in the same system.</td>
</tr>
<tr>
<td>Syscall RDF Dir Count/sec</td>
<td>The number of calls sent using RDF to a remote system.</td>
</tr>
<tr>
<td>Prefetched Tracks/sec</td>
<td>The number of tracks pre-fetched from disk to cache upon detection of a sequential read stream.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The number of reads per second in MBs.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The number of writes per second in MBs.</td>
</tr>
<tr>
<td>Clone Copy Read</td>
<td></td>
</tr>
<tr>
<td>Clone Copy Write</td>
<td></td>
</tr>
<tr>
<td>PHCO Rebuild Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Optimized Write</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>PHCO Rebuild Read</td>
<td>Internal metric.</td>
</tr>
</tbody>
</table>
### Table 9 BE director (DA) metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressed Read Reqs/sec</td>
<td>The number of compressed read requests per second.</td>
</tr>
<tr>
<td>Compressed Write Reqs/sec</td>
<td>The number of compressed write requests per second.</td>
</tr>
<tr>
<td>% Compressed Read Reqs</td>
<td>The percentage of read requests that are compressed.</td>
</tr>
<tr>
<td>% Compressed Write Reqs</td>
<td>The percentage of write requests that are compressed.</td>
</tr>
<tr>
<td>Compressed Read MBs/sec</td>
<td>The size of compressed read MBs per second.</td>
</tr>
<tr>
<td>Compressed Write MBs/sec</td>
<td>The size of compressed write MBs per second.</td>
</tr>
<tr>
<td>Compressed MBs/sec</td>
<td>The total size of compressed MBs (read and write) per second.</td>
</tr>
<tr>
<td>Compressed Reqs/sec</td>
<td>The total number of compressed requests (read and write) per second.</td>
</tr>
<tr>
<td>% Compressed Reqs</td>
<td>The total percent of all read and write requests.</td>
</tr>
<tr>
<td>% Compressed Read MBs</td>
<td>The percent of all compressed MBs that were read requests.</td>
</tr>
<tr>
<td>% Compressed Write MBs</td>
<td>The percent of all compressed MBs that were write requests.</td>
</tr>
<tr>
<td>% Compressed MBs</td>
<td>The total percent of all read and write compressed MBs.</td>
</tr>
<tr>
<td>Syscall Time/sec</td>
<td>Total time spent processing all system calls.</td>
</tr>
<tr>
<td>% Busy Logical Core 0</td>
<td>The percent of time that core 0 is busy serving IOs.</td>
</tr>
<tr>
<td>% Busy Logical Core 1</td>
<td>The percent of time that core 1 is busy serving IOs.</td>
</tr>
<tr>
<td>% Idle Logical Core 0</td>
<td>The percent of time that core 0 is idle.</td>
</tr>
<tr>
<td>% Idle Logical Core 1</td>
<td>The percent of time that core 1 is idle.</td>
</tr>
<tr>
<td>% Non-IO Busy Logical Core 0</td>
<td>The percent of time that core 0 is busy serving other non-IO tasks, such as FAST swaps, Optimizer moves, Snap copies, etc.</td>
</tr>
<tr>
<td>% Non-IO Busy Logical Core 1</td>
<td>The percent of time that core 1 is busy serving other non-IO tasks, such as FAST swaps, Optimizer moves, Snap copies, etc.</td>
</tr>
<tr>
<td>% Non-IO Busy</td>
<td>The percent of time the director was busy with non-IO tasks, such as FAST swaps, Optimizer moves, Snap copies, etc.</td>
</tr>
</tbody>
</table>
**BE Emulation metrics**

The following table lists all metrics that are available for back-end emulation.

**Table 10 BE emulation metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Work Time</td>
<td></td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time the director is busy.</td>
</tr>
</tbody>
</table>

**BE Port metrics**

The following table lists all metrics that are available for back-end ports.

**Table 11 BE port metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reads/sec</td>
<td>The number of read operations performed each second by the port.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The number of write operations performed each second by the port.</td>
</tr>
<tr>
<td>Host IOs/sec</td>
<td>The number of host operations performed each second by the port.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The read throughput (MBs) of the port per second.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The write throughput (MBs) of the port per second.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The size of the data transfer from the host in MBs per second.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Speed</td>
<td>Total port capacity. Note that in the REST API, for backward compatibility reasons, this metric is named Max Speed Gb/sec.</td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time that the port is busy.</td>
</tr>
</tbody>
</table>

**Board metrics**

The following table lists all metrics that are available for boards.

The measurements reflect the transfer rate to and from BOSCO compared with the maximum bandwidth.

Utilization, as well as inbound and outbound speed, are measured across all processors, regardless of type.
### Table 12 Board metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outbound MBs/sec</td>
<td>Outbound speed.</td>
</tr>
<tr>
<td>Inbound MBs/sec</td>
<td>Inbound speed.</td>
</tr>
<tr>
<td>Max Speed MBs/sec</td>
<td>Maximum speed.</td>
</tr>
<tr>
<td>Utilization</td>
<td>Calculated value: ( \frac{(\text{transfer-rate-in} + \text{transfer-rate-out})}{\text{max-transfer-rate}} )</td>
</tr>
</tbody>
</table>

### Cache Partition metrics

The following table lists all metrics that are available for cache partitions.

### Table 13 Cache partition metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquired Slot Count</td>
<td></td>
</tr>
<tr>
<td>Age Non WP Slots</td>
<td></td>
</tr>
<tr>
<td>Avg Age Given Destage</td>
<td></td>
</tr>
<tr>
<td>Avg Age of Write to Non WP Slot</td>
<td></td>
</tr>
<tr>
<td>Cache Age GT 10 Min</td>
<td></td>
</tr>
<tr>
<td>Cache Age GT 1 hour</td>
<td></td>
</tr>
<tr>
<td>Cache Age GT 1 Min</td>
<td></td>
</tr>
<tr>
<td>Cache Hit Ages 1</td>
<td></td>
</tr>
<tr>
<td>Cache Hit Ages 2</td>
<td></td>
</tr>
<tr>
<td>Cache Hit Ages 3</td>
<td></td>
</tr>
<tr>
<td>Cache Hit Ages 4</td>
<td></td>
</tr>
<tr>
<td>Cache Hit Ages 5</td>
<td></td>
</tr>
<tr>
<td>Cache Hit Ages 6</td>
<td></td>
</tr>
<tr>
<td>Cache Hit Ages 7</td>
<td></td>
</tr>
<tr>
<td>Cache Slot Ages 1</td>
<td></td>
</tr>
<tr>
<td>Cache Slot Ages 2</td>
<td></td>
</tr>
<tr>
<td>Cache Slot Ages 3</td>
<td></td>
</tr>
<tr>
<td>Cache Slot Ages 4</td>
<td></td>
</tr>
<tr>
<td>Cache Slot Ages 5</td>
<td></td>
</tr>
<tr>
<td>Cache Slot Ages 6</td>
<td></td>
</tr>
<tr>
<td>Cache Slot Ages 7</td>
<td></td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Cache Slot Ages 8</td>
<td></td>
</tr>
<tr>
<td>Cache Slots Used</td>
<td></td>
</tr>
<tr>
<td>Destage Slot Age</td>
<td></td>
</tr>
<tr>
<td>Destaged Slot Count</td>
<td></td>
</tr>
<tr>
<td>Donation Give Count</td>
<td></td>
</tr>
<tr>
<td>Donation Take Count</td>
<td></td>
</tr>
<tr>
<td>Donation Time</td>
<td></td>
</tr>
<tr>
<td>Host IOs/sec</td>
<td>Host operations performed each second by the cache partition.</td>
</tr>
<tr>
<td>Local WP Count</td>
<td>The number of write pending slots waiting to be de-staged to disk on the local system. The value should be less than or equal to the system write pending count.</td>
</tr>
<tr>
<td>% Max Cache</td>
<td>Maximum slot allocation for a partition.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The number of host MBs written and read each second.</td>
</tr>
<tr>
<td>% Min Cache</td>
<td>Minimum slot allocation for a partition</td>
</tr>
<tr>
<td>% WP Utilization</td>
<td>The percent of tracks in cache that are write pending. Until the data is destaged to disk, those tracks are not used to serve reads and improve the hit ratio.</td>
</tr>
<tr>
<td>% Hit</td>
<td>The percent of IO operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Remote WP count</td>
<td>The number of write pending slots waiting to be de-staged to disk on the remote system. The value should be less than or equal to the system write pending count.</td>
</tr>
<tr>
<td>% Cache Used</td>
<td>The percent of the cache partition that is used.</td>
</tr>
<tr>
<td>% Target Cache</td>
<td>Percent of total cache allocated to this partition.</td>
</tr>
<tr>
<td>Total Replace Slots</td>
<td></td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of cache partition slots that are write pending.</td>
</tr>
<tr>
<td>WP Limit</td>
<td>The maximum number of write-pending slots.</td>
</tr>
<tr>
<td>Writes to All Non WP Slots</td>
<td></td>
</tr>
<tr>
<td>Writes to Young Non WP Slots</td>
<td></td>
</tr>
</tbody>
</table>
## DATA Volume metrics

The following table lists all metrics that are available for DATA volumes.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocated Capacity (GB)</td>
<td>The total allocated volume capacity.</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the volume each second.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>Calculated value: (MBs read per sec + MBs written per sec)</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the volume from the disk director each second.</td>
</tr>
<tr>
<td>BE % Reads</td>
<td>The percent of the back-end IO that were read requests.</td>
</tr>
<tr>
<td>BE % Writes</td>
<td>The percent of the back-end IO that were write requests.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>The number of write requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>Kbytes Written for IVTOC</td>
<td></td>
</tr>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Kbytes Read for Rebuild</td>
<td></td>
</tr>
<tr>
<td>BE Reads For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Optimize Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Partial Sector Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Reads for Rebuild</td>
<td></td>
</tr>
<tr>
<td>BE Reads For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads (KB)</td>
<td>Internal metric.</td>
</tr>
</tbody>
</table>
Table 14 DATA volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE XOR Reads</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Device Block Size</td>
<td>The block size of the volume.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the volume (GBs).</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
<tr>
<td>Parity Generation Kbytes Read</td>
<td></td>
</tr>
<tr>
<td>Parity Generation Reads</td>
<td></td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of tracks per second prefetched from disk to cache upon detection of a sequential read stream.</td>
</tr>
<tr>
<td>BE_reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode for the volume.</td>
</tr>
<tr>
<td>Writes for IVTOC</td>
<td></td>
</tr>
</tbody>
</table>

Database metrics

The following table lists all metrics that are available for databases.

Table 15 Database metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>Host operations performed each second by the group.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>Host read operations performed each second by the group.</td>
</tr>
<tr>
<td>RDF Reads/sec</td>
<td></td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>Host write operations performed each second by the group.</td>
</tr>
<tr>
<td>Writes for IVTOC</td>
<td></td>
</tr>
<tr>
<td>RDFWrites/sec</td>
<td>Total RDF writes per second for the database.</td>
</tr>
<tr>
<td>Host Hits/sec</td>
<td>Host read/write operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Host Read Hits/sec</td>
<td>Host read operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
</tbody>
</table>
### Table 15 Database metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host Write Hits/sec</td>
<td>Host write operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Host Misses/sec</td>
<td>Host read/write operations performed each second by the group that could not be satisfied from cache.</td>
</tr>
<tr>
<td>Host Read Misses/sec</td>
<td>Host read operations performed each second by the group that were not satisfied from cache.</td>
</tr>
<tr>
<td>Host Write Misses/sec</td>
<td>Host write operations performed each second by the group that were not satisfied from cache.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>Cumulative number of host MBs read/writes per second by the group.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>Cumulative number of host MBs read per second by the group.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>Cumulative number of host MBs written per second by the group.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>Number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>Number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>Number of write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Kbytes written for IVTOC</td>
<td></td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time that it took the system to serve one read command.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time that it took the system to serve one write command.</td>
</tr>
<tr>
<td>Read Miss RT (ms)</td>
<td>The average time a read miss operation was performed by the group. A miss occurs when the requested data is not found in cache.</td>
</tr>
<tr>
<td>Write Miss RT (ms)</td>
<td>The average time a write miss operation was performed by the group. A miss occurs when the write operation has to wait while data is destaged from cache to disks.</td>
</tr>
<tr>
<td>RDF/S Write RT (ms)</td>
<td>The average time it took the volume to serve one write IO.</td>
</tr>
<tr>
<td>% Reads</td>
<td>Percentage of IO operations that were reads.</td>
</tr>
<tr>
<td>% Writes</td>
<td>Percentage of IO operations that were writes.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>% Read Hit</td>
<td>The percentage of read operations performed that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Write Hit</td>
<td>The percentage of write operations performed that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Read Miss</td>
<td>The percentage of read miss operations performed, a miss occurs when the requested read data is not found in cache or the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>% Write Miss</td>
<td>The percentage of write miss operations performed, a miss occurs when the requested read data is not found in cache or the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode for the volume.</td>
</tr>
<tr>
<td>Seq IOs/sec</td>
<td>The number of IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Reads/sec</td>
<td>The number of read IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Writes/sec</td>
<td>The number of write IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Read Hits/sec</td>
<td>The number of sequential read operations performed each second that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Read Miss/sec</td>
<td>The number of sequential read operations performed each that were misses.</td>
</tr>
<tr>
<td>Seq Write Hits/sec</td>
<td>The number of sequential write operations performed by the volume that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Write Misses/sec</td>
<td>The number of sequential write operations performed each second that were misses.</td>
</tr>
<tr>
<td>Random IOs/sec</td>
<td>The number of IOs from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Reads/sec</td>
<td>The number of read IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Writes/sec</td>
<td>The number of write IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Read Hits/sec</td>
<td>The number of random read IOs that were satisfied from the cache.</td>
</tr>
</tbody>
</table>
Table 15 Database metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random Write Hits/sec</td>
<td>The number of random write IOs that were immediately placed in cache because space was available.</td>
</tr>
<tr>
<td>Random Read Misses/sec</td>
<td>The number of random read IOs that were misses.</td>
</tr>
<tr>
<td>Random Write Misses/sec</td>
<td>The number of random write IOs that were misses.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec / total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec / total writes per sec)</td>
</tr>
<tr>
<td>% Sequential IO</td>
<td>Calculated value: 100 * (total seq IOs per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read</td>
<td>Calculated value: 100 * (seq reads per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read Hit</td>
<td>The percent of the sequential read operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Read Miss</td>
<td>The percent of the sequential read operations that were misses.</td>
</tr>
<tr>
<td>% Seq Writes</td>
<td>Calculated value: 100 * (seq writes per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Write Hit</td>
<td>The percent of the sequential write operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Write Miss</td>
<td>The percent of the sequential write operations that were misses.</td>
</tr>
<tr>
<td>% Random IO</td>
<td>The percent of IO operations that were random.</td>
</tr>
<tr>
<td>% Random Read Hit</td>
<td>Calculated value: 100 * (random read hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Miss</td>
<td>Calculated value: 100 * (random read misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Read Miss</td>
<td>Calculated value: 100 * (random write hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Hit</td>
<td>Calculated value: 100 * (random write misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Max WP Threshold</td>
<td>The maximum number of write-pending slots available for the volume.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The number of MBs read per sec + MBs written per sec.</td>
</tr>
</tbody>
</table>
## Table 15 Database metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE Prefetched Tracks/sec</td>
<td>The total prefetched tracks each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Read Request Time (ms)</td>
<td>The average time it takes read requests from the disk directors to cache.</td>
</tr>
<tr>
<td>BE Disk Read RT (ms)</td>
<td>The average time it takes read requests from the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Task Time (ms)</td>
<td>The time from the point when the HA puts the read request on the queue and the DA picks it up - can be considered queue time.</td>
</tr>
<tr>
<td>Parity Generation Kbytes Read</td>
<td></td>
</tr>
<tr>
<td>Parity Generation Reads</td>
<td></td>
</tr>
<tr>
<td>% Hit</td>
<td>The percent of operations that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Miss</td>
<td>The percent of operations that were misses. A miss occurs when the operation cannot be immediately satisfied from cache because the data is not there or the operation has to wait while data is destaged from cache to disks.</td>
</tr>
<tr>
<td>% Random Reads</td>
<td>The percent of read commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>% Random Writes</td>
<td>The percent of write commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>BE % Reads</td>
<td>The percent of read operations from the back-end directors that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>BE % Writes</td>
<td>The percent of write operations from the back-end directors that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Write RT Count 5 to 8</td>
<td></td>
</tr>
<tr>
<td>Write RT Count 8 to 14</td>
<td></td>
</tr>
<tr>
<td>Read RT Over 32</td>
<td></td>
</tr>
<tr>
<td>Read RT Count 8 to 14</td>
<td></td>
</tr>
<tr>
<td>Skew</td>
<td></td>
</tr>
<tr>
<td>Read RT Count 0 to 1</td>
<td></td>
</tr>
</tbody>
</table>
Table 15 Database metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDF Response Time (ms)</td>
<td></td>
</tr>
<tr>
<td>Write RT Count 14 to 32</td>
<td></td>
</tr>
<tr>
<td>Write RT Count Over 32</td>
<td></td>
</tr>
<tr>
<td>Read RT 14 to 32</td>
<td></td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
<tr>
<td>Write RT 14 to 32</td>
<td></td>
</tr>
<tr>
<td>Write RT Over 32</td>
<td></td>
</tr>
<tr>
<td>Read RT Count 3 to 5</td>
<td></td>
</tr>
<tr>
<td>Read RT Count 5 to 8</td>
<td></td>
</tr>
<tr>
<td>Read RT Count 14 to 32</td>
<td></td>
</tr>
<tr>
<td>Read RT Count Over 32</td>
<td></td>
</tr>
<tr>
<td>Write RT Count 0 to 1</td>
<td></td>
</tr>
<tr>
<td>Write RT Count 1 to 3</td>
<td></td>
</tr>
<tr>
<td>Write RT Count 3 to 5</td>
<td></td>
</tr>
<tr>
<td>Read RT Count 1 to 3</td>
<td></td>
</tr>
<tr>
<td>Information Alert Count</td>
<td>Number of information alerts.</td>
</tr>
<tr>
<td>Critical Alert Count</td>
<td>Number of critical alerts.</td>
</tr>
<tr>
<td>Warning Alert Count</td>
<td>Number of information alerts.</td>
</tr>
<tr>
<td>Allocated Capacity (GB)</td>
<td>The total allocated database capacity.</td>
</tr>
<tr>
<td>BE Partial Sector Writes (KB)</td>
<td>The KBs of back-end IO that were partial sector writes.</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
<tr>
<td>BE Optimize Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Read (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Rebuild (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
</tbody>
</table>
### Table 15 Database metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Writes For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy (MB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Reads For Rebuild</td>
<td></td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the database.</td>
</tr>
<tr>
<td>Device Block Size</td>
<td>The block size of the volume.</td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of tracks per second prefetched from disk to cache upon detection of a sequential read stream.</td>
</tr>
<tr>
<td>RDF Read Hits/sec</td>
<td></td>
</tr>
<tr>
<td>Optimized Read Misses/sec</td>
<td>Number of read requests each second performed directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Optimized MBs Read Miss/sec</td>
<td>Number of host megabytes read each second directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>RDF MBs Read/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Rewrites/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Written/sec</td>
<td></td>
</tr>
<tr>
<td>Avg Optimized Read Miss Size (KB)</td>
<td></td>
</tr>
<tr>
<td>Write Paced Delay (ms)</td>
<td></td>
</tr>
</tbody>
</table>

### Database by Pool metrics

The following table lists all metrics that are available for databases by pool.

### Table 16 Database by pool metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Allocated Capacity</td>
<td>The allocated pool capacity.</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk. (BE Reads + BE Writes) /allocated capacity. With FAST moving active extents to higher tiers, this metric is a good indication of success (the IO density on Flash tiers should be higher than the density on SATA tiers).</td>
</tr>
</tbody>
</table>
### Table 16 Database by pool metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Destage Writes/sec</td>
<td>The number of writes per second that were destaged to disk.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>Calculated value: (MBs read per sec + MBs written per sec)</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>Destage Write MBs/sec</td>
<td>The size (MBs) of writes per second that were destaged to disk.</td>
</tr>
<tr>
<td>Prefetched Tracks/sec</td>
<td>The number of tracks per second prefetched from disk to cache upon detection of a sequential read stream.</td>
</tr>
<tr>
<td>Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>Total Tracks</td>
<td>The number of allocated tracks in the database by pool.</td>
</tr>
<tr>
<td>Compressed Tracks</td>
<td>The number of compressed tracks in the database by pool (applies only to storage systems running Enginuity OS 5876).</td>
</tr>
<tr>
<td>% Compressed Tracks</td>
<td>The percent of the total tracks that are compressed (applies only to storage systems running Enginuity OS 5876).</td>
</tr>
</tbody>
</table>

### Device Group metrics

The following table lists all metrics that are available for device groups.

### Table 17 Device group metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The number of host operations performed each second by the group.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>The number of host read operations performed each second by the group.</td>
</tr>
<tr>
<td>RDF Reads/sec</td>
<td>Total RDF reads per second for the device group.</td>
</tr>
<tr>
<td>RDF Writes/sec</td>
<td>The number of host write operations performed each second by the group.</td>
</tr>
</tbody>
</table>
**Table 17 Device group metrics (continued)**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host Hits/sec</td>
<td>The number of host read/write operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Host Read Hits/sec</td>
<td>The number of host read operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Host Write Hits/sec</td>
<td>The number of host write operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Host Misses/sec</td>
<td>The number of host read/write operations performed each second by the group that could not be satisfied from cache.</td>
</tr>
<tr>
<td>Host Read Misses/sec</td>
<td>The number of host read operations performed each second by the group that were not satisfied from cache.</td>
</tr>
<tr>
<td>Host Write Misses/sec</td>
<td>The number of host write operations performed each second by the group that were not satisfied from cache.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The cumulative number of host MBs read/writes per second by the group.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>The cumulative number of host MBs read per second by the group.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>The cumulative number of host MBs written per second by the group.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>The number of write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time that it took the Symmetrix to serve one read IO for this group.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time that it took the Symmetrix to serve one write IO for this group.</td>
</tr>
<tr>
<td>Read Miss RT (ms)</td>
<td>The average time that it took the Symmetrix to serve one read miss IO for this group.</td>
</tr>
<tr>
<td>Write Miss RT (ms)</td>
<td>The average time that it took the Symmetrix to serve one write miss IO for this group.</td>
</tr>
<tr>
<td>RDF/S Write RT (ms)</td>
<td>A summary of the read, write, and average response times for the selected SRDF/S group.</td>
</tr>
</tbody>
</table>
**Table 17 Device group metrics (continued)**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Reads</td>
<td>The percent of IO operations that were reads.</td>
</tr>
<tr>
<td>% Writes</td>
<td>The percent of IO operations that were writes.</td>
</tr>
<tr>
<td>% Read Hit</td>
<td>The percent of read operations, performed by the group, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Write Hit</td>
<td>The percent of write operations, performed by the group, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Read Miss</td>
<td>The percent of read miss operations performed each second by the group. A miss occurs when the requested read data is not found in cache.</td>
</tr>
<tr>
<td>% Write Miss</td>
<td>The percent of write miss operations performed each second by the group. A miss occurs when the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode for the group.</td>
</tr>
<tr>
<td>Seq IOs/sec</td>
<td>Number of IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Reads/sec</td>
<td>Number of read IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Writes/sec</td>
<td>Number of write IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Read Hits/sec</td>
<td>Number of sequential read operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Read Miss/sec</td>
<td>Number of sequential read operations performed each second by the group that were misses.</td>
</tr>
<tr>
<td>Seq Write Hits/sec</td>
<td>Number of sequential write operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Write Misses/sec</td>
<td>Number of sequential write operations performed each second by the group that were misses.</td>
</tr>
<tr>
<td>Random IOs/sec</td>
<td>IOs from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Reads/sec</td>
<td>Read IO commands from a host not identified as part of a sequential stream.</td>
</tr>
</tbody>
</table>
Table 17 Device group metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random Writes/sec</td>
<td>Write IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Read Hits/sec</td>
<td>Random read IOs that were satisfied from the cache.</td>
</tr>
<tr>
<td>Random Write Hits/sec</td>
<td>Random write IOs that were immediately placed in cache because space was available.</td>
</tr>
<tr>
<td>Random Read Misses/sec</td>
<td>Random read IOs that were misses.</td>
</tr>
<tr>
<td>Random Write Misses/sec</td>
<td>Random write IOs that were misses.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec/total IOs per sec)</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec/total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec/total writes per sec)</td>
</tr>
<tr>
<td>% Sequential IO</td>
<td>Calculated value: 100 * (total seq IOs per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read</td>
<td>Calculated value: 100 * (seq reads per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read Hit</td>
<td>The percent of the sequential read operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Read Miss</td>
<td>The percent of the sequential read operations that were misses.</td>
</tr>
<tr>
<td>% Seq Writes</td>
<td>Calculated value: 100 * (seq writes per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Write Hit</td>
<td>The percent of the sequential write operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Write Miss</td>
<td>The percent of the sequential write operations that were misses.</td>
</tr>
<tr>
<td>% Random IO</td>
<td>The percent of IO operations that were random.</td>
</tr>
<tr>
<td>% Random Write Miss</td>
<td>Calculated value: 100 * (random write misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Read Hit</td>
<td>Calculated value: 100 * (random read hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Read Miss</td>
<td>Calculated value: 100 * (random read misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Hit</td>
<td>Calculated value: 100 * (random write hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Max WP Threshold</td>
<td>The maximum number of write-pending slots available for the group.</td>
</tr>
</tbody>
</table>
Table 17 Device group metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE MBs Transferred/sec</td>
<td>Calculated value: (MBs read per sec + MBs written per sec)</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE Prefetched Tracks/sec</td>
<td>The total prefetched tracks each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Read Request Time (ms)</td>
<td>The average time it takes to make a request by the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Disk Read RT (ms)</td>
<td>The average time it takes cache to respond to a read request by the disk directors.</td>
</tr>
<tr>
<td>BE Read Task Time (ms)</td>
<td>The time from the point when the HA puts the read request on the queue and the DA picks it up; this can be considered queue time.</td>
</tr>
<tr>
<td>% Hit</td>
<td>The percent of IO operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Miss</td>
<td>The percent of IO operations that were misses.</td>
</tr>
<tr>
<td>% Random Reads</td>
<td>The percent of all read IOs that were random.</td>
</tr>
<tr>
<td>% RandomWrites</td>
<td>The percent of all write IOs that were random.</td>
</tr>
<tr>
<td>BE % Reads</td>
<td>The percent of the back-end IO that were read requests.</td>
</tr>
<tr>
<td>BE % Writes</td>
<td>The percent of the back-end IO that were write requests.</td>
</tr>
<tr>
<td>RDF Response Time (ms)</td>
<td>The average time it takes to satisfy IO requests.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average time it takes to satisfy IO requests.</td>
</tr>
<tr>
<td>BE Partial Sector Writes (KB)</td>
<td>The number of partial sector writes by the disk directors.</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
<tr>
<td>BE Optimize Writes (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE XOR Reads</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE XOR Read (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric</td>
</tr>
</tbody>
</table>
Table 17 Device group metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Writes For Copy</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Writes For Copy (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Writes For Rebuild (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE RDF Copy</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE RDF Copy (MB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the device group.</td>
</tr>
<tr>
<td>Allocated Capacity (GB)</td>
<td>The allocated capacity of the device group.</td>
</tr>
<tr>
<td>Device Block Size</td>
<td>The block size of the volume.</td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>RDF Rewrites/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Read/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Written/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Read Hits/sec</td>
<td></td>
</tr>
<tr>
<td>Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>Avg. Write Paced Delay (ms)</td>
<td></td>
</tr>
</tbody>
</table>

Disk metrics

The following table lists all metrics that are available for disks.

Table 18 Disk metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time that the disk is busy serving IOs.</td>
</tr>
<tr>
<td>% Idle</td>
<td>The percent of time the disk is idle.</td>
</tr>
<tr>
<td>Avg Queue Depth</td>
<td>Calculated value: Accumulated queue depth/total SCSI command per sec.</td>
</tr>
<tr>
<td>Total SCSI Commands/sec</td>
<td>The total number of read commands, write commands, skip mask commands, verify commands, XOR write commands, and XOR</td>
</tr>
</tbody>
</table>
### Table 18 Disk metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOs/sec</td>
<td>The number of host read and write requests for the disk.</td>
</tr>
<tr>
<td>Reads/sec</td>
<td>The number of host reads per second for the disk.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The number of host writes per second for the disk.</td>
</tr>
<tr>
<td>MBs/sec</td>
<td>The size of the IO from the host to the disk per second.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The read throughput (MBs) of the disk per second.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The write throughput (MBs) of the disk per second.</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>The average number of kilobytes for a single read command.</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>The average number of kilobytes for a single write command.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the disk to serve one read command.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the disk to serve one write command.</td>
</tr>
<tr>
<td>Avg Hypers per Seek</td>
<td>The average number of hypervolumes that the disk head crossed during one seek.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the disk (GBs).</td>
</tr>
<tr>
<td>Used Capacity (GB)</td>
<td>The total used capacity of the disk (GBs).</td>
</tr>
<tr>
<td>% Used Capacity</td>
<td>The percent of the disk that is used.</td>
</tr>
<tr>
<td>% Free Capacity</td>
<td>The percent of the disk that is free.</td>
</tr>
</tbody>
</table>

### Disk Bucket metrics

The following table lists all metrics that are available for disk buckets.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent busy of disks in this bucket.</td>
</tr>
</tbody>
</table>
### Disk bucket metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg lOs/sec</td>
<td>The average number of disk IOs of disks in this bucket.</td>
</tr>
<tr>
<td>Avg MBs/sec</td>
<td>The average number of disk MBs read and written to disks in this bucket.</td>
</tr>
<tr>
<td>Avg Queue Depth</td>
<td>As an IO enters the queue it first checks how deep the queue is. After incrementing the queue depth bucket, it increments the associated count bucket by 1. This then represents the number of IOs that encountered queues of certain depth during the past time interval. The intent of these buckets is to identify IO bursts which in turn generate large queues and long response times.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The weighted average response time (read + writes) for disks in this bucket.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of disks in this bucket.</td>
</tr>
<tr>
<td>Used Capacity (GB)</td>
<td>The used capacity of disks in this bucket.</td>
</tr>
<tr>
<td>Avg Number of Disks</td>
<td>The average number of disks in this bucket.</td>
</tr>
<tr>
<td>Reads/sec</td>
<td>The average number of disk Reads of disks in this bucket.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The average number of disk Writes of disks in this bucket.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The average number of MBs read from disks in this bucket.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The average number of MBs written to disks in this bucket.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average read response time.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average write response time.</td>
</tr>
</tbody>
</table>

### Disk Group metrics

The following table lists all metrics that are available for disk groups.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec/total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec/total writes per sec)</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
<tr>
<td>IOs/sec</td>
<td>The number of IO commands to the disk.</td>
</tr>
</tbody>
</table>
**Table 20 Disk group metrics (continued)**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBs/sec</td>
<td>The total IO (reads and writes) per second in MBs.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The average throughput of host MBs read (per second) by the director.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The average throughput of host MBs written (per second) by the director.</td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time that the disk is busy serving IOs.</td>
</tr>
<tr>
<td>% Idle</td>
<td>The percent of time the disk is idle.</td>
</tr>
<tr>
<td>% Free Capacity</td>
<td>The percent of the disk that is free.</td>
</tr>
<tr>
<td>% Used Capacity</td>
<td>The percent of the disk group capacity that is allocated.</td>
</tr>
<tr>
<td>Reads/sec</td>
<td>The number of host reads per second for the disk.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The number of host writes per second for the disk.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the disk to serve one read command.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the disk to serve one write command.</td>
</tr>
<tr>
<td>Total SCSI Commands/sec</td>
<td>The total number of read commands, write commands, skip mask commands, verify commands, XOR write commands, and XOR write-read commands performed by the disk each second.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the disk (GBs).</td>
</tr>
<tr>
<td>Used Capacity (GB)</td>
<td>The total used capacity of the disk (GBs).</td>
</tr>
</tbody>
</table>

**Disk Group tier metrics**

The following table lists all metrics that are available for disk group tiers.

**Table 21 Disk group tier metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time that the disk group is busy serving IOs.</td>
</tr>
<tr>
<td>% Idle</td>
<td>The percent of time the disk group is idle.</td>
</tr>
<tr>
<td>Total SCSI Commands/sec</td>
<td>The total number of read commands, write commands, skip mask commands, verify commands, XOR write commands, and XOR write-read commands performed by the disk group each second.</td>
</tr>
<tr>
<td>IOs/sec</td>
<td>The total number of read and write IOs per second.</td>
</tr>
<tr>
<td>Reads/sec</td>
<td>The number of reads per second for the disk group.</td>
</tr>
</tbody>
</table>
Table 21 Disk group tier metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Writes/sec</td>
<td>The number of writes per second for the disk group.</td>
</tr>
<tr>
<td>MBs/sec</td>
<td>The total number of MBs per second for the disk group.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The read throughput (MBs) of the disk group per second.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The write throughput (MBs) of the disk group per second.</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>The average number of kilobytes for a single read command.</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>The average number of kilobytes for a single write command.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average time it took the disk group to service IOs.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the disk group to serve one read command.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the disk group to serve one write command.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity (in GB) of all the disks in the disk group.</td>
</tr>
<tr>
<td>Used Capacity (GB)</td>
<td>The total capacity (in GB) allocated for all the disks in the disk group.</td>
</tr>
<tr>
<td>% Used Capacity</td>
<td>The percent of the disk group capacity that is allocated.</td>
</tr>
<tr>
<td>% Free Capacity</td>
<td>The percent of the disk group capacity that is free.</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk. (BE Reads + BE Writes) /allocated capacity With FAST moving active extents to higher tiers, this metric is a good indication of success (the IO density on Flash tiers should be higher than the density on SATA tiers.)</td>
</tr>
</tbody>
</table>

Disk Technology metrics

The following table lists all metrics that are available for disk technologies.

Table 22 Disk technology metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time that the disk group is busy serving IOs.</td>
</tr>
<tr>
<td><strong>Metric</strong></td>
<td><strong>Description</strong></td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>% Idle</td>
<td>The percent of time the disk group is idle.</td>
</tr>
<tr>
<td>Total SCSI Commands/sec</td>
<td>The total number of read commands, write commands, skip mask commands, verify commands, XOR write commands, and XOR write-read commands performed by the disk group each second.</td>
</tr>
<tr>
<td>IOs/sec</td>
<td>The total number of read and write IOs per second.</td>
</tr>
<tr>
<td>Reads/sec</td>
<td>The number of reads per second for the disk group.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The number of writes per second for the disk group.</td>
</tr>
<tr>
<td>MBs/sec</td>
<td>The total number of MBs per second for the disk group.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The read throughput (MBs) of the disk group per second.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The write throughput (MBs) of the disk group per second.</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>The average number of kilobytes for a single read command.</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>The average number of kilobytes for a single write command.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average time it took the disk group to service IOs.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the disk group to serve one read command.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the disk group to serve one write command.</td>
</tr>
<tr>
<td>Seek Distance/sec</td>
<td>The number of hypervolumes that the disk head crossed (during all seeks) each second.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity (in GB) of all the disks in the disk group.</td>
</tr>
<tr>
<td>Used Capacity (GB)</td>
<td>The total capacity (in GB) allocated for all the disks in the disk group.</td>
</tr>
<tr>
<td>% Used Capacity</td>
<td>The percent of the disk group capacity that is allocated.</td>
</tr>
<tr>
<td>% Free Capacity</td>
<td>The percent of the disk group capacity that is free.</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk. (BE Reads + BE Writes) /allocated capacity With FAST moving active extents to higher Performance Management 640 Dell EMC Unisphere for PowerMax 9.0.1 Online Help (PDF version)</td>
</tr>
</tbody>
</table>
Table 22 Disk technology metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>tiers, this metric is a good indication of success (the IO density on Flash tiers should be higher than the density on SATA tiers.)</td>
</tr>
</tbody>
</table>

DSE Pool metrics

The following table lists all metrics that are available for DSE pools.

Table 23 DSE pool metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>The number of write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>Calculated value: (MBs read per sec + MBs written per sec)</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE Read Request Time (ms)</td>
<td>The average time it takes to make a read request by the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Disk Read RT (ms)</td>
<td>The average time it takes cache to respond to a read request by the disk directors.</td>
</tr>
<tr>
<td>BE Read Task Time (ms)</td>
<td>The time from the point when the HA puts the read request on the queue and the DA picks it up; this can be considered queue time.</td>
</tr>
<tr>
<td>% Used Capacity</td>
<td>The percent of the pools total capacity that is used.</td>
</tr>
<tr>
<td>Total Pool Capacity (GB)</td>
<td>The total pool capacity in GBs.</td>
</tr>
<tr>
<td>Enabled Pool Capacity (GB)</td>
<td>The enabled pool capacity in GBs.</td>
</tr>
<tr>
<td>Used Pool Capacity (GB)</td>
<td>The used pool capacity in GBs.</td>
</tr>
<tr>
<td>Allocated Pool Capacity (GB)</td>
<td>The allocated pool capacity in GBs.</td>
</tr>
</tbody>
</table>

DX Emulation metrics

The following table lists all metrics that are available for DX emulations.
Table 24 DX emulation metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Work Time</td>
<td></td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time the directory is busy.</td>
</tr>
</tbody>
</table>

**DX Port metrics**

The following table lists all metrics that are available for DX ports.

Table 25 DX port metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reads/sec</td>
<td></td>
</tr>
<tr>
<td>Writes/sec</td>
<td></td>
</tr>
<tr>
<td>Host IOs/sec</td>
<td></td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td></td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td></td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td></td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td></td>
</tr>
<tr>
<td>Speed</td>
<td></td>
</tr>
<tr>
<td>% Busy</td>
<td></td>
</tr>
</tbody>
</table>

**EDS Director metrics**

The following table lists all metrics that are available for EDS directors.

Table 26 EDS director metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random Read Misses</td>
<td>The number of random read IOs that were misses.</td>
</tr>
<tr>
<td>Random Read Misses Mbytes</td>
<td>The number of random read IOs that were misses in MBs.</td>
</tr>
<tr>
<td>Random Write Misses</td>
<td>The number of random write IOs that were misses.</td>
</tr>
<tr>
<td>Random Write Misses Mbytes</td>
<td>The number of random write IOs that were misses in MBs.</td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time the director is busy.</td>
</tr>
<tr>
<td>Glacial Tracks In</td>
<td>Ingress to glacial tier.</td>
</tr>
<tr>
<td>Glacial Tracks Out</td>
<td>Egress from glacial tier.</td>
</tr>
</tbody>
</table>
EDS Emulation metrics

The following table lists all metrics that are available for EDS emulations.

Table 27 EDS director metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Work Time</td>
<td></td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time the directory is busy.</td>
</tr>
</tbody>
</table>

External Director metrics

The following table lists all metrics that are available for external directors.

Table 28 External director metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time that a director is busy.</td>
</tr>
<tr>
<td>IOs/sec</td>
<td>The number of IOs performed each second by the director.</td>
</tr>
<tr>
<td>Reqs/sec</td>
<td>A data transfer between the director and the cache. An IO may require multiple requests depending on IO size, alignment or both. For writes the request counter increments at the time that the write pending flag is removed from the cache slot. In the event that multiple DAs are involved in the IO operation (such as RAID-1), the request count may not reconcile with the IO count and IO size.</td>
</tr>
<tr>
<td>Read Reqs/sec</td>
<td>A data transfer of a read between the director and the cache.</td>
</tr>
<tr>
<td>Write Reqs/sec</td>
<td>A data transfer of a write between the cache and the director.</td>
</tr>
<tr>
<td>MBs/sec</td>
<td>The total IO (reads and writes) per second in MBs.</td>
</tr>
<tr>
<td>% Read Reqs</td>
<td>The percent of read requests out of the total requests.</td>
</tr>
<tr>
<td>% Write Reqs</td>
<td>The percent of write requests out of the total requests.</td>
</tr>
<tr>
<td>Syscall Count/sec</td>
<td>The total number of calls seen by this director.</td>
</tr>
<tr>
<td>Avg Time per Syscall</td>
<td>The average time spent processing all system calls.</td>
</tr>
<tr>
<td>Syscall Remote Dir Count/sec</td>
<td>The number of calls sent from the local director to another director in the same system.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Syscall RDF Dir Count/sec</td>
<td>The number of calls sent using RDF to a remote system.</td>
</tr>
<tr>
<td>Prefetched Tracks/sec</td>
<td>The number of tracks pre-fetched from disk to cache upon detection of a sequential read stream.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The number of reads per second in MBs.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The number of writes per second in MBs.</td>
</tr>
<tr>
<td>Clone Copy Read</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Clone Copy Write</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>PHCO Rebuild Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Optimized Write</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>PHCO Rebuild Read</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Compressed Read Reqs/sec</td>
<td>The number of compressed read requests per second.</td>
</tr>
<tr>
<td>Compressed Write Reqs/sec</td>
<td>The number of compressed write requests per second.</td>
</tr>
<tr>
<td>% Compressed Read Reqs</td>
<td>The percentage of read requests that are compressed.</td>
</tr>
<tr>
<td>% Compressed Write Reqs</td>
<td>The percentage of write requests that are compressed.</td>
</tr>
<tr>
<td>Compressed Read MBs/sec</td>
<td>The size of compressed read MBs per second.</td>
</tr>
<tr>
<td>Compressed Write MBs/sec</td>
<td>The size of compressed write MBs per second.</td>
</tr>
<tr>
<td>Compressed MBs/sec</td>
<td>The total size of compressed MBs (read and write) per second.</td>
</tr>
<tr>
<td>Compressed Reqs/sec</td>
<td>The total number of compressed requests (read and write) per second.</td>
</tr>
<tr>
<td>% Compressed Reqs</td>
<td>The total percent of all read and write requests.</td>
</tr>
<tr>
<td>% Compressed Read MBs</td>
<td>The percent of all compressed MBs that were read requests.</td>
</tr>
<tr>
<td>% Compressed Write MBs</td>
<td>The percent of all compressed MBs that were write requests.</td>
</tr>
<tr>
<td>% Compressed MBs</td>
<td>The total percent of all read and write compressed MBs.</td>
</tr>
<tr>
<td>Syscall Time/sec</td>
<td>Total time spent processing all system calls</td>
</tr>
<tr>
<td>% Busy Logical Core 0</td>
<td>The percent of time that core 0 is busy serving IOs.</td>
</tr>
</tbody>
</table>
Table 28 External director metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy Logical Core 1</td>
<td>The percent of time that core 1 is busy serving IOs.</td>
</tr>
<tr>
<td>% Idle Logical Core 0</td>
<td>The percent of time that core 0 is idle.</td>
</tr>
<tr>
<td>% Idle Logical Core 1</td>
<td>The percent of time that core 1 is idle.</td>
</tr>
<tr>
<td>% Non-IO Busy Logical Core 0</td>
<td>The percent of time that core 0 is busy serving other non-IO tasks, such as FAST swaps, Optimizer moves, Snap copies, etc.</td>
</tr>
<tr>
<td>% Non-IO Busy Logical Core 1</td>
<td>The percent of time that core 1 is busy serving other non-IO tasks, such as FAST swaps, Optimizer moves, Snap copies, etc.</td>
</tr>
<tr>
<td>% Non-IO Busy</td>
<td>The percent of time the director was busy with non-IO tasks, such as FAST swaps, Optimizer moves, Snap copies, etc.</td>
</tr>
</tbody>
</table>

External Disk metrics

The following table lists all metrics that are available for external disks.

Table 29 External disk metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reads/sec</td>
<td>The number of host reads per second for the external disk.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The number of host writes per second for the external disk.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The read throughput (MBs) of the external disk per second.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The write throughput (MBs) of the external disk per second.</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>The average number of kilobytes for a single read command.</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>The average number of kilobytes for a single write command.</td>
</tr>
</tbody>
</table>
Table 29 External disk metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the external disk to serve one read command.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the external disk to serve one write command.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
<tr>
<td>MBs/sec</td>
<td>The size of the IO from the host to the external disk per second.</td>
</tr>
<tr>
<td>IOs/sec</td>
<td>The total number of read and write IOs per second for the external disk.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the external disk (GBs).</td>
</tr>
<tr>
<td>Used Capacity (GB)</td>
<td>The used capacity of the external disk (GBs).</td>
</tr>
<tr>
<td>% Used Capacity</td>
<td>The percent of the external disk that is used.</td>
</tr>
<tr>
<td>Avg Queue Depth</td>
<td>Calculated value: Accumulated queue depth/total SCSI command per sec.</td>
</tr>
<tr>
<td>% Idle</td>
<td>The percent of time the disk is idle.</td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time the disk is busy.</td>
</tr>
</tbody>
</table>

**External Disk Group metrics**

The following table lists all metrics that are available for external disk groups.
Table 30 External disk group metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reads/sec</td>
<td>The number of reads per second for the disk group.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The number of writes per second for the disk group.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The read throughput (MBs) of the disk group per second.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The write throughput (MBs) of the disk group per second.</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>The average number of kilobytes for a single read command.</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>The average number of kilobytes for a single write command.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the disk group to serve one read command.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the disk group to serve one write command.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
<tr>
<td>MBs/sec</td>
<td>The total number of MBs per second for the disk group.</td>
</tr>
<tr>
<td>IOs/sec</td>
<td>The total number of read and write IOs per second.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of all the disks in the disk group.</td>
</tr>
<tr>
<td>Used Capacity (GB)</td>
<td>The total capacity allocated for all the disks in the disk group.</td>
</tr>
<tr>
<td>% Used Capacity</td>
<td>The percent of the disk group capacity that is allocated.</td>
</tr>
<tr>
<td>Avg Queue Depth</td>
<td>Calculated value: Accumulated queue depth/ total SCSI command per sec.</td>
</tr>
<tr>
<td>% Idle</td>
<td>The percent of time the disk group is idle.</td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time the disk group is busy.</td>
</tr>
<tr>
<td>Members</td>
<td>The number of members in the external disk group.</td>
</tr>
</tbody>
</table>

FAST VP Policy metrics

The following table lists all metrics that are available for FAST VP policies.
### Table 31 FAST VP policy metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocated SG Capacity (GB)</td>
<td>The number of GBs of the storage group that are allocated to the FAST VP policy.</td>
</tr>
<tr>
<td>Total SG Capacity (GB)</td>
<td>The total capacity of the storage group.</td>
</tr>
<tr>
<td>Allocated Pool Capacity (GB)</td>
<td>The number of GBs of the virtual pool that are allocated to the FAST policy.</td>
</tr>
<tr>
<td>Total Pool Capacity (GB)</td>
<td>The total capacity of the virtual pool.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>The number of data requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The number of MBs transferred each second between cache and the director.</td>
</tr>
<tr>
<td>Allocated SG OOP Capacity (GB)</td>
<td>The GBs in the storage group that currently do not reside on the tiers defined in the FAST VP policy.</td>
</tr>
<tr>
<td>% Used Capacity (GB)</td>
<td>The percent of the pools capacity that is used.</td>
</tr>
<tr>
<td>Ingress Tracks</td>
<td>The number of tracks entering the pool.</td>
</tr>
<tr>
<td>Egress Tracks</td>
<td>The number of tracks leaving the pool.</td>
</tr>
</tbody>
</table>

### FE Director metrics

The following table lists all metrics that are available for FE directors.

### Table 32 FE director metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time the director is busy.</td>
</tr>
<tr>
<td>Host IOs/sec</td>
<td>A host command for data transfer.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The size of the data transfer from the host in MBs per second.</td>
</tr>
<tr>
<td>Reqs/sec</td>
<td>Data transfer between the director and the cache. An IO may require multiple requests depending on IO size, alignment or both. The requests rate should be either equal to or greater than the IO rate.</td>
</tr>
<tr>
<td>Read Reqs/sec</td>
<td>A read data transfer between the director and the cache. An IO may require multiple requests depending on IO size, alignment or both. The requests rate should be either equal to or greater than the IO rate.</td>
</tr>
<tr>
<td>Write Reqs/sec</td>
<td>A write data transfer between the director and the cache. An IO may require multiple requests depending on IO size, alignment or both. The requests rate should be either equal to or greater than the IO rate.</td>
</tr>
</tbody>
</table>
**Table 32** FE director metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>both. The requests rate should be either equal to or greater than the I/O rate.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The calculated average response time for reads.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The calculated average response time for writes.</td>
</tr>
<tr>
<td>Hits Reqs/sec</td>
<td>A request that is immediately serviced from the cache (instead of having to wait for the data to arrive, or destage from the disk).</td>
</tr>
<tr>
<td>Read Hit Reqs/sec</td>
<td>A read request that is immediately serviced from the cache (instead of having to wait for the data to arrive from the disk.)</td>
</tr>
<tr>
<td>Write Hit Reqs/sec</td>
<td>A write request that is immediately serviced from the cache (instead of having to wait for the data to be destaged to the disk.)</td>
</tr>
<tr>
<td>Miss Reqs/sec</td>
<td>A request that is a miss.</td>
</tr>
<tr>
<td>Read Miss Reqs/sec</td>
<td>A read request that cannot be satisfied immediately from the cache and needs to wait for the data to arrive from the disk.</td>
</tr>
<tr>
<td>Write Miss Reqs/sec</td>
<td>A write request that cannot be satisfied immediately from the cache and needs to wait for the data to be destaged to the disk.</td>
</tr>
<tr>
<td>% Read Reqs</td>
<td>The percent of read requests out of host commands for data transfer.</td>
</tr>
<tr>
<td>% Write Reqs</td>
<td>The percent of write requests out of host commands for data transfer.</td>
</tr>
<tr>
<td>% Hit Reqs</td>
<td>The percent of requests that are served from cache.</td>
</tr>
<tr>
<td>% Read Req Hit</td>
<td>The percent of read requests that are served from cache.</td>
</tr>
<tr>
<td>System WP Events/sec</td>
<td>A write miss due to the system write pending limit having been reached.</td>
</tr>
<tr>
<td>Device WP Events/sec</td>
<td>A write miss due to the volume write pending limit having been reached.</td>
</tr>
<tr>
<td>Syscall Count/sec</td>
<td>The total number of calls seen by this director.</td>
</tr>
<tr>
<td>Avg Time per Syscall</td>
<td>The average time that it took to serve one system call.</td>
</tr>
<tr>
<td>Syscall Remote Dir Count/sec</td>
<td>The number of calls per second sent from the local director to another director in the same system.</td>
</tr>
</tbody>
</table>
Table 32 FE director metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syscall RDF Dir Count/sec</td>
<td>The number of calls per second sent via RDF to a remote system.</td>
</tr>
<tr>
<td>Slot Collisions/sec</td>
<td>The number of write misses due to the desired cache slot being locked by another request.</td>
</tr>
<tr>
<td>Queue Depth Count Range 0-9</td>
<td>As an IO enters the queue it first checks how deep the queue is. After incrementing the queue depth bucket, it increments the associated count bucket by 1. This then represents the number of IOs that encountered queues of certain depth during the past time interval. The intent of these buckets is to identify IO bursts which in turn generate large queues and long response times.</td>
</tr>
<tr>
<td>Avg Queue Depth Range 0-9</td>
<td>As an IO enters the queue it first checks how deep the queue is. Based on depth, the applicable queue depth bucket increments with the value seen by the IO. For example, an IO that encounters a queue depth of 7 will increment bucket #2 (depth 5-9 for OS or 7-14 for MF) by 7. The intent of these buckets is to identify IO bursts which in turn generate large queues and long response times.</td>
</tr>
<tr>
<td>% Busy Logical Core 0</td>
<td>The percent of time that core 0 is busy serving IOs.</td>
</tr>
<tr>
<td>Syscall Time/sec</td>
<td>Total time spent processing all system calls.</td>
</tr>
<tr>
<td>Avg RDF Write Time (ms)</td>
<td></td>
</tr>
<tr>
<td>Avg WP Disconnect Time (ms)</td>
<td></td>
</tr>
<tr>
<td>Avg Read Miss Time (ms)</td>
<td></td>
</tr>
<tr>
<td>Random MBs Written to non WP Slots/sec</td>
<td></td>
</tr>
<tr>
<td>Random Writes to non WP Slots/sec</td>
<td></td>
</tr>
<tr>
<td>Random MBs Written to WP Slots/sec</td>
<td></td>
</tr>
<tr>
<td>Random Writes to WP Slots/sec</td>
<td></td>
</tr>
<tr>
<td>% Busy Logical Core 1</td>
<td>The percent of time that core 1 is busy serving IOs.</td>
</tr>
<tr>
<td>% Write Req Hit</td>
<td>The percent of write requests that were satisfied from cache.</td>
</tr>
<tr>
<td>Read RT Count Range 0 to Read RT Count</td>
<td>These buckets show the distribution of the number of reads to the FE directors over the specified time range.</td>
</tr>
<tr>
<td>Read RT Count Range Over 64</td>
<td></td>
</tr>
</tbody>
</table>
### Table 32 FE director metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write RT Count Range 0 to Write RT Count</td>
<td>These buckets show the distribution of the number of writes to the FE directors over the specified time range.</td>
</tr>
<tr>
<td>Range Over 64</td>
<td></td>
</tr>
<tr>
<td>Total Read Count</td>
<td>The total number of reads to the FE directors.</td>
</tr>
<tr>
<td>Total Write Count</td>
<td>The total number of writes to the FE directors.</td>
</tr>
<tr>
<td>Read RT 0 to 1to Read RT Over 64</td>
<td>These buckets show the distribution of the total average read response time.</td>
</tr>
<tr>
<td>Write RT 0 to 1toWrite RT Over 64</td>
<td>These buckets show the distribution of the total average write response time.</td>
</tr>
<tr>
<td>Host IO Limit IOs/sec</td>
<td>The number of IOs the FE director is processing.</td>
</tr>
<tr>
<td>Host IO Limit MBs/sec</td>
<td>The number of MBs the FE port is processing.</td>
</tr>
<tr>
<td>Queue Depth Utilization</td>
<td>A weighted sum of the utilizations according to the number of IOs in each bucket. Queue depth range metrics are used in the calculation. Calculation: Sx=1..9 [(Avg Queue Depth Range X - 1) / Avg Queue Depth Range X] * (Queue Depth Count Range X / Queue Depth Count Total) * 100</td>
</tr>
<tr>
<td>CCWS Per IO</td>
<td></td>
</tr>
<tr>
<td>Avg Optimized Read Miss Size (KB)</td>
<td></td>
</tr>
<tr>
<td>Optimized MBs Read Miss/sec</td>
<td>Number of host MBs read each second directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Optimized Read Misses/sec</td>
<td>Number of read requests each second performed directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>ORS ASync IOs/sec</td>
<td></td>
</tr>
<tr>
<td>ORS ASync MBs/sec</td>
<td></td>
</tr>
<tr>
<td>ORS Sync MBs/sec</td>
<td></td>
</tr>
<tr>
<td>ZHPF reads</td>
<td></td>
</tr>
<tr>
<td>ZHPF Reads MBs</td>
<td></td>
</tr>
<tr>
<td>ZHPF Writes</td>
<td></td>
</tr>
<tr>
<td>ZHPF Writes MBs</td>
<td></td>
</tr>
</tbody>
</table>

### Table 33 FE director metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time the director is busy.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Host IOs/sec</td>
<td>A host command for data transfer.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The size of the data transfer from the host in MBs per second.</td>
</tr>
<tr>
<td>Reqs/sec</td>
<td>Data transfer between the director and the cache. An IO may require multiple requests depending on IO size, alignment or both. The requests rate should be either equal to or greater than the IO rate.</td>
</tr>
<tr>
<td>Read Reqs/sec</td>
<td>A read data transfer between the director and the cache. An IO may require multiple requests depending on IO size, alignment or both. The requests rate should be either equal to or greater than the IO rate.</td>
</tr>
<tr>
<td>Write Reqs/sec</td>
<td>A write data transfer between the director and the cache. An IO may require multiple requests depending on IO size, alignment or both. The requests rate should be either equal to or greater than the IO rate.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The calculated average response time for reads.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The calculated average response time for writes.</td>
</tr>
<tr>
<td>Hits Reqs/sec</td>
<td>A request that is immediately serviced from the cache (instead of having to wait for the data to arrive, or destage from the disk).</td>
</tr>
<tr>
<td>Read Hit Reqs/sec</td>
<td>A read request that is immediately serviced from the cache (instead of having to wait for the data to arrive from the disk.)</td>
</tr>
<tr>
<td>Write Hit Reqs/sec</td>
<td>A write request that is immediately serviced from the cache (instead of having to wait for the data to be destaged to the disk.)</td>
</tr>
<tr>
<td>Miss Reqs/sec</td>
<td>A request that is a miss.</td>
</tr>
<tr>
<td>Read Miss Reqs/sec</td>
<td>A read request that cannot be satisfied immediately from the cache and needs to wait for the data to arrive from the disk.</td>
</tr>
<tr>
<td>Write Miss Reqs/sec</td>
<td>A write request that cannot be satisfied immediately from the cache and needs to wait for the data to be destaged to the disk.</td>
</tr>
<tr>
<td>% Read Reqs</td>
<td>The percent of read requests out of host commands for data transfer.</td>
</tr>
<tr>
<td>% Write Reqs</td>
<td>The percent of write requests out of host commands for data transfer.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>% Hit Reqs</td>
<td>The percent of requests that are served from cache.</td>
</tr>
<tr>
<td>% Read Req Hit</td>
<td>The percent of read requests that are served from cache.</td>
</tr>
<tr>
<td>System WP Events/sec</td>
<td>A write miss due to the system write pending limit having been reached.</td>
</tr>
<tr>
<td>Device WP Events/sec</td>
<td>A write miss due to the volume write pending limit having been reached.</td>
</tr>
<tr>
<td>Syscall Count/sec</td>
<td>The total number of calls seen by this director.</td>
</tr>
<tr>
<td>Avg Time per Syscall</td>
<td>The average time that it took to serve one system call.</td>
</tr>
<tr>
<td>Syscall Remote Dir Count/sec</td>
<td>The number of calls per second sent from the local director to another director in the same system.</td>
</tr>
<tr>
<td>Syscall RDF Dir Count/sec</td>
<td>The number of calls per second sent via RDF to a remote system.</td>
</tr>
<tr>
<td>Slot Collisions/sec</td>
<td>The number of write misses due to the desired cache slot being locked by another request.</td>
</tr>
<tr>
<td>Queue Depth Count Range 0-9</td>
<td>As an IO enters the queue it first checks how deep the queue is. After incrementing the queue depth bucket, it increments the associated count bucket by 1. This then represents the number of IOs that encountered queues of certain depth during the past time interval. The intent of these buckets is to identify IO bursts which in turn generate large queues and long response times.</td>
</tr>
<tr>
<td>Avg Queue Depth Range 0-9</td>
<td>As an IO enters the queue it first checks how deep the queue is. Based on depth, the applicable queue depth bucket increments with the value seen by the IO. For example, an IO that encounters a queue depth of 7 will increment bucket #2 (depth 5-9 for OS or 7-14 for MF) by 7. The intent of these buckets is to identify IO bursts which in turn generate large queues and long response times.</td>
</tr>
<tr>
<td>% Busy Logical Core 0</td>
<td>The percent of time that core 0 is busy serving IOs.</td>
</tr>
<tr>
<td>Syscall Time/sec</td>
<td>Total time spent processing all system calls.</td>
</tr>
<tr>
<td>Avg RDF Write Time (ms)</td>
<td></td>
</tr>
<tr>
<td>Avg WP Disconnect Time (ms)</td>
<td></td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Avg Read Miss Time (ms)</td>
<td></td>
</tr>
<tr>
<td>Random MBs Written to non WP Slots/sec</td>
<td></td>
</tr>
<tr>
<td>Random Writes to non WP Slots/sec</td>
<td></td>
</tr>
<tr>
<td>Random MBs Written to WP Slots/sec</td>
<td></td>
</tr>
<tr>
<td>Random Writes to WP Slots/sec</td>
<td></td>
</tr>
<tr>
<td>% Busy Logical Core 1</td>
<td>The percent of time that core 1 is busy serving IOs.</td>
</tr>
<tr>
<td>% Write Req Hit</td>
<td>The percent of write requests that were satisfied from cache.</td>
</tr>
<tr>
<td>Read RT Count Range 0 to Read RT Count Range Over 64</td>
<td>These buckets show the distribution of the number of reads to the FE directors over the specified time range.</td>
</tr>
<tr>
<td>Write RT Count Range 0 to Write RT Count Range Over 64</td>
<td>These buckets show the distribution of the number of writes to the FE directors over the specified time range.</td>
</tr>
<tr>
<td>Total Read Count</td>
<td>The total number of reads to the FE directors.</td>
</tr>
<tr>
<td>Total Write Count</td>
<td>The total number of writes to the FE directors.</td>
</tr>
<tr>
<td>Read RT 0 to 1toRead RT Over 64</td>
<td>These buckets show the distribution of the total average read response time.</td>
</tr>
<tr>
<td>Write RT 0 to 1toWrite RT Over 64</td>
<td>These buckets show the distribution of the total average write response time.</td>
</tr>
<tr>
<td>Host IO Limit IOs/sec</td>
<td>The number of IOs the FE director is processing.</td>
</tr>
<tr>
<td>Host IO Limit MBs/sec</td>
<td>The number of MBs the FE port is processing.</td>
</tr>
<tr>
<td>Queue Depth Utilization</td>
<td>A weighted sum of the utilizations according to the number of IOs in each bucket. Queue depth range metrics are used in the calculation. Calculation: ( Sx=1..9 \frac{\text{Avg Queue Depth Range } X - 1}{\text{Avg Queue Depth Range } X} \times \frac{\text{Queue Depth Count Range } X}{\text{Queue Depth Count Total}} \times 100 )</td>
</tr>
<tr>
<td>CCWS Per IO</td>
<td></td>
</tr>
<tr>
<td>Avg Optimized Read Miss Size (KB)</td>
<td></td>
</tr>
<tr>
<td>Optimized MBs Read Miss/sec</td>
<td>Number of host MBs read each second directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Optimized Read Misses/sec</td>
<td>Number of read requests each second performed directly from disks bypassing the cache.</td>
</tr>
</tbody>
</table>
Table 33 FE director metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORS ASync IOs/sec</td>
<td></td>
</tr>
<tr>
<td>ORS ASync MBs/sec</td>
<td></td>
</tr>
<tr>
<td>ORS Sync MBs/sec</td>
<td></td>
</tr>
<tr>
<td>ZHPF reads</td>
<td></td>
</tr>
<tr>
<td>ZHPF Reads MBs</td>
<td></td>
</tr>
<tr>
<td>ZHPF Writes</td>
<td></td>
</tr>
<tr>
<td>ZHPF Writes MBs</td>
<td></td>
</tr>
<tr>
<td>EPL Busy</td>
<td></td>
</tr>
<tr>
<td>SPA Busy</td>
<td></td>
</tr>
</tbody>
</table>

FE Emulation metrics

The following table lists all metrics that are available for FE emulations.

Table 34 FE emulation metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Work Time</td>
<td></td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time the directory is busy.</td>
</tr>
</tbody>
</table>

FE Port metrics

The following table lists all metrics that are available for FE ports.

Table 35 FE port metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reads/sec</td>
<td>The average number of host reads performed per second.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The average number of host writes performed per second.</td>
</tr>
<tr>
<td>Host IOs/sec</td>
<td>The number of IOs the port is performing on behalf of the specific SG.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The throughput in MBs read per second.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The throughput in MBs written per second.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The number of MBs the port is processing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Speed Gb/sec</td>
<td></td>
</tr>
</tbody>
</table>
### Table 35 FE port metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Speed Gb/sec</td>
<td></td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time the port is busy.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it takes to serve one read IO.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it takes to serve one write IO.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
<tr>
<td>iSCSI Checksum Error Count</td>
<td>The percent of time that the port is busy.</td>
</tr>
</tbody>
</table>

### FE Port - FE metrics

The following table lists all metrics that are available for FE ports (FE).

#### Table 36 FE port (FE) metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IO Limit IOs/sec</td>
<td>The number of IOs the FE port is processing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit MBs/sec</td>
<td>The number of MBs the FE port is processing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit Exceeded Secs</td>
<td>The number of IOs the FE port is performing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit % Time Exceeded</td>
<td></td>
</tr>
</tbody>
</table>

### FE Port - SG metrics

The following table lists all metrics that are available for FE ports (SG).

#### Table 37 FE port (SG) metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IO Limit IOs/sec</td>
<td>The number of IOs the FE port is processing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit MBs/sec</td>
<td>The number of MBs the FE port is processing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit Exceeded Secs</td>
<td>The number of IOs the FE port is performing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit % Time Exceeded</td>
<td></td>
</tr>
</tbody>
</table>
**FICON Emulation metrics**

The following table lists all metrics that are available for FICON emulations.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time the FICON channel is busy.</td>
</tr>
</tbody>
</table>

**FICON Emulation Threads metrics**

The following table lists all metrics that are available for FICON emulation threads.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time the FICON emulation threads were busy.</td>
</tr>
<tr>
<td>% Idle</td>
<td>The percent of time the FICON emulation threads were idle.</td>
</tr>
</tbody>
</table>

**FICON Port Threads metrics**

The following table lists all metrics that are available for FICON emulations.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time the FICON port was busy.</td>
</tr>
<tr>
<td>% Idle</td>
<td>The percent of time the FICON port was idle.</td>
</tr>
</tbody>
</table>

**Host metrics**

The following table lists all metrics that are available for hosts.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The total number of host read IO and write IO operations performed each second by the host.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>The total number of host read IO operations performed each second by the host.</td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>The total number of host write IO operations performed each second by the host.</td>
</tr>
</tbody>
</table>
Table 41 Host metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host MBs/sec</td>
<td>The size of the data transfer from the host in MBs per second.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the system to serve one read IO for this host.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the system to serve one write IO for this host.</td>
</tr>
<tr>
<td>Syscall Count/sec</td>
<td>The total number of calls seen by this host.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>Cumulative number of host MBs read per second.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>Cumulative number of host MBs written per second.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
</tbody>
</table>

Host IO Limit by FE metrics

The following table lists all metrics that are available for host IO limits (by FE).

Table 42 Host IO limit (by FE) metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IO Limit IOs/sec</td>
<td>The number of IOs the FE port is processing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit MBs/sec</td>
<td>The number of MBs the FE port is processing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit Exceeded Secs</td>
<td>The number of IOs the FE port is performing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit % Time Exceeded</td>
<td></td>
</tr>
</tbody>
</table>

Host IO Limit by SG metrics

The following table lists all metrics that are available for host IO limits (by SG).

Table 43 Host IO limit (by SG) metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IO Limit IOs/sec</td>
<td>The number of IOs the FE port is processing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit MBs/sec</td>
<td>The number of MBs the FE port is processing on behalf of the specific SG.</td>
</tr>
<tr>
<td>Host IO Limit Exceeded Secs</td>
<td>The number of IOs the FE port is performing on behalf of the specific SG.</td>
</tr>
</tbody>
</table>
Table 43 Host IO limit (by SG) metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IO Limit % Time Exceeded</td>
<td></td>
</tr>
</tbody>
</table>

IM Director metrics

The following table lists all metrics that are available for IM directors.

Table 44 IM director metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time the director is busy.</td>
</tr>
<tr>
<td>Memory Page Usage</td>
<td></td>
</tr>
<tr>
<td>Memory Page Fall thru Time</td>
<td></td>
</tr>
</tbody>
</table>

IM Emulation metrics

The following table lists all metrics that are available for IM emulations.

Table 45 IM emulations metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Work Time</td>
<td></td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time the directory is busy.</td>
</tr>
</tbody>
</table>

Initiator metrics

The following table lists all metrics that are available for initiators.

Table 46 Initiator metrics

<table>
<thead>
<tr>
<th>Metrics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>A host command for data transfer.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>The number of host read operations performed each second by the initiator.</td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>The number of host write operations performed each second by the initiator.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>A cumulative number of host MBs read/writes per second.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the system to serve one read IO for this initiator.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the system to serve one write IO for this initiator.</td>
</tr>
<tr>
<td>Syscall Count/sec</td>
<td>The total number of calls seen by this initiator.</td>
</tr>
</tbody>
</table>
### Initiator metrics (continued)

<table>
<thead>
<tr>
<th>Metrics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host MBs Read/sec</td>
<td>A cumulative number of host MBs read per second.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>A cumulative number of host MBs written per second.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
</tbody>
</table>

### Initiators by Port metrics

The following table lists all metrics that are available for initiators (by port).

<table>
<thead>
<tr>
<th>Metrics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>A host command for data transfer.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>The number of host read operations performed each second by the initiator (by port).</td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>The number of host write operations performed each second by the initiator (by port).</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>A cumulative number of host MBs read/writes per second.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the system to serve one read IO for this initiator (by port).</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the system to serve one write IO for this initiator (by port).</td>
</tr>
<tr>
<td>Syscall Count/sec</td>
<td>The total number of calls seen by this initiator (by port).</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>A cumulative number of host MBs read per second.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>A cumulative number of host MBs written per second.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
</tbody>
</table>

### IP Interface metrics

The following table lists all metrics that are available for IP interfaces.
### Table 48 IP interface metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packets/sec</td>
<td></td>
</tr>
<tr>
<td>MBs/sec</td>
<td></td>
</tr>
<tr>
<td>Duplicate Acks Received/sec</td>
<td></td>
</tr>
<tr>
<td>TCP Retransmits/sec</td>
<td></td>
</tr>
<tr>
<td>Reads/sec</td>
<td>The number of read operations performed each second.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The number of write operations performed each second.</td>
</tr>
<tr>
<td>Host IOs/sec</td>
<td>The number of host operations performed each second.</td>
</tr>
<tr>
<td>Total Read Time</td>
<td>Total time spent performing reads.</td>
</tr>
<tr>
<td>Total Write Time</td>
<td>Total time spent performing writes.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
</tbody>
</table>

### iSCSI Target metrics

The following table lists all metrics that are available for iSCSI targets.

### Table 49 iSCSI target metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packets/sec</td>
<td></td>
</tr>
<tr>
<td>MBs/sec</td>
<td></td>
</tr>
<tr>
<td>Duplicate Acks Received/sec</td>
<td></td>
</tr>
<tr>
<td>TCP Retransmits/sec</td>
<td></td>
</tr>
<tr>
<td>Reads/sec</td>
<td>The number of read operations performed each second.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The number of write operations performed each second.</td>
</tr>
<tr>
<td>Host IOs/sec</td>
<td>The number of host operations performed each second.</td>
</tr>
<tr>
<td>Total Read Time</td>
<td>Total time spent performing reads.</td>
</tr>
<tr>
<td>Total Write Time</td>
<td>Total time spent performing writes.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
</tbody>
</table>
## Masking View metrics

The following table lists all metrics that are available for masking views.

**Table 50 Masking view metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The number of host operations performed each second by the masking group.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>Number of MBs per second being processed for the specific masking group.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it takes to serve one read IO.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it takes to serve one write IO.</td>
</tr>
<tr>
<td>Capacity (GB)</td>
<td>The total capacity of the masking group in GBs.</td>
</tr>
</tbody>
</table>

## Metas metrics

The following table lists all metrics that are available for metas.

**Table 51 Metas metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The total number of host read IO and write IO operations performed each second by the volume.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>The total number of host read IO operations performed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>The total number of host write IO operations performed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Hits/sec</td>
<td>The total number of host read IO and write IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Read Hits/sec</td>
<td>The total number of host read IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Write Hits/sec</td>
<td>The total number of host write IO operations performed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Host Misses/sec</td>
<td>The total number of host read IO and write IO operations missed each second</td>
</tr>
<tr>
<td></td>
<td>by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Read Misses/sec</td>
<td>The total number of host read IO operations missed each second by the</td>
</tr>
<tr>
<td></td>
<td>Symmetrix volume.</td>
</tr>
<tr>
<td>Host Write Misses/sec</td>
<td>The total number of host write IO operations missed each second by the</td>
</tr>
<tr>
<td></td>
<td>Symmetrix volume.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>A cumulative number of host MBs read/writes per second.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>A cumulative number of host MBs read per second.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>A cumulative number of host MBs written per second.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors</td>
</tr>
<tr>
<td></td>
<td>to the cache.</td>
</tr>
<tr>
<td>Parity Generation Reads</td>
<td></td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to</td>
</tr>
<tr>
<td></td>
<td>the cache.</td>
</tr>
<tr>
<td>Parity Generation Kbytes Read</td>
<td></td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>The number of write requests each second performed by the disk directors to</td>
</tr>
<tr>
<td></td>
<td>the cache.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the system to serve one read IO for this volume.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the system to serve one write IO for this volume.</td>
</tr>
<tr>
<td>Read Miss RT (ms)</td>
<td>The average time a read miss operation was performed by the volume. A miss</td>
</tr>
<tr>
<td></td>
<td>occurs when the requested data is not found in cache.</td>
</tr>
<tr>
<td>Write Miss RT (ms)</td>
<td>The average time a write miss operation was performed by the volume. A miss</td>
</tr>
<tr>
<td></td>
<td>occurs when the write operation has to wait while data is destaged from</td>
</tr>
<tr>
<td></td>
<td>cache to disks.</td>
</tr>
<tr>
<td>RDF/S Write RT (ms)</td>
<td>The average time it took the volume to serve one write IO.</td>
</tr>
<tr>
<td>% Reads</td>
<td>The percentage of IO operations that were reads.</td>
</tr>
<tr>
<td><strong>Metric</strong></td>
<td><strong>Description</strong></td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>% Writes</td>
<td>The percentage of IO operations that were writes.</td>
</tr>
<tr>
<td>% Read Hit</td>
<td>The percentage of read operations, performed by the Symmetrix volume, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Write Hit</td>
<td>The percentage of write operations, performed by the Symmetrix volume, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Read Miss</td>
<td>The percentage of read miss operations performed each second by the Symmetrix volume. A miss occurs when the requested read data is not found in cache or the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>% Write Miss</td>
<td>The percent of write miss operations performed each second by the Symmetrix volume. A miss occurs when the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode for the volume.</td>
</tr>
<tr>
<td>Seq IOs/sec</td>
<td>The number of IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Reads/sec</td>
<td>The number of read IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Writes/sec</td>
<td>The number of write IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Read Hits/sec</td>
<td>The number of sequential read operations performed each second by the Symmetrix volume that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Read Miss/sec</td>
<td>The number of sequential read operations performed each second by the Symmetrix volume that were misses.</td>
</tr>
<tr>
<td>Seq Write Hits/sec</td>
<td>The number of sequential write operations performed each second by the Symmetrix volume that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Write Misses/sec</td>
<td>The number of sequential write operations performed each second by the Symmetrix volume that were misses.</td>
</tr>
<tr>
<td>Random IOs/sec</td>
<td>The number of IOs from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Random Reads/sec</td>
<td>The number of read IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Writes/sec</td>
<td>The number of write IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Read Hits/sec</td>
<td>The number of random read IOs that were satisfied from the cache.</td>
</tr>
<tr>
<td>Random Write Hits/sec</td>
<td>The number of random write IOs that were immediately placed in cache because space was available.</td>
</tr>
<tr>
<td>Random Read Misses/sec</td>
<td>The number of random read IOs that were misses.</td>
</tr>
<tr>
<td>Random Write Misses/sec</td>
<td>The number of random write IOs that were misses.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec / total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec / total writes per sec)</td>
</tr>
<tr>
<td>% Sequential IO</td>
<td>Calculated value: 100 * (total seq IOs per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read</td>
<td>Calculated value: 100 * (seq reads per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read Hit</td>
<td>The percent of the sequential read operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Read Miss</td>
<td>The percent of the sequential read operations that were misses.</td>
</tr>
<tr>
<td>% Seq Writes</td>
<td>Calculated value: 100 * (seq writes per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Write Hit</td>
<td>The percent of the sequential write operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Write Miss</td>
<td>The percent of the sequential write operations that were misses.</td>
</tr>
<tr>
<td>% Random IO</td>
<td>The percent of IO operations that were random.</td>
</tr>
<tr>
<td>% Random Read Hit</td>
<td>Calculated value: 100 * (random read hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Read Miss</td>
<td>Calculated value: 100 * (random read misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>% Random Write Hit</td>
<td>Calculated value: 100 * (random write hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Miss</td>
<td>Calculated value: 100 * (random write misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Max WP Threshold</td>
<td>The maximum number of write-pending slots available for the Symmetrix volume.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The number of MBs read per sec + MBs written per sec.</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE Prefetched Tracks/sec</td>
<td>The total prefetched tracks each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Read Request Time (ms)</td>
<td>The average time it takes read requests from the disk directors to cache.</td>
</tr>
<tr>
<td>BE Disk Read RT (ms)</td>
<td>The average time it takes read requests from the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Task Time (ms)</td>
<td>The time from the point when the HA puts the read request on the queue and the DA picks it up - can be considered queue time.</td>
</tr>
<tr>
<td>% Random Reads</td>
<td>The percent of read operations from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Hits/sec</td>
<td>The total number of hits per second that were not sequential.</td>
</tr>
<tr>
<td>% Random Writes</td>
<td>The percent of read commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>% Hit</td>
<td>The percent of operations that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Miss</td>
<td>The percent of operations that were misses. A miss occurs when the operation cannot be immediately satisfied from cache because the data is not there or the operation has to wait while data is destaged from cache to disks.</td>
</tr>
<tr>
<td>BE % Reads</td>
<td>The percent of read operations from the back-end directors that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>BE % Writes</td>
<td>The percent of write operations from the back-end directors that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache per second.</td>
</tr>
<tr>
<td>Number of RDF Invalid Tracks</td>
<td></td>
</tr>
<tr>
<td>RDF Response Time (ms)</td>
<td></td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
<tr>
<td>BE Partial Sector Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Optimize Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Kbytes Read for Rebuild</td>
<td></td>
</tr>
<tr>
<td>BE Reads For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Writes for IVTOC</td>
<td></td>
</tr>
<tr>
<td>BE Writes For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Kbytes Written for IVTOC</td>
<td></td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy (MB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Allocated Capacity (GB)</td>
<td>The allocated capacity of the meta.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the meta.</td>
</tr>
<tr>
<td>Device Block Size</td>
<td>The block size of the volume.</td>
</tr>
<tr>
<td>XtremSW Cache Read Hits/sec</td>
<td>The cumulative number of reads that were hits by XtremSW Cache per second.</td>
</tr>
<tr>
<td>XtremSW Cache Write Hits/sec</td>
<td>The cumulative number of writes that were hits by XtremSW Cache per second.</td>
</tr>
<tr>
<td>XtremSW Cache Reads/sec</td>
<td>The average time it took XtremSW Cache to serve one read.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>XtremSW Cache Writes/sec</td>
<td>The average time it took XtremSW Cache to serve one write.</td>
</tr>
<tr>
<td>XtremSW Cache IOs/sec</td>
<td>The average time it took XtremSW Cache to serve one IO.</td>
</tr>
<tr>
<td>XtremSW Cache Skipped IOs/sec</td>
<td>The number of IOs that were skipped by XtremSW Cache per second.</td>
</tr>
<tr>
<td>XtremSW Cache Dedup Hits/sec</td>
<td>The number of XtremSW Cache Dedup hits per second.</td>
</tr>
<tr>
<td>XtremSW Cache Dedup Reads/sec</td>
<td>The number of XtremSW Cache Dedup reads per second.</td>
</tr>
<tr>
<td>XtremSW Cache Dedup Writes/sec</td>
<td>The number of XtremSW Cache Dedup writes per second.</td>
</tr>
<tr>
<td>% XtremSW Cache Reads</td>
<td>The percent of XtremSW Cache IO that were reads.</td>
</tr>
<tr>
<td>% XtremSW Cache Writes</td>
<td>The percent of XtremSW Cache IO that were writes.</td>
</tr>
<tr>
<td>% XtremSW Cache Read Hits</td>
<td>The percent of XtremSW Cache IO that were read hits.</td>
</tr>
<tr>
<td>XtremSW Cache MBs Read/sec</td>
<td>Cumulative number of host MBs read by the XtremSW Cache per second.</td>
</tr>
<tr>
<td>XtremSW Cache MBs Written/sec</td>
<td>Cumulative number of host MBs written by the XtremSW Cache per second.</td>
</tr>
<tr>
<td>XtremSW Cache MBs/sec</td>
<td>Cumulative number of host MBs read and written by the XtremSW Cache per second.</td>
</tr>
<tr>
<td>XtremSW Cache Read RT (ms)</td>
<td>The average time it took the XtremSW Cache to serve one read.</td>
</tr>
<tr>
<td>XtremSW Cache Write RT (ms)</td>
<td>The average time it took the XtremSW Cache to serve one write.</td>
</tr>
<tr>
<td>XtremSW Cache RT (ms)</td>
<td>The average time it took the XtremSW Cache to serve one IO.</td>
</tr>
<tr>
<td>XtremSW Cache Avg Read Size (KB)</td>
<td>The average size of a read served by XtremSW Cache.</td>
</tr>
<tr>
<td>XtremSW Cache Avg Write Size (KB)</td>
<td>The average size of a write served by XtremSW Cache.</td>
</tr>
<tr>
<td>XtremSW Cache Avg IO Size (KB)</td>
<td>The average size of an IO served by XtremSW Cache.</td>
</tr>
<tr>
<td>Optimized Read Misses/sec</td>
<td>Number of read requests each second performed directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Optimized MBs Read Miss/sec</td>
<td>Number of host megabytes read each second directly from disks bypassing the cache.</td>
</tr>
</tbody>
</table>
Table 51 Metas metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg Optimized Read Miss Size (KB)</td>
<td></td>
</tr>
<tr>
<td>Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>Avg. Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>RDF Reads/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Writes/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Read/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Written/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Read Hits/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Rewrites/sec</td>
<td></td>
</tr>
</tbody>
</table>

Other - Pool Bound Volume metrics

The following table lists all metrics that are available for pool-bound volumes.

Table 52 Pool-bound volumes metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The total number of host read IO and write IO operations performed each second by the volume.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>The total number of host read IO operations performed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>The total number of host write IO operations performed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Hits/sec</td>
<td>The total number of host read IO and write IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Read Hits/sec</td>
<td>The total number of host read IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Write Hits/sec</td>
<td>The total number of host write IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Misses/sec</td>
<td>The total number of host read IO and write IO operations missed each second by the Symmetrix volume.</td>
</tr>
</tbody>
</table>
### Table 52 Pool-bound volumes metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host Read Misses/sec</td>
<td>The total number of host read IO operations missed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Write Misses/sec</td>
<td>The total number of host write IO operations missed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>A cumulative number of host MBs read/writes per second.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>A cumulative number of host MBs read per second.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>A cumulative number of host MBs written per second.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>Parity Generation Reads</td>
<td>The number of read requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>Parity Generation Kbytes Read</td>
<td>The number of write requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the system to serve one read IO for this volume.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the system to serve one write IO for this volume.</td>
</tr>
<tr>
<td>Read Miss RT (ms)</td>
<td>The average time a read miss operation was performed by the volume. A miss occurs when the requested data is not found in cache.</td>
</tr>
<tr>
<td>Write Miss RT (ms)</td>
<td>The average time a write miss operation was performed by the volume. A miss occurs when the write operation has to wait while data is destaged from cache to disks.</td>
</tr>
<tr>
<td>RDF/S Write RT (ms)</td>
<td>The average time it took the volume to serve one write IO.</td>
</tr>
<tr>
<td>% Reads</td>
<td>The percentage of IO operations that were reads.</td>
</tr>
<tr>
<td>% Writes</td>
<td>The percentage of IO operations that were writes.</td>
</tr>
<tr>
<td>% Read Hit</td>
<td>The percentage of read operations, performed by the Symmetrix volume, that were immediately satisfied by cache.</td>
</tr>
</tbody>
</table>
### Table 52 Pool-bound volumes metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Write Hit</td>
<td>The percentage of write operations, performed by the Symmetrix volume, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Read Miss</td>
<td>The percentage of read miss operations performed each second by the Symmetrix volume. A miss occurs when the requested read data is not found in cache or the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>% Write Miss</td>
<td>The percent of write miss operations performed each second by the Symmetrix volume. A miss occurs when the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode for the volume.</td>
</tr>
<tr>
<td>Seq IOs/sec</td>
<td>The number of IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Reads/sec</td>
<td>The number of read IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Writes/sec</td>
<td>The number of write IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Read Hits/sec</td>
<td>The number of sequential read operations performed each second by the Symmetrix volume that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Read Miss/sec</td>
<td>The number of sequential read operations performed each second by the Symmetrix volume that were misses.</td>
</tr>
<tr>
<td>Seq Write Hits/sec</td>
<td>The number of sequential write operations performed each second by the Symmetrix volume that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Write Misses/sec</td>
<td>The number of sequential write operations performed each second by the Symmetrix volume that were misses.</td>
</tr>
<tr>
<td>Random IOs/sec</td>
<td>The number of IOs from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Reads/sec</td>
<td>The number of read IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Writes/sec</td>
<td>The number of write IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Random Read Hits/sec</td>
<td>The number of random read IOs that were satisfied from the cache.</td>
</tr>
<tr>
<td>Random Write Hits/sec</td>
<td>The number of random write IOs that were immediately placed in cache because space was available.</td>
</tr>
<tr>
<td>Random Read Misses/sec</td>
<td>The number of random read IOs that were misses.</td>
</tr>
<tr>
<td>Random Write Misses/sec</td>
<td>The number of random write IOs that were misses.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec / total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec / total writes per sec)</td>
</tr>
<tr>
<td>% Sequential IO</td>
<td>Calculated value: 100 * (total seq IOs per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read</td>
<td>Calculated value: 100 * (seq reads per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read Hit</td>
<td>The percent of the sequential read operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Read Miss</td>
<td>The percent of the sequential read operations that were misses.</td>
</tr>
<tr>
<td>% Seq Writes</td>
<td>Calculated value: 100 * (seq writes per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Write Hit</td>
<td>The percent of the sequential write operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Write Miss</td>
<td>The percent of the sequential write operations that were misses.</td>
</tr>
<tr>
<td>% Random IO</td>
<td>The percent of IO operations that were random.</td>
</tr>
<tr>
<td>% Random Read Hit</td>
<td>Calculated value: 100 * (random read hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Read Miss</td>
<td>Calculated value: 100 * (random read misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Hit</td>
<td>Calculated value: 100 * (random write hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Miss</td>
<td>Calculated value: 100 * (random write misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Max WP Threshold</td>
<td>The maximum number of write-pending slots available for the Symmetrix volume.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The number of MBs read per sec + MBs written per sec.</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE Prefetched Tracks/sec</td>
<td>The total prefetched tracks each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Read Request Time (ms)</td>
<td>The average time it takes read requests from the disk directors to cache.</td>
</tr>
<tr>
<td>BE Disk Read RT (ms)</td>
<td>The average time it takes read requests from the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Task Time (ms)</td>
<td>The time from the point when the HA puts the read request on the queue and the DA picks it up - can be considered queue time.</td>
</tr>
<tr>
<td>% Random Reads</td>
<td>The percent of read commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Hits/sec</td>
<td>The total number of hits per second that were not sequential.</td>
</tr>
<tr>
<td>% Random Writes</td>
<td>The percent of write commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>% Hit</td>
<td>The percent of operations that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Miss</td>
<td>The percent of operations that were misses. A miss occurs when the operation cannot be immediately satisfied from cache because the data is not there or the operation has to wait while data is destaged from cache to disks.</td>
</tr>
<tr>
<td>BE % Reads</td>
<td>The percent of read operations from the back-end directors that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>BE % Writes</td>
<td>The percent of write operations from the back-end directors that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache per second.</td>
</tr>
<tr>
<td>Number of RDF Invalid Tracks</td>
<td></td>
</tr>
<tr>
<td>RDF Response Time (ms)</td>
<td></td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
</tbody>
</table>
Table 52 Pool-bound volumes metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Partial Sector Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Optimize Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Reads for Rebuild</td>
<td></td>
</tr>
<tr>
<td>Kbytes Read for Rebuild</td>
<td></td>
</tr>
<tr>
<td>BE Reads For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Writes for IVTOC</td>
<td></td>
</tr>
<tr>
<td>BE Writes For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Kbytes Written for IVTOC</td>
<td></td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy (MB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Allocated Capacity (GB)</td>
<td>The allocated pool capacity in GBs.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the pool in GBs.</td>
</tr>
<tr>
<td>Device Block Size</td>
<td>The block size of the volume.</td>
</tr>
<tr>
<td>Optimized Read Misses/sec</td>
<td>Number of read requests each second performed directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Optimized MBs Read Miss/sec</td>
<td>Number of host MBs read each second directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Avg Optimized Read Miss Size (KB)</td>
<td></td>
</tr>
<tr>
<td>Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>Avg. Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>RDF Reads/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Writes/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Read/sec</td>
<td></td>
</tr>
</tbody>
</table>
Table 52 Pool-bound volumes metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDF MBs Written/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Read Hits/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Rewrites/sec</td>
<td></td>
</tr>
</tbody>
</table>

Pool by Storage Group metrics

The following table lists all metrics that are available for pools by storage group.

Table 53 Pool by storage group metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Reqs/sec</td>
<td>The number of data transfers between cache and the pool by storage group.</td>
</tr>
<tr>
<td>Allocated Capacity</td>
<td>The allocated capacity for the pool by storage group in GBs.</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk. (BE Reads + destaged writes) / capacity</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>A data transfer of a read between the cache and the director.</td>
</tr>
<tr>
<td>Destage Writes/sec</td>
<td>The number of writes per second that were destaged to disk.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>Calculated value: (MBs read per sec + MBs written per sec)</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>Destage Write MBs/sec</td>
<td>The size (MBs) of writes per second that were destaged to disk.</td>
</tr>
<tr>
<td>Prefetched Tracks/sec</td>
<td>The number of tracks per second prefetched from disk to cache upon detection of a sequential read stream.</td>
</tr>
<tr>
<td>Pretetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>Allocated Tracks</td>
<td>The number of allocated tracks in the pool.</td>
</tr>
<tr>
<td>Compressed Tracks</td>
<td>The number of compressed tracks (applies only to storage systems running Enginuity OS 5876).</td>
</tr>
<tr>
<td>% Compressed Tracks</td>
<td>The percent of the total tracks that are compressed (applies only to storage systems running Enginuity OS 5876).</td>
</tr>
<tr>
<td>Local Replication Tracks</td>
<td></td>
</tr>
</tbody>
</table>
Port Group metrics

The following table lists all metrics that are available for port groups.

**Table 54 Port group metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reads/sec</td>
<td>The average number of host reads performed per second.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The average number of host writes performed per second.</td>
</tr>
<tr>
<td>Host IOs/sec</td>
<td>The number of host IO operations performed each second, including writes and random and sequential reads.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The number of reads per second in MBs.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The number of writes per second in MBs.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The number of host MBs read each second.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time the port group is busy.</td>
</tr>
</tbody>
</table>

RDF Director metrics

The following table lists all metrics that are available for RDF directors.

**Table 55 RDF director metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time the directory is busy.</td>
</tr>
<tr>
<td>IOs/sec</td>
<td>The average IO count per second for the director.</td>
</tr>
<tr>
<td>Avg IO Service Time (ms)</td>
<td>The average time the director takes to serve IO.</td>
</tr>
<tr>
<td>Write Reqs/sec</td>
<td>The write requests per second.</td>
</tr>
<tr>
<td>MBs Sent and Received/sec</td>
<td>The total read and write MBs on the RDF director per second.</td>
</tr>
<tr>
<td>MBs Sent/sec</td>
<td>The size of the host data transfer in MBs for the director.</td>
</tr>
<tr>
<td>MBs Received/sec</td>
<td>The size of the data received in MBs for the director.</td>
</tr>
<tr>
<td>Avg IO Size Received (KB)</td>
<td>Calculated value: (MBs received per sec / reads per sec)</td>
</tr>
<tr>
<td>Avg IO Size Sent (KB)</td>
<td>Calculated value: (MBs sent per sec / writes per sec)</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Syscall Count/sec</td>
<td>The total number of calls seen by this director.</td>
</tr>
<tr>
<td>Syscall Time/sec</td>
<td>The time to satisfy the calls by this director.</td>
</tr>
<tr>
<td>Syscall Remote Dir Count/sec</td>
<td>The number of calls sent from the local director to another director in the same system.</td>
</tr>
<tr>
<td>Syscall RDF Dir Count/sec</td>
<td>The number of calls sent via RDF to a remote system.</td>
</tr>
<tr>
<td>Avg Time per Syscall</td>
<td>Calculated value: (syscall time / syscall count)</td>
</tr>
<tr>
<td>Rewrites/sec</td>
<td></td>
</tr>
<tr>
<td>Tracks Received/sec</td>
<td>The number of tracks received by this director per second.</td>
</tr>
<tr>
<td>Tracks Sent/sec</td>
<td>The number of tracks sent by this director per second.</td>
</tr>
<tr>
<td>Copy IOs/sec</td>
<td>The number of copy IOs per second via this RDF director. Copy is a generic SRDF term meaning a full track that comes from background data movement. These copies can be generated by a number of different things, including if the RDF device is in adaptive copy mode. Adaptive copy is included in this term, but not exclusively. For example, if SRDF is suspended, hosts continue to write to the R1 and then SRDF is resumed, the resulting R1-&gt;R2 copy of tracks (due to invalids) is a &quot;copy.&quot;</td>
</tr>
<tr>
<td>Copy MBs/sec</td>
<td>The throughput of copy MBs per second via this RDF director.</td>
</tr>
<tr>
<td>Sync Write Reqs/sec</td>
<td>The number of sync write requests managed by this RDF director per second.</td>
</tr>
<tr>
<td>Sync MBs Sent/sec</td>
<td>The number of sync MBs sent per second via this RDF director.</td>
</tr>
<tr>
<td>Async Write Reqs/sec</td>
<td>The number of async write requests managed by this RDF director per second.</td>
</tr>
<tr>
<td>Async MBs Sent/sec</td>
<td>The number of async MBs sent per second via this RDF director.</td>
</tr>
<tr>
<td>% Compressed MBs Sent and Received/sec</td>
<td>Calculated value: ((Compressed MBs Sent and Received/sec / MBs Sent and Received/sec) * 100)</td>
</tr>
<tr>
<td>% Compressed MBs Received/sec</td>
<td>Calculated value: ((Compressed MBs Received/sec / MBs Received/sec) * 100)</td>
</tr>
</tbody>
</table>

**Table 55 RDF director metrics (continued)**
Table 55 RDF director metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Compressed MBs Sent/sec</td>
<td>Calculated value: ((Compressed MBs Sent/sec / MBs Sent/sec) * 100)</td>
</tr>
<tr>
<td>Compressed MBs Sent and Received/sec</td>
<td>The number of compressed MBs sent and received by this RDF director.</td>
</tr>
<tr>
<td>Compressed MBs Received/sec</td>
<td>The number of compressed MBs/sec received by this RDF director.</td>
</tr>
<tr>
<td>Compressed MBs Sent/sec</td>
<td>The number of compressed MBs/sec sent by this RDF director.</td>
</tr>
<tr>
<td>Number of Compressed Links</td>
<td>The number of compressed links used by this RDF director.</td>
</tr>
<tr>
<td>Number of Links</td>
<td>The number of links used by this RDF director.</td>
</tr>
<tr>
<td>Reqs/sec</td>
<td>The average number of requests performed by the director per second.</td>
</tr>
</tbody>
</table>

**RDF Emulation metrics**

The following table lists all metrics that are available for RDF emulations.

Table 56 RDF emulation metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Work Time</td>
<td></td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time that a director is busy.</td>
</tr>
</tbody>
</table>

**RDF Port metrics**

The following table lists all metrics that are available for RDF ports.

Table 57 RDF port metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reads/sec</td>
<td>The number of read operations performed by the port per second.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The number of write operations performed by the port per second.</td>
</tr>
<tr>
<td>Host IOs/sec</td>
<td>The number of host operations performed each second by the port.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The read throughput (MBs) of the port per second.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The write throughput (MBs) of the port per second.</td>
</tr>
</tbody>
</table>
Table 57 RDF port metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host MBs/sec</td>
<td>The size of the data transfer from the host in MBs per second.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Speed Gb/sec</td>
<td></td>
</tr>
<tr>
<td>Max Speed Gb/sec</td>
<td></td>
</tr>
<tr>
<td>% Busy</td>
<td>The percent of time that the port is busy.</td>
</tr>
</tbody>
</table>

RDF/A Group metrics

The following table lists all metrics that are available for RDF/A groups.

Table 58 RDF/A group metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg Cycle Time</td>
<td>The mean time (in seconds) of the last 16 cycles. (Calculated as true averages- e.g. if only 8 cycles have occurred, the average represents those 8 cycles only.)</td>
</tr>
<tr>
<td>RDF Reads/sec</td>
<td></td>
</tr>
<tr>
<td>Avg Cycle Size</td>
<td>The average size of all the cycles in RDFA sessions.</td>
</tr>
<tr>
<td>Avg IO Service Time (ms)</td>
<td>The average time the director takes to serve IO.</td>
</tr>
<tr>
<td>RDF Writes/sec</td>
<td></td>
</tr>
<tr>
<td>Duration of Last Cycle</td>
<td>The cycle time (in seconds) of the most recently completed cycle. It should be noted that in a regular case the cycles switch every ~30 sec, however, in most cases the collection interval is in minutes, which means some cycle times will be skipped. This an important counter to look at to figure out if SRDF/A is working as expected.</td>
</tr>
<tr>
<td>Total HA Writes/sec</td>
<td>The total host adapter writes, measured in write commands to SRDF/A volumes only.</td>
</tr>
<tr>
<td>Total HA Repeat Writes/sec</td>
<td>The total number of writes to a slot already in the active cycle. Total host adapter repeat writes, measured in write commands to SRDF/A volumes only. This counter helps estimate the cache locality of reference, i.e., how much cache is saved by the re-writes. This does not give any indication to the bandwidth locality of reference.</td>
</tr>
</tbody>
</table>
Table 58 RDF/A group metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDF R1 to R2 IOs/sec</td>
<td>The number of IOs/sec being transmitted across the links for this session.</td>
</tr>
<tr>
<td>RDF R1 to R2 MBs/sec</td>
<td>The MB/sec being transmitted across the links for this session.</td>
</tr>
<tr>
<td>RDF R2 to R1 IOs/sec</td>
<td>The number of IOs/sec being transmitted across the links for this session.</td>
</tr>
<tr>
<td>RDF R2 to R1 MBs/sec</td>
<td>The MB/sec being transmitted across the links for this session.</td>
</tr>
<tr>
<td>System WP Limit</td>
<td>The maximum number of write-pending slots for the entire storage system.</td>
</tr>
<tr>
<td>System WP Count</td>
<td>The number of system cache slots that are write pending.</td>
</tr>
<tr>
<td>Local WP Count</td>
<td>The number of write pending slots waiting to be de-staged to disk. On the R1 - should be less than or equal to the system write pending count.</td>
</tr>
<tr>
<td>RDF/A WP Count</td>
<td>The number of RDF/A writes pending.</td>
</tr>
<tr>
<td>DSE Used Tracks</td>
<td>The active cycle spilled count plus the inactive cycle spilled count.</td>
</tr>
<tr>
<td>Reads/sec</td>
<td>The number of tracks read from the R2 (host reads + copy).</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The total amount of data read from the R2 in MBs+G5.</td>
</tr>
<tr>
<td>Time Since Last Switch</td>
<td>The time (in seconds) since the last switch from active to inactive or vice versa. Since in a regular case the cycles switch every ~30 sec and the samples are taken every few minutes, this counter may not show very significant data, however, when cycles elongate beyond the sample time, this counter can help indicate an estimate of the R1 to R1 lag time.</td>
</tr>
<tr>
<td>Active Cycle Size</td>
<td>The count of cache slots that measures the amount of data captured (on the R1 side) or received (on the R2 side).</td>
</tr>
<tr>
<td>Inactive Cycle Size</td>
<td>The count of cache slots that measures the amount of data transmitted (on the R1 side) or applied (on the R2 side).</td>
</tr>
<tr>
<td>RDF/A Session Indicator</td>
<td>Indicates if group is RDFA (0/1).</td>
</tr>
<tr>
<td>RDF/A Active Indicator</td>
<td>Indicates if RDF/A group is active (0/1).</td>
</tr>
<tr>
<td>Cycle Number</td>
<td>The active cycle number identifier for the given SRDF/A session. In a regular case, the</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>R1 to R2 Lag Time</td>
<td>The time that R2 is behind R1 (RPO). This is calculated as the last cycle time plus the time since last switch. In a regular case, the cycles switch every ~30 sec and the samples are taken every few minutes, therefore this counter may not show very significant data, however, when cycles elongate beyond the sample time, this counter can help indicate an estimate of the RPO.</td>
</tr>
<tr>
<td>Num Devs in Session</td>
<td>The number of storage volumes defined in this session.</td>
</tr>
<tr>
<td>R2 Last Restore Time</td>
<td>The time, in seconds, that the restore of the last active cycle took to complete. The restore is an operation done by the DA and RA to mark the tracks in the apply cycle as Write Pending to the local drives. This operation is usually a very quick cache operation, unless one of the volumes reaches its WP limit. The importance of this counter is that is shows one of the common reasons for an increase in the cycle time.</td>
</tr>
<tr>
<td>DSE Threshold</td>
<td>The percent of write pendings before DSE activates.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The number of write requests to the RDF director per second.</td>
</tr>
<tr>
<td>Session Number</td>
<td>The number of the SRDF/A session.</td>
</tr>
<tr>
<td>Uncommitted Tracks</td>
<td>The number of tracks for all the SRDF/A volumes in the session that have not been committed to the R2 volume.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The number of MBs written per second for the SRDF/A session.</td>
</tr>
<tr>
<td>Read Hits/sec</td>
<td>The total number of read operations that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Number of RDF Invalid Tracks</td>
<td></td>
</tr>
<tr>
<td>RDF Response Time (ms)</td>
<td></td>
</tr>
<tr>
<td>Spillover Packed Slots</td>
<td></td>
</tr>
<tr>
<td>Number of Links</td>
<td>The number of links used by this RDF/A group.</td>
</tr>
</tbody>
</table>
Table 58 RDF/A group metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Compressed Links</td>
<td>The number of compressed links used by this RDF/A group.</td>
</tr>
<tr>
<td>Compressed MBs Received/sec</td>
<td>The number of compressed MBs/sec received by this RDF/A group.</td>
</tr>
<tr>
<td>Compressed MBs Sent/sec</td>
<td>The number of compressed MBs/sec sent by this RDF/A group.</td>
</tr>
<tr>
<td>Compressed MBs Sent and Received/sec</td>
<td>The number of compressed MBs sent and received by this RDF/A group.</td>
</tr>
<tr>
<td>% Compressed MBs Received</td>
<td>Calculated value: ((Compressed MBs Received/sec / MBs Received/sec) * 100)</td>
</tr>
<tr>
<td>% Compressed MBs Sent</td>
<td>Calculated value: ((Compressed MBs Sent/sec / MBs Sent/sec) * 100)</td>
</tr>
<tr>
<td>% Compressed MBs Sent and Received</td>
<td>Calculated value: ((Compressed MBs Sent and Received/sec / MBs Sent and Received/sec) * 100)</td>
</tr>
<tr>
<td>RDF Rewrites/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Written/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Read/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Read Hits/sec</td>
<td></td>
</tr>
<tr>
<td>Total Tracks Spilled Back</td>
<td></td>
</tr>
<tr>
<td>Total Tracks Spilled Over</td>
<td></td>
</tr>
<tr>
<td>Total Tracks Spilled Over Used</td>
<td></td>
</tr>
</tbody>
</table>

RDF/S Group metrics

The following table lists all metrics that are available for RDF/S groups.

Table 59 RDF/S group metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The number of host operations performed each second by the RDF/S Group.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>Host read operations performed each second by the group.</td>
</tr>
<tr>
<td>RDF Reads/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Writes/sec</td>
<td></td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>The number of host write operations performed each second by the group.</td>
</tr>
</tbody>
</table>
Table 59 RDF/S group metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host Hits/sec</td>
<td>The number of host read/write operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Host Read Hits/sec</td>
<td>The number of host read operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Host Write Hits/sec</td>
<td>The number of host write operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Host Misses/sec</td>
<td>The number of host read/write operations performed each second by the group that could not be satisfied from cache.</td>
</tr>
<tr>
<td>Host Read Misses/sec</td>
<td>The number of host read operations performed each second by the group that were not satisfied from cache.</td>
</tr>
<tr>
<td>Host Write Misses/sec</td>
<td>The number of host write operations performed each second by the group that were not satisfied from cache.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The cumulative number of host MBs read/writes per second by the group.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>The cumulative number of host MBs read per second by the group.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>The cumulative number of host MBs written per second by the group.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>The number of write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time that it took the Symmetrix to serve one read IO for this group.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time that it took the Symmetrix to serve one write IO for this group.</td>
</tr>
<tr>
<td>Read Miss RT (ms)</td>
<td>The average time that it took the Symmetrix to serve one read miss IO for this group.</td>
</tr>
<tr>
<td>Write Miss RT (ms)</td>
<td>The average time that it took the Symmetrix to serve one write miss IO for this group.</td>
</tr>
</tbody>
</table>
### Table 59 RDF/S group metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDF/S Write RT (ms)</td>
<td>A summary of the read, write, and average response times for the selected SRDF/S group.</td>
</tr>
<tr>
<td>% Reads</td>
<td>The percent of IO operations that were reads.</td>
</tr>
<tr>
<td>% Writes</td>
<td>The percent of IO operations that were writes.</td>
</tr>
<tr>
<td>% Read Hit</td>
<td>The percent of read operations, performed by the group, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Write Hit</td>
<td>The percent of write operations, performed by the group, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Read Miss</td>
<td>The percent of read miss operations performed each second by the group. A miss occurs when the requested read data is not found in cache.</td>
</tr>
<tr>
<td>% Write Miss</td>
<td>The percent of write miss operations performed each second by the group. A miss occurs when the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode for the group.</td>
</tr>
<tr>
<td>Seq IOs/sec</td>
<td>Number of IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Reads/sec</td>
<td>Number of read IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Writes/sec</td>
<td>Number of write IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Read Hits/sec</td>
<td>Number of sequential read operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Read Miss/sec</td>
<td>Number of sequential read operations performed each second by the group that were misses.</td>
</tr>
<tr>
<td>Seq Write Hits/sec</td>
<td>Number of sequential write operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Write Misses/sec</td>
<td>Number of sequential write operations performed each second by the group that were misses.</td>
</tr>
<tr>
<td>Random IOs/sec</td>
<td>IOs from a host not identified as part of a sequential stream. Adam</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Random Reads/sec</td>
<td>Read IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Writes/sec</td>
<td>Write IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Read Hits/sec</td>
<td>Random read IOs that were satisfied from the cache.</td>
</tr>
<tr>
<td>Random Write Hits/sec</td>
<td>Random write IOs that were immediately placed in cache because space was available.</td>
</tr>
<tr>
<td>Random Read Misses/sec</td>
<td>Random read IOs that were misses.</td>
</tr>
<tr>
<td>Random Write Misses/sec</td>
<td>Random write IOs that were misses.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec / total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec / total writes per sec)</td>
</tr>
<tr>
<td>% Sequential IO</td>
<td>Calculated value: 100 * (total seq IOs per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read</td>
<td>Calculated value: 100 * (seq reads per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read Hit</td>
<td>The percent of the sequential read operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Read Miss</td>
<td>The percent of the sequential read operations that were misses.</td>
</tr>
<tr>
<td>% Seq Writes</td>
<td>Calculated value: 100 * (seq writes per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Write Hit</td>
<td>The percent of the sequential write operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Write Miss</td>
<td>The percent of the sequential write operations that were misses.</td>
</tr>
<tr>
<td>% Random IO</td>
<td>The percent of IO operations that were random.</td>
</tr>
<tr>
<td>% Random Write Miss</td>
<td>Calculated value: 100 * (random write misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Read Hit</td>
<td>Calculated value: 100 * (random read hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Read Miss</td>
<td>Calculated value: 100 * (random read misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Hit</td>
<td>Calculated value: 100 * (random write hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Max WP Threshold</td>
<td>The maximum number of write-pending slots available for the group.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>Calculated value: (MBs read per sec + MBs written per sec)</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE Prefetched Tracks/sec</td>
<td>The total prefetched tracks each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Read Request Time (ms)</td>
<td>The average time it takes to make a request by the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Disk Read RT (ms)</td>
<td>The average time it takes cache to respond to a read request by the disk directors.</td>
</tr>
<tr>
<td>BE Read Task Time (ms)</td>
<td>The time from the point when the HA puts the read request on the queue and the DA picks it up; this can be considered queue time.</td>
</tr>
<tr>
<td>% Hit</td>
<td>The percent of IO operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Miss</td>
<td>The percent of IO operations that were misses.</td>
</tr>
<tr>
<td>% Random Reads</td>
<td>The percent of all read IOs that were random.</td>
</tr>
<tr>
<td>% Random Writes</td>
<td>The percent of all write IOs that were random.</td>
</tr>
<tr>
<td>BE % Reads</td>
<td>The percent of the back-end IO that were read requests.</td>
</tr>
<tr>
<td>BE % Writes</td>
<td>The percent of the back-end IO that were write requests.</td>
</tr>
<tr>
<td>RDF Response Time (ms)</td>
<td>The average time it takes to satisfy IO requests.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average time it takes to satisfy IO requests.</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of partial sector writes by the disk directors.</td>
</tr>
<tr>
<td>BE Partial Sector Writes (KB)</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
<tr>
<td>BE Optimize Writes (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE XOR Reads</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE XOR Read (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric</td>
</tr>
</tbody>
</table>
Table 59 RDF/S group metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Writes For Copy</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE Writes For Rebuild (KB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE RDF Copy</td>
<td>Internal metric</td>
</tr>
<tr>
<td>BE RDF Copy (MB)</td>
<td>Internal metric</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the device group.</td>
</tr>
<tr>
<td>Device Block Size</td>
<td>The block size of the volume.</td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>RDF MBs Read/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Read Hits/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Written/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Rewrites/sec</td>
<td></td>
</tr>
<tr>
<td>Spillover Packed Slots</td>
<td></td>
</tr>
<tr>
<td>Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>Avg. Write Paced Delay (ms)</td>
<td></td>
</tr>
</tbody>
</table>

SAVE Volume metrics

The following table lists all metrics that are available for SAVE volumes.

Table 60 SAVE volume metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The total number of host read IO and write IO operations performed each second by the volume.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>The total number of host read IO operations performed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>The total number of host write IO operations performed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Hits/sec</td>
<td>The total number of host read IO and write IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Read Hits/sec</td>
<td>The total number of host read IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Write Hits/sec</td>
<td>The total number of host write IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Misses/sec</td>
<td>The total number of host read IO and write IO operations missed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Read Misses/sec</td>
<td>The total number of host read IO operations missed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Write Misses/sec</td>
<td>The total number of host write IO operations missed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>A cumulative number of host MBs read/writes per second.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>A cumulative number of host MBs read per second.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>A cumulative number of host MBs written per second.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>Parity Generation Reads</td>
<td></td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>Parity Generation Kbytes Read</td>
<td></td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>The number of write requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the system to serve one read IO for this volume.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the system to serve one write IO for this volume.</td>
</tr>
<tr>
<td>Read Miss RT (ms)</td>
<td>The average time a read miss operation was performed by the volume. A miss occurs when the requested data is not found in cache.</td>
</tr>
<tr>
<td>Write Miss RT (ms)</td>
<td>The average time a write miss operation was performed by the volume. A miss occurs when the write operation has to wait while data is destaged from cache to disks.</td>
</tr>
<tr>
<td>RDF/S Write RT (ms)</td>
<td>The average time it took the volume to serve one write IO.</td>
</tr>
<tr>
<td>% Reads</td>
<td>The percentage of IO operations that were reads.</td>
</tr>
<tr>
<td>% Writes</td>
<td>The percentage of IO operations that were writes.</td>
</tr>
<tr>
<td>% Read Hit</td>
<td>The percentage of read operations, performed by the Symmetrix volume, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Write Hit</td>
<td>The percentage of write operations, performed by the Symmetrix volume, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Read Miss</td>
<td>The percentage of read miss operations performed each second by the Symmetrix volume. A miss occurs when the requested read data is not found in cache or the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>% Write Miss</td>
<td>The percent of write miss operations performed each second by the Symmetrix volume. A miss occurs when the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode for the volume.</td>
</tr>
<tr>
<td>Seq IOs/sec</td>
<td>The number of IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Reads/sec</td>
<td>The number of read IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Writes/sec</td>
<td>The number of write IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Read Hits/sec</td>
<td>The number of sequential read operations performed each second by the Symmetrix</td>
</tr>
</tbody>
</table>
Table 60 SAVE volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seq Read Miss/sec</td>
<td>The number of sequential read operations performed each second by the Symmetrix volume that were misses.</td>
</tr>
<tr>
<td>Seq Write Hits/sec</td>
<td>The number of sequential write operations performed each second by the Symmetrix volume that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Write Misses/sec</td>
<td>The number of sequential write operations performed each second by the Symmetrix volume that were misses.</td>
</tr>
<tr>
<td>Random IOs/sec</td>
<td>The number of IOs from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Reads/sec</td>
<td>The number of read IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Writes/sec</td>
<td>The number of write IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Read Hits/sec</td>
<td>The number of random read IOs that were satisfied from the cache.</td>
</tr>
<tr>
<td>Random Write Hits/sec</td>
<td>The number of random write IOs that were immediately placed in cache because space was available.</td>
</tr>
<tr>
<td>Random Read Misses/sec</td>
<td>The number of random read IOs that were misses.</td>
</tr>
<tr>
<td>Random Write Misses/sec</td>
<td>The number of random write IOs that were misses.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec / total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec / total writes per sec)</td>
</tr>
<tr>
<td>% Sequential IO</td>
<td>Calculated value: 100 * (total seq IOs per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read</td>
<td>Calculated value: 100 * (seq reads per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read Hit</td>
<td>The percent of the sequential read operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Read Miss</td>
<td>The percent of the sequential read operations that were misses.</td>
</tr>
</tbody>
</table>
### Table 60 SAVE volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Seq Writes</td>
<td>Calculated value: 100 * (seq writes per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Write Hit</td>
<td>The percent of the sequential write operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Write Miss</td>
<td>The percent of the sequential write operations that were misses.</td>
</tr>
<tr>
<td>% Random IO</td>
<td>The percent of IO operations that were random.</td>
</tr>
<tr>
<td>% Random Read Hit</td>
<td>Calculated value: 100 * (random read hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Read Miss</td>
<td>Calculated value: 100 * (random read misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Hit</td>
<td>Calculated value: 100 * (random write hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Miss</td>
<td>Calculated value: 100 * (random write misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Max WP Threshold</td>
<td>The maximum number of write-pending slots available for the Symmetrix volume.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The number of MBs read per sec + MBs written per sec.</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE Prefetched Tracks/sec</td>
<td>The total prefetched tracks each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Read Request Time (ms)</td>
<td>The average time it takes read requests from the disk directors to cache.</td>
</tr>
<tr>
<td>BE Disk Read RT (ms)</td>
<td>The average time it takes read requests from the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Task Time (ms)</td>
<td>The time from the point when the HA puts the read request on the queue and the DA picks it up - can be considered queue time.</td>
</tr>
<tr>
<td>% Random Reads</td>
<td>The percent of read commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Hits/sec</td>
<td>The total number of hits per second that were not sequential.</td>
</tr>
<tr>
<td>% Random Writes</td>
<td>The percent of write commands from a host not identified as part of a sequential stream.</td>
</tr>
</tbody>
</table>
### Table 60 SAVE volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Hit</td>
<td>The percent of operations that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Miss</td>
<td>The percent of operations that were misses. A miss occurs when the operation cannot be immediately satisfied from cache because the data is not there or the operation has to wait while data is destaged from cache to disks.</td>
</tr>
<tr>
<td>BE % Reads</td>
<td>The percent of read operations from the back-end directors that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>BE % Writes</td>
<td>The percent of write operations from the back-end directors that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache per second.</td>
</tr>
<tr>
<td>Number of RDF Invalid Tracks</td>
<td></td>
</tr>
<tr>
<td>RDF Response Time (ms)</td>
<td></td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
<tr>
<td>BE Partial Sector Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Optimize Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Reads for Rebuild</td>
<td></td>
</tr>
<tr>
<td>Kbytes Read for Rebuild</td>
<td></td>
</tr>
<tr>
<td>BE Reads For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Writes for IVTOC</td>
<td></td>
</tr>
<tr>
<td>BE Writes For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Kbytes Written for IVTOC</td>
<td></td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy</td>
<td>Internal metric.</td>
</tr>
</tbody>
</table>
### Table 60 SAVE volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE RDF Copy (MB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Allocated Capacity (GB)</td>
<td>The allocated volume capacity in GBs.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the volume in GBs.</td>
</tr>
<tr>
<td>Device Block Size</td>
<td>The block size of the volume.</td>
</tr>
<tr>
<td>Optimized Read Misses/sec</td>
<td>Number of read requests each second performed directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Optimized MBs Read Miss/sec</td>
<td>Number of host MBs read each second directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Avg Optimized Read Miss Size (KB)</td>
<td></td>
</tr>
<tr>
<td>Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>Avg. Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>RDF Reads/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Writes/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Read/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Written/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Read Hits/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Rewrites/sec</td>
<td></td>
</tr>
</tbody>
</table>

### Snap Pool metrics

The following table lists all metrics that are available for snap pools.

### Table 61 Snap pool metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>The number of write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The MBs transferred per second to the disk directors.</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read each second by the disk directors.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
</tbody>
</table>
Table 61 Snap pool metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Read Request Time (ms)</td>
<td>The average time it takes to make a request by the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Disk Read RT (ms)</td>
<td>The average time it takes cache to respond to a read request by the disk directors.</td>
</tr>
<tr>
<td>% Used Capacity</td>
<td>The percent of the pools capacity that is used.</td>
</tr>
<tr>
<td>Total Pool Capacity (GB)</td>
<td>The total pool capacity in GBs.</td>
</tr>
<tr>
<td>Enabled Pool Capacity (GB)</td>
<td>The enabled pool capacity in GBs.</td>
</tr>
<tr>
<td>Used Pool Capacity (GB)</td>
<td>The used pool capacity in GBs.</td>
</tr>
<tr>
<td>Allocated Pool Capacity (GB)</td>
<td>The allocated pool capacity in GBs.</td>
</tr>
</tbody>
</table>

Spare Disk metrics

The following table lists all metrics that are available for spare disks.

Table 62 Spare disk metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Busy</td>
<td>The percent of time that the disk is busy serving IOs.</td>
</tr>
<tr>
<td>% Idle</td>
<td>The percent of time the disk is idle.</td>
</tr>
<tr>
<td>Avg Queue Depth</td>
<td>Calculated value: Accumulated queue depth/total SCSI command per sec.</td>
</tr>
<tr>
<td>Total SCSI Commands/sec</td>
<td>The total number of read commands, write commands, skip mask commands, verify commands, XOR write commands, and XOR write-read commands performed by the Symmetrix disk each second.</td>
</tr>
<tr>
<td>lOs/sec</td>
<td>The number of host read and write requests for the disk.</td>
</tr>
<tr>
<td>Reads/sec</td>
<td>The number of host reads per second for the disk.</td>
</tr>
<tr>
<td>Writes/sec</td>
<td>The number of host writes per second for the disk.</td>
</tr>
<tr>
<td>MBs/sec</td>
<td>The size of the IO from the host to the disk per second.</td>
</tr>
<tr>
<td>MBs Read/sec</td>
<td>The read throughput (MBs) of the disk per second.</td>
</tr>
<tr>
<td>MBs Written/sec</td>
<td>The write throughput (MBs) of the disk per second.</td>
</tr>
</tbody>
</table>
### Table 62 Spare disk metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg Read Size (KB)</td>
<td>The average number of kilobytes for a single read command.</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>The average number of kilobytes for a single write command.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average response time for the reads and writes.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the disk to serve one read command.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the disk to serve one write command.</td>
</tr>
<tr>
<td>Seeks/sec</td>
<td>The number of times each second that the disk head moved to find data.</td>
</tr>
<tr>
<td>Seek Distance/sec</td>
<td>The number of hypervolumes that the disk head crossed (during all seeks) each second.</td>
</tr>
<tr>
<td>Avg Hypers per Seek</td>
<td>The average number of hypervolumes that the disk head crossed during one seek.</td>
</tr>
<tr>
<td>Verify Commands/sec</td>
<td>The number of commands that verify the integrity of the data on the disk.</td>
</tr>
<tr>
<td>Skip Mask Commands/sec</td>
<td>The skip mask support offers an emulation of the ability to efficiently transfer “nearly sequential” streams of data. It allows a sequential read or write to execute but “skip over” certain unwanted or unchanged portions of the data stream, thereby transferring only those portions of the sequential stream that have changed and need to be updated. The skip mask mechanism increases throughput by saving bandwidth; both the bandwidth of processing multiple commands and the bandwidth of transferring unnecessary data.</td>
</tr>
<tr>
<td>XOR Write Commands/sec</td>
<td>The number of exclusive OR (XOR) write commands performed each second by the disk. XOR commands are used to establish parity protection in RAID-S and RAID 5 configurations.</td>
</tr>
<tr>
<td>XOR Read Commands/sec</td>
<td>The number of exclusive OR (XOR) write commands performed each second by the disk. XOR commands are used to establish parity protection in RAID-S and RAID 5 configurations.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the disk (GBs).</td>
</tr>
<tr>
<td>Used Capacity (GB)</td>
<td>The total used capacity of the disk (GBs).</td>
</tr>
</tbody>
</table>
### Table 62 Spare disk metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Used Capacity</td>
<td>The percent of the disk that is used.</td>
</tr>
<tr>
<td>% Free Capacity</td>
<td>The percent of the disk that is free.</td>
</tr>
</tbody>
</table>

### SRP metrics

The following table lists all metrics that are available for SRPs.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The number of host IO operations performed each second, including writes and random and sequential reads.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>Host read operations performed each second by the SRP.</td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>Host write operations performed each second by the SRP.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The number of host MBs read each second.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>The cumulative number of host MBs read per second by the SRP.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>The cumulative number of host MBs written per second by the SRP.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Req/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Write Req/sec</td>
<td>The number of write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>Calculated value: (MBs read per sec + MBs written per sec)</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average time it takes to satisfy IO requests.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the system to serve one read IO for this SRP.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the system to serve one write IO for this SRP.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Overall Efficiency Ratio</td>
<td>Ratio of the sum of all TDEVs + snapshot sizes (calculated based on the 128K track size) and the Physical Used Storage (calculated based on the compressed pool track size).</td>
</tr>
<tr>
<td>% Snapshot Saved</td>
<td>Percentage savings of the sum of all TDEV Snapshot sizes (at the time of Snapshot creation) and the TDEV Snapshot Allocated Storage.</td>
</tr>
<tr>
<td>% Virtual Provisioning Saved</td>
<td>Percentage savings of the TDEV configured storage presented to the hosts and the TDEV Allocated Storage.</td>
</tr>
<tr>
<td>Virtual Provisioning Compression Ratio</td>
<td>Ratio of the TDEV Logical Backend Storage (calculated based on the 128K track size) and the TDEV Physical Used Storage (calculated based on the compressed pool track size).</td>
</tr>
<tr>
<td></td>
<td><strong>Note</strong></td>
</tr>
<tr>
<td></td>
<td>Compression ratio metrics are supported only on systems capable of compression. Any value reported on a system that is not capable of compression should be disregarded.</td>
</tr>
<tr>
<td>Virtual Provisioning Efficiency Ratio</td>
<td>Ratio of the TDEV configured storage and the TDEV Logical Backend Storage (calculated based on TDEV allocated tracks without shared unowned).</td>
</tr>
<tr>
<td>Virtual Provisioning Shared Ratio</td>
<td>Ratio of the TDEV allocated storage and the TDEV Logical Backend Storage. Backend Storage is the sum of TDEV allocated tracks without counting the TDEV shared unowned tracks.</td>
</tr>
<tr>
<td>Snapshot Compression Ratio</td>
<td>Ratio of the RDP Logical Backend Storage (calculated based on the 128K track size) and the RDP Physical Used Storage of the RDP space (calculated based on the compressed pool track size).</td>
</tr>
<tr>
<td></td>
<td><strong>Note</strong></td>
</tr>
<tr>
<td></td>
<td>Compression ratio metrics are supported only on systems capable of compression. Any value reported on a system that is not capable of compression should be disregarded.</td>
</tr>
<tr>
<td>Snapshot Efficiency Ratio</td>
<td>Ratio of the sum of all snapshot sizes and the RDP Logical Backend Storage.</td>
</tr>
</tbody>
</table>
### Table 63 SRP metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snapshot Shared Ratio</td>
<td>Ratio of the Snapshot Allocated Storage and the RDP Logical Backend Storage. Sum of all modified tracks on all snapshots / Sum of the RDP size for all snapshot.</td>
</tr>
<tr>
<td>Overall Compression Ratio</td>
<td>Ratio of the sum of all TDEVs + snapshot sizes (calculated based on the 128K track size) and the Physical Used Storage (calculated based on the compressed pool track size).</td>
</tr>
</tbody>
</table>

**Note**
Compression ratio metrics are supported only on systems capable of compression. Any value reported on a system that is not capable of compression should be disregarded.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total SRP Capacity GB</td>
<td>The total amount of capacity available in all SRPs in GB.</td>
</tr>
<tr>
<td>Used SRP Capacity GB</td>
<td>The amount of used capacity in all SRPs in GB.</td>
</tr>
</tbody>
</table>

### Storage Group metrics

The following table lists all metrics that are available for storage groups.

**Table 64 Storage group metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The number of host operations performed each second by the group.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>The number of host read operations performed each second by the group.</td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>The number of host write operations performed each second by the group.</td>
</tr>
<tr>
<td>Host IO Limit Exceeded Secs</td>
<td>The number of IOs the FE port is performing on behalf of the specific storage group.</td>
</tr>
<tr>
<td>Host Hits/sec</td>
<td>The number of host read/write operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Host IO Limit MBs/sec</td>
<td>The number of MBs the FE port is processing on behalf of the specific storage group.</td>
</tr>
<tr>
<td>Host Read Hits/sec</td>
<td>The number of host read operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Host Write Hits/sec</td>
<td>The number of host write operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Host Misses/sec</td>
<td>The number of host read/write operations performed each second by the group that could not be satisfied from cache.</td>
</tr>
<tr>
<td>Host Read Misses/sec</td>
<td>The number of host read operations performed each second by the group that were not satisfied from cache.</td>
</tr>
<tr>
<td>Host IO Limit IOs/sec</td>
<td>The number of IOs the FE port is processing on behalf of the specific storage group.</td>
</tr>
<tr>
<td>Host Write Misses/sec</td>
<td>The number of host write operations performed each second by the group that were not satisfied from cache.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>The cumulative number of host MBs read/writes per second by the group.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>The cumulative number of host MBs read per second by the group.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>The cumulative number of host MBs written per second by the group.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>The number of write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The calculated average read response time.</td>
</tr>
<tr>
<td>Host IO Limit % Time Exceeded</td>
<td>The percent of IO operations that were reads.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The calculated average write response time</td>
</tr>
<tr>
<td>Read Miss RT (ms)</td>
<td>The average time that it took the storage to serve one read miss IO for this group.</td>
</tr>
<tr>
<td>Write Miss RT (ms)</td>
<td>The average time that it took the storage to serve one write miss IO for this group.</td>
</tr>
<tr>
<td>RDF/S Write RT (ms)</td>
<td>A summary of the read, write, and average response times for the selected SRDF/S group.</td>
</tr>
<tr>
<td>% Reads</td>
<td>The percent of IO operations that were reads.</td>
</tr>
<tr>
<td>% Writes</td>
<td>The percent of IO operations that were writes.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>% Read Hit</td>
<td>The percent of read operations, performed by the group, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Write Hit</td>
<td>The percent of write operations, performed by the group, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Read Miss</td>
<td>The percent of read miss operations performed each second by the group. A miss occurs when the requested read data is not found in cache.</td>
</tr>
<tr>
<td>% Write Miss</td>
<td>The percent of write miss operations performed each second by the group. A miss occurs when the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode for the group.</td>
</tr>
<tr>
<td>Seq IOs/sec</td>
<td>The number of IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Reads/sec</td>
<td>The number of read IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Writes/sec</td>
<td>The number of write IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Read Hits/sec</td>
<td>The number of sequential read operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Read Miss/sec</td>
<td>The number of sequential read operations performed each second by the group that were misses.</td>
</tr>
<tr>
<td>Seq Write Hits/sec</td>
<td>The number of sequential write operations performed each second by the group that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Write Misses/sec</td>
<td>The number of sequential write operations performed each second by the group that were misses.</td>
</tr>
<tr>
<td>Random IOs/sec</td>
<td>IOs from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Reads/sec</td>
<td>Read IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Writes/sec</td>
<td>Write IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Read Hits/sec</td>
<td>Random read IOs that were satisfied from the cache.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Random Write Hits/sec</td>
<td>Random write IOs that were immediately placed in cache because space was available.</td>
</tr>
<tr>
<td>Random Read Misses/sec</td>
<td>Random read IOs that were misses.</td>
</tr>
<tr>
<td>Random Write Misses/sec</td>
<td>Random write IOs that were misses.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec / total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec / total writes per sec)</td>
</tr>
<tr>
<td>% Sequential IO</td>
<td>The percent of IO operations that were sequential.</td>
</tr>
<tr>
<td>% Seq Read</td>
<td>Calculated value: 100 * (seq reads per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read Hit</td>
<td>The percent of the sequential read operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Read Miss</td>
<td>The percent of the sequential read operations that were misses.</td>
</tr>
<tr>
<td>% Seq Writes</td>
<td>Calculated value: 100 * (seq writes per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Write Hit</td>
<td>The percent of the sequential write operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Write Miss</td>
<td>The percent of the sequential write operations that were misses.</td>
</tr>
<tr>
<td>% Random IO</td>
<td>The percent of IO operations that were random.</td>
</tr>
<tr>
<td>% Random Read Hit</td>
<td>Calculated value: 100 * (random read hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Miss</td>
<td>Calculated value: 100 * (random write misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Read Miss</td>
<td>Calculated value: 100 * (random read misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Hit</td>
<td>Calculated value: 100 * (random write hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Max WP Threshold</td>
<td>The maximum number of write-pending slots available for the group.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>Calculated value: (MBs read per sec + MBs written per sec)</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td><strong>Metric</strong></td>
<td><strong>Description</strong></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE Prefetched Tracks/sec</td>
<td>Total prefetched tracks each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Read Request Time (ms)</td>
<td>The average time it takes to make a request by the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Disk Read RT (ms)</td>
<td>The average time it takes cache to respond to a read request by the disk directors.</td>
</tr>
<tr>
<td>BE Read Task Time (ms)</td>
<td>The time from the point when the HA puts the read request on the queue and the DA picks it up; this can be considered queue time.</td>
</tr>
<tr>
<td>% Hit</td>
<td>The percent of IO operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Miss</td>
<td>The percent of IO operations that were misses.</td>
</tr>
<tr>
<td>% Random Reads</td>
<td>The percent of all read IOs that were random.</td>
</tr>
<tr>
<td>% Random Writes</td>
<td>The percent of all write IOs that were random.</td>
</tr>
<tr>
<td>BE % Reads</td>
<td>The percent of the back-end IO that were read requests.</td>
</tr>
<tr>
<td>BE % Writes</td>
<td>The percent of the back-end IO that were write requests.</td>
</tr>
<tr>
<td>Read RT Count 5 to 8</td>
<td></td>
</tr>
<tr>
<td>Write RT Count 1 to 3</td>
<td></td>
</tr>
<tr>
<td>Read RT Count Over 32</td>
<td></td>
</tr>
<tr>
<td>Write RT Count 0 to 1</td>
<td></td>
</tr>
<tr>
<td>Read RT Count 14 to 32</td>
<td></td>
</tr>
<tr>
<td>Skew</td>
<td></td>
</tr>
<tr>
<td>Write RT Count 8 to 14</td>
<td></td>
</tr>
<tr>
<td>Write RT Count 14 to 32</td>
<td></td>
</tr>
<tr>
<td>Write RT Count Over 32</td>
<td></td>
</tr>
<tr>
<td>Write RT Count 3 to 5</td>
<td></td>
</tr>
<tr>
<td>Read RT 14 to 32</td>
<td></td>
</tr>
<tr>
<td>Write RT Count 5 to 8</td>
<td></td>
</tr>
<tr>
<td>Read RT Count 8 to 14</td>
<td></td>
</tr>
<tr>
<td>Read RT Over 32</td>
<td></td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Write RT 14 to 32</td>
<td></td>
</tr>
<tr>
<td>RDF Response Time (ms)</td>
<td></td>
</tr>
<tr>
<td>Write RT Over 32</td>
<td></td>
</tr>
<tr>
<td>Read RT Count 0 to 1</td>
<td></td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The calculated average response time.</td>
</tr>
<tr>
<td>Read RT Count 1 to 3</td>
<td></td>
</tr>
<tr>
<td>Read RT Count 3 to 5</td>
<td></td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
<tr>
<td>BE Partial Sector Writes (KB)</td>
<td>The KBs of back-end IO that were partial sector writes.</td>
</tr>
<tr>
<td>BE Optimize Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy (MB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Allocated Capacity (GB)</td>
<td>The total allocated storage group capacity.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the storage group (GBs).</td>
</tr>
<tr>
<td>Device Block Size</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of tracks per second prefetched from disk to cache upon detection of a sequential read stream.</td>
</tr>
<tr>
<td>Total Tracks</td>
<td>The total number of tracks for the storage group.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Compressed Tracks</td>
<td>The number of compressed tracks for the storage group (applies only to storage systems running Enginuity OS 5876).</td>
</tr>
<tr>
<td>% Compressed Tracks</td>
<td>The percent of the storage group tracks that are compressed tracks (applies only to storage systems running Enginuity OS 5876).</td>
</tr>
<tr>
<td>Write paced delay</td>
<td></td>
</tr>
<tr>
<td>Avg. Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>Sync Write Reqs/sec</td>
<td>The number of sync write requests managed by this storage group per second.</td>
</tr>
<tr>
<td>Sync MBs Sent/sec</td>
<td>The number of sync MBs sent per second via this storage group.</td>
</tr>
<tr>
<td>Async Write Reqs/sec</td>
<td>The number of async write requests managed by this storage group per second.</td>
</tr>
<tr>
<td>Async MBs Sent/sec</td>
<td>The number of async MBs sent per second via this storage group.</td>
</tr>
<tr>
<td>Information Alert Count</td>
<td>Number of information alerts.</td>
</tr>
<tr>
<td>Warning Alert Count</td>
<td>Number of warning alerts.</td>
</tr>
<tr>
<td>Critical Alert Count</td>
<td>Number of critical alerts.</td>
</tr>
<tr>
<td>RDF Reads/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Writes/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Read/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Written/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Read Hits/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Rewrites/sec</td>
<td></td>
</tr>
<tr>
<td>% Virtual Provisioning Space Saved</td>
<td></td>
</tr>
<tr>
<td>Compression Ratio</td>
<td></td>
</tr>
</tbody>
</table>

**Note**

Compression ratio metrics are supported only on systems capable of compression. Any value reported on a system that is not capable of compression should be disregarded.

| QOS Delayed IO Count      | The amount of IO delayed that was introduced by enabling QoS services.                           |
| QOS Delayed IO Time (μs)  | The amount of time IO was delayed that was introduced by enabling QoS services.                  |
| QOS Host Delayed IO Count | The amount of Host IO delayed that was introduced by enabling QoS services.                      |
### Table 64 Storage group metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>QOS Host Delayed IO Time (μs)</td>
<td>The amount of time IO was delayed that was introduced by enabling QoS services.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The calculated average response time.</td>
</tr>
<tr>
<td>PowerPath Average Response Time (ms)</td>
<td>The average response time in milliseconds using PowerPath metrics.</td>
</tr>
<tr>
<td>PowerPath Observed Delta RT (ms)</td>
<td>The difference between PowerPath average response time and device/storage group response time.</td>
</tr>
<tr>
<td>PowerPath Observed Relative RT (%)</td>
<td>The relative response times between the PowerPath average response time and the device/storage group response time.</td>
</tr>
<tr>
<td>Tracks Deduped Not Written</td>
<td>Indicates number of LRU writes deduped and not producing backend IO. This metric will be used for rate calculation.</td>
</tr>
<tr>
<td>Writes Broke Dedup Relationships</td>
<td>Indicates number of writes forcing dedup-split (2*128K IO's and allocation expense). This metric will be used for rate calculation.</td>
</tr>
<tr>
<td>Duplicate Track Count</td>
<td>Indicates capacity cost of disabling de-dup for a given device. This is used to indicate the number of de-dup track at the instance of the query and not used for rate calculation.</td>
</tr>
</tbody>
</table>

### Storage Group by Pool metrics

The following table lists all metrics that are available for storage groups (by pool).

### Table 65 Storage group (by pool) metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Allocated Capacity</td>
<td>The total allocated SG capacity.</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Destage Writes/sec</td>
<td></td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The MBs transferred per second to the disk directors.</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read each second by the disk directors.</td>
</tr>
<tr>
<td>Destage Write MBs/sec</td>
<td></td>
</tr>
</tbody>
</table>
### Table 65 Storage group (by pool) metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefetched Tracks/sec</td>
<td>The number of tracks prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>Pretetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>Allocated Tracks</td>
<td></td>
</tr>
<tr>
<td>Compressed Tracks</td>
<td>The number of compressed tracks in the storage group (applies only to storage systems running Enginuity OS 5876).</td>
</tr>
<tr>
<td>% Compressed Tracks</td>
<td>The percent of the total tracks that are compressed (applies only to storage systems running Enginuity OS 5876).</td>
</tr>
<tr>
<td>Local Replication Tracks</td>
<td></td>
</tr>
</tbody>
</table>

### Storage Group by Tier metrics

The following table lists all metrics that are available for storage groups (by tier).

**Table 66 Storage group (by tier) metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Allocated Tracks</td>
<td>The number of allocated tracks in the storage group (by tier).</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk. (BE Reads + BE Writes) / allocated capacity With FAST moving active extents to higher tiers, this metric is a good indication of success (the IO density on Flash tiers should be higher than the density on SATA tiers.)</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Destage Writes/sec</td>
<td></td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The MBs transferred per second to the disk directors.</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read each second by the disk directors.</td>
</tr>
<tr>
<td>Destage Write MBs/sec</td>
<td></td>
</tr>
<tr>
<td>Prefetched Tracks/sec</td>
<td>The number of tracks prefetched from disk to cache in a second.</td>
</tr>
</tbody>
</table>
### Table 66 Storage group (by tier) metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>Allocated Capacity</td>
<td>The total allocated SG capacity.</td>
</tr>
<tr>
<td>Compressed Tracks</td>
<td>The number of compressed tracks for the storage group (applies only to storage systems running Enginuity OS 5876).</td>
</tr>
<tr>
<td>% Compressed Tracks</td>
<td>The percent of the storage group tracks that are compressed tracks (applies only to storage systems running Enginuity OS 5876).</td>
</tr>
<tr>
<td>Local Replication Tracks</td>
<td></td>
</tr>
</tbody>
</table>

### Thin Pool metrics

The following table lists all metrics that are available for thin pools.

### Table 67 Thin pool metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Req/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Write Req/sec</td>
<td>The number of write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The MBs transferred per second to the disk directors.</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read each second by the disk directors.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written each second by the disk directors.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode for the thin pool.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec/total IOs per sec)</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec/total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec/total writes per sec)</td>
</tr>
<tr>
<td>% Used Capacity</td>
<td>The percent of the pools capacity that is used.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Total Pool Capacity (GB)</td>
<td>The total pool capacity in GBs.</td>
</tr>
<tr>
<td>Enabled Pool Capacity (GB)</td>
<td>The enabled pool capacity in GBs.</td>
</tr>
<tr>
<td>Used Pool Capacity (GB)</td>
<td>The used pool capacity in GBs.</td>
</tr>
<tr>
<td>Allocated Pool Capacity (GB)</td>
<td>The allocated pool capacity in GBs.</td>
</tr>
<tr>
<td>BE Read RT (ms)</td>
<td>A calculated value of the response time for all back-end read requests.</td>
</tr>
<tr>
<td>BE Write RT (ms)</td>
<td>A calculated value of the response time for all back-end write requests.</td>
</tr>
<tr>
<td>BE Response Time (ms)</td>
<td>A calculated value of the response time for all back-end read and write requests.</td>
</tr>
<tr>
<td>BE % Reads</td>
<td>The percent of the back-end requests that were read requests.</td>
</tr>
<tr>
<td>BE % Writes</td>
<td>The percent of the back-end requests that were write requests.</td>
</tr>
<tr>
<td>Ingress Tracks</td>
<td>The number of tracks entering the pool.</td>
</tr>
<tr>
<td>Egress Tracks</td>
<td>The number of tracks leaving the pool.</td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>Redirect On Write</td>
<td></td>
</tr>
<tr>
<td>Copy on Write</td>
<td></td>
</tr>
<tr>
<td>BE Partial Sector Writes (KB)</td>
<td></td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk. (BE Reads + BE Writes) / allocated capacity With FAST moving active extents to higher tiers, this metric is a good indication of success (the IO density on Flash tiers should be higher than the density on SATA tiers.)</td>
</tr>
<tr>
<td>BE Optimize Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Blocks Written For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Blocks Read For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
</tbody>
</table>
### Table 67 Thin pool metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Blocks Written For VLUN Migration</td>
<td></td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Prefetched Tracks/sec</td>
<td></td>
</tr>
<tr>
<td>BE Writes For Rebuild (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE RDF Copy (MB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the thin pool (GBs).</td>
</tr>
<tr>
<td>Device Block Size</td>
<td>The block size of the volume.</td>
</tr>
<tr>
<td>Total Tracks</td>
<td>The number of allocated tracks in the thin pool.</td>
</tr>
<tr>
<td>Compressed Tracks</td>
<td>The number of compressed tracks in the thin pool (applies only to storage systems running Enginuity OS 5876).</td>
</tr>
<tr>
<td>Compression Scan Reads</td>
<td></td>
</tr>
<tr>
<td>% Compressed Tracks</td>
<td>The percent of the total tracks that are compressed (applies only to storage systems running Enginuity OS 5876).</td>
</tr>
</tbody>
</table>

### Thin Volume metrics

The following table lists all metrics that are available for thin volumes.

### Table 68 Thin volume metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The total number of host read IO and write IO operations performed each second by the volume.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>The total number of host read IO operations performed each second by the volume.</td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>The total number of host write IO operations performed each second by the volume.</td>
</tr>
<tr>
<td>Host Hits/sec</td>
<td>The total number of host read IO and write IO operations performed each second by the volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Read Hits/sec</td>
<td>The total number of host read IO operations performed each second by the volume that were immediately satisfied by cache.</td>
</tr>
</tbody>
</table>
### Table 68 Thin volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host Write Hits/sec</td>
<td>The total number of host write IO operations performed each second by the volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Misses/sec</td>
<td>The total number of host read IO and write IO operations missed each second by the volume.</td>
</tr>
<tr>
<td>Host Read Misses/sec</td>
<td>The total number of host read IO operations missed each second by the volume.</td>
</tr>
<tr>
<td>Host Write Misses/sec</td>
<td>The total number of host write IO operations missed each second by the volume.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>A cumulative number of host MBs read/writes per second.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>A cumulative number of host MBs read per second.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>A cumulative number of host MBs written per second.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>Number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>The number of write requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The calculated average read response time.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The calculated average write response time.</td>
</tr>
<tr>
<td>Read Miss RT (ms)</td>
<td>The average time a read miss operation was performed by the volume. A miss occurs when the requested data is not found in cache.</td>
</tr>
<tr>
<td>Write Miss RT (ms)</td>
<td>The average time a write miss operation was performed by the volume. A miss occurs when the write operation has to wait while data is destaged from cache to disks.</td>
</tr>
<tr>
<td>RDF/S Write RT (ms)</td>
<td>The average time it took the volume to serve one write IO.</td>
</tr>
<tr>
<td>% Reads</td>
<td>The percentage of IO operations that were reads.</td>
</tr>
<tr>
<td>% Writes</td>
<td>The percentage of IO operations that were writes.</td>
</tr>
<tr>
<td>% Read Hit</td>
<td>The percentage of read operations, performed by the volume, that were immediately satisfied by cache.</td>
</tr>
</tbody>
</table>
Table 68 Thin volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Write Hit</td>
<td>The percentage of write operations, performed by the volume, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Read Miss</td>
<td>The percentage of read miss operations performed each second by the volume. A miss occurs when the requested read data is not found in cache or the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>% Write Miss</td>
<td>The percent of write miss operations performed each second by the volume. A miss occurs when the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode for the volume.</td>
</tr>
<tr>
<td>Seq IOs/sec</td>
<td>The number of IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Reads/sec</td>
<td>The number of read IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Writes/sec</td>
<td>The number of write IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Read Hits/sec</td>
<td>The number of sequential read operations performed each second by the volume that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Read Miss/sec</td>
<td>The number of sequential read operations performed each second by the volume that were misses.</td>
</tr>
<tr>
<td>Seq Write Hits/sec</td>
<td>The number of sequential write operations performed each second by the volume that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Write Misses/sec</td>
<td>The number of sequential write operations performed each second by the volume that were misses.</td>
</tr>
<tr>
<td>Random IOs/sec</td>
<td>The number of IOs from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Reads/sec</td>
<td>The number of read IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Writes/sec</td>
<td>The number of write IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Read Hits/sec</td>
<td>The number of random read IOs that were satisfied from the cache.</td>
</tr>
</tbody>
</table>
### Table 68 Thin volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random Write Hits/sec</td>
<td>The number of random write IOs that were immediately placed in cache because space was available.</td>
</tr>
<tr>
<td>Random Read Misses/sec</td>
<td>The number of random read IOs that were misses.</td>
</tr>
<tr>
<td>Random Write Misses/sec</td>
<td>The number of random write IOs that were misses.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec / total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec / total writes per sec)</td>
</tr>
<tr>
<td>% Sequential IO</td>
<td>Calculated value:100 * (total seq ios per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read</td>
<td>Calculated value: 100 * (seq reads per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read Hit</td>
<td>The percent of the sequential read operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Read Miss</td>
<td>The percent of the sequential read operations that were misses.</td>
</tr>
<tr>
<td>% Seq Writes</td>
<td>Calculated value: 100*(seq writes per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Write Hit</td>
<td>The percent of the sequential write operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Write Miss</td>
<td>The percent of the sequential write operations that were misses.</td>
</tr>
<tr>
<td>% Random IO</td>
<td>The percent of IO operations that were random.</td>
</tr>
<tr>
<td>% Random Read Hit</td>
<td>Calculated value: 100 * (random read hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Read Miss</td>
<td>Calculated value: 100 * (random read misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Hit</td>
<td>Calculated value: 100 * (random write hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Miss</td>
<td>Calculated value: 100 * (random write misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Max WP Threshold</td>
<td>The maximum number of write-pending slots available for the volume.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>Calculated value: (MBs read per sec + MBs written per sec)</td>
</tr>
</tbody>
</table>
### Table 68 Thin volume metrics (continued)

<table>
<thead>
<tr>
<th><strong>Metric</strong></th>
<th><strong>Description</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE Pretetched Tracks/sec</td>
<td>The total prefetched tracks each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>% Random Reads</td>
<td>The percent of read commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Hits/sec</td>
<td>The total number of hits per second that were not sequential.</td>
</tr>
<tr>
<td>% Hit</td>
<td>The percent of operations that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Random Writes</td>
<td>The percent of write commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>% Miss</td>
<td>The percent of operations that were misses. A miss occurs when the operation cannot be immediately satisfied from cache because the data is not there or the operation has to wait while data is destaged from cache to disks.</td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>Number of RDF Invalid Tracks</td>
<td></td>
</tr>
<tr>
<td>RDF Response Time (ms)</td>
<td></td>
</tr>
<tr>
<td>BE RDF Copy</td>
<td></td>
</tr>
<tr>
<td>BE RDF Copy (MB)</td>
<td></td>
</tr>
<tr>
<td>Allocated Capacity (GB)</td>
<td>The allocated capacity of the thin volume (GB).</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the thin volume (GB).</td>
</tr>
<tr>
<td>Device Block Size</td>
<td>The block size of the volume.</td>
</tr>
<tr>
<td>Optimized Read Misses/sec</td>
<td>Number of read requests each second performed directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Optimized MBs Read Miss/sec</td>
<td>Number of host megabytes read each second directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Avg Optimized Read Miss Size (KB)</td>
<td></td>
</tr>
<tr>
<td>Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>Avg. Write Paced Delay (ms)</td>
<td></td>
</tr>
</tbody>
</table>
### Table 68 Thin volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDF Reads/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Writes/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Read/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Written/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Read Hits/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Rewrites/sec</td>
<td></td>
</tr>
<tr>
<td>Random Writes to WP slots per second</td>
<td>Number of writes to affect the back end.</td>
</tr>
<tr>
<td>Random Writes to WB Slots in KB per second.</td>
<td>The amount of writes to affect the back end (KB).</td>
</tr>
<tr>
<td>QOS Delayed IO Count</td>
<td>The amount of IO delayed that was introduced by enabling QoS services.</td>
</tr>
<tr>
<td>QOS Delayed IO Time (μs)</td>
<td>The amount of time IO was delayed that was introduced by enabling QoS services.</td>
</tr>
<tr>
<td>QOS Host Delayed IO Count</td>
<td>The amount of Host IO delayed that was introduced by enabling QoS services.</td>
</tr>
<tr>
<td>QOS Host Delayed IO Time (μs)</td>
<td>The amount of time IO was delayed that was introduced by enabling QoS services.</td>
</tr>
<tr>
<td>Response time (ms)</td>
<td>The calculated average response time.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The calculated average response time.</td>
</tr>
<tr>
<td>PowerPath Average Response Time (ms)</td>
<td>The average response time in milliseconds using PowerPath metrics.</td>
</tr>
<tr>
<td>PowerPath Observed Delta RT (ms)</td>
<td>The difference between PowerPath average response time and device/storage group response time.</td>
</tr>
<tr>
<td>PowerPath Observed Relative RT (%)</td>
<td>The relative response times between the PowerPath average response time and the device/storage group response time.</td>
</tr>
<tr>
<td>Tracks Deduped Not Written</td>
<td>Indicates number of LRU writes deduped and not producing backend IO. This metric will be used for rate calculation.</td>
</tr>
<tr>
<td>Writes Broke Dedup Relationships</td>
<td>Indicates number of writes forcing dedup-split (2*128K IO’s and allocation expense). This metric will be used for rate calculation.</td>
</tr>
<tr>
<td>Duplicate Track Count</td>
<td>Indicates capacity cost of disabling de-dup for a given device. This is used to indicate the number of de-dup track at the instance of the query and not used for rate calculation.</td>
</tr>
</tbody>
</table>
### Tier by Storage Group metrics

The following table lists all metrics that are available for tiers (by storage group).

#### Table 69 Tier (by storage group) metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Allocated Capacity</td>
<td>The total allocated SG capacity.</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk. (BE Reads + BE Writes) / allocated capacity With FAST moving active extents to higher tiers, this metric is a good indication of success (the IO density on Flash tiers should be higher than the density on SATA tiers.)</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Destage Writes/sec</td>
<td>The number of writes per second that were destaged to disk.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The MBs transferred per second to the disk directors.</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read each second by the disk directors.</td>
</tr>
<tr>
<td>Destage Write MBs/sec</td>
<td>The size (MBs) of writes per second that were destaged to disk.</td>
</tr>
<tr>
<td>Prefetched Tracks/sec</td>
<td>The number of tracks prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache in a second.</td>
</tr>
<tr>
<td>Allocated Tracks</td>
<td>The number of allocated tracks in the storage group.</td>
</tr>
<tr>
<td>Compressed Tracks</td>
<td>The number of compressed tracks for the storage group (applies only to storage systems running Enginuity OS 5876).</td>
</tr>
<tr>
<td>% Compressed Tracks</td>
<td>The percent of the storage group tracks that are compressed tracks (applies only to storage systems running Enginuity OS 5876).</td>
</tr>
<tr>
<td>Local Replication Tracks</td>
<td></td>
</tr>
</tbody>
</table>

### Virtual Pool Tier metrics

The following table lists all metrics that are available for virtual pool tiers.
### Table 70 Virtual pool tier metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocated Capacity (GB)</td>
<td>Allocated capacity in GBs.</td>
</tr>
<tr>
<td>Allocated Pool Capacity (GB)</td>
<td>The allocated pool capacity in GBs.</td>
</tr>
<tr>
<td>Total Tracks</td>
<td>The total number of tracks for the virtual pool.</td>
</tr>
<tr>
<td>BE Disk Read RT (ms)</td>
<td>The average time it takes read requests from the disk directors to cache.</td>
</tr>
<tr>
<td>BE Read Request Time (ms)</td>
<td>The time from the point when the HA puts the read request on the queue and the DA picks it up - can be considered queue time.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec/total IOs per sec)</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec/total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec/total writes per sec)</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read each second by the disk directors.</td>
</tr>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The MBs transferred per second to the disk directors.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE % Reads</td>
<td>The percent of the back-end IO that were read requests.</td>
</tr>
<tr>
<td>BE % Writes</td>
<td>The percent of the back-end IO that were write requests.</td>
</tr>
<tr>
<td>BE Prefetched Tracks/sec</td>
<td>The total prefetched tracks each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Read Req/sec</td>
<td>The number of read requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>BE RT (ms)</td>
<td>A calculated value of the response time for all back-end read requests.</td>
</tr>
<tr>
<td>BE Write RT (ms)</td>
<td>A calculated value of the response time for all back-end write requests.</td>
</tr>
<tr>
<td>BE Write Req/sec</td>
<td>The number of write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Compressed Tracks</td>
<td>The number of compressed tracks in the thin pool. (applies only to storage systems running Enginuity OS 5876).</td>
</tr>
</tbody>
</table>
Table 70 Virtual pool tier metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE RDF Copy (MB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Blocks Read For VLUN Migration</td>
<td></td>
</tr>
<tr>
<td>BE Blocks Written For Copy (KB)</td>
<td></td>
</tr>
<tr>
<td>BE Writes For Rebuild (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Blocks Written For VLUN Migration</td>
<td></td>
</tr>
<tr>
<td>BE Optimize Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Partial Sector Writes (KB)</td>
<td>The number of partial sector writes by the disk directors.</td>
</tr>
<tr>
<td>BE RDF Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Device Block Size</td>
<td>The block size of the volume.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the virtual pool tier.</td>
</tr>
<tr>
<td>Egress Tracks</td>
<td>The number of tracks leaving the pool.</td>
</tr>
<tr>
<td>Enabled Pool Capacity (GB)</td>
<td>The enabled pool capacity in GBs.</td>
</tr>
<tr>
<td>Ingress Tracks</td>
<td>The number of tracks entering the pool.</td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
<tr>
<td>% Compressed Tracks</td>
<td>The percent of the total tracks that are compressed.</td>
</tr>
<tr>
<td>% Reads</td>
<td>The percentage of IO operations that were reads.</td>
</tr>
<tr>
<td>% Used Capacity</td>
<td>The percent of the virtual pool tier that is used.</td>
</tr>
<tr>
<td>% Write</td>
<td>The percentage of IO operations that were writes.</td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache per second.</td>
</tr>
<tr>
<td>Response Time (ms)</td>
<td>The average time it takes to satisfy IO requests.</td>
</tr>
</tbody>
</table>
### Table 70 Virtual pool tier metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the system to serve one read IO for this volume.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the system to serve one write IO for this volume.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to cache.</td>
</tr>
<tr>
<td>Total Pool Capacity (GB)</td>
<td>The total capacity of the virtual pool.</td>
</tr>
<tr>
<td>Used Pool Capacity (GB)</td>
<td>The used pool capacity in GBs.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode.</td>
</tr>
</tbody>
</table>

### Volume metrics

The following table lists all metrics that are available for volumes.

### Table 71 Volume metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host IOs/sec</td>
<td>The total number of host read IO and write IO operations performed each second by the volume.</td>
</tr>
<tr>
<td>Host Reads/sec</td>
<td>The total number of host read IO operations performed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Writes/sec</td>
<td>The total number of host write IO operations performed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Hits/sec</td>
<td>The total number of host read IO and write IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Read Hits/sec</td>
<td>The total number of host read IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Write Hits/sec</td>
<td>The total number of host write IO operations performed each second by the Symmetrix volume that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>Host Misses/sec</td>
<td>The total number of host read IO and write IO operations missed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Host Read Misses/sec</td>
<td>The total number of host read IO operations missed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host Write Misses/sec</td>
<td>The total number of host write IO operations missed each second by the Symmetrix volume.</td>
</tr>
<tr>
<td>Host MBs/sec</td>
<td>A cumulative number of host MBs read/writes per second.</td>
</tr>
<tr>
<td>Host MBs Read/sec</td>
<td>A cumulative number of host MBs read per second.</td>
</tr>
<tr>
<td>Host MBs Written/sec</td>
<td>A cumulative number of host MBs written per second.</td>
</tr>
<tr>
<td>BE Reqs/sec</td>
<td>The number of read/write requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Read Reqs/sec</td>
<td>The number of read requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>Parity Generation Kbytes Read</td>
<td></td>
</tr>
<tr>
<td>Parity Generation Reads</td>
<td></td>
</tr>
<tr>
<td>BE Write Reqs/sec</td>
<td>The number of write requests each second performed by the disk directors to the cache.</td>
</tr>
<tr>
<td>Read RT (ms)</td>
<td>The average time it took the system to serve one read IO for this volume.</td>
</tr>
<tr>
<td>Write RT (ms)</td>
<td>The average time it took the system to serve one write IO for this volume.</td>
</tr>
<tr>
<td>Read Miss RT (ms)</td>
<td>The average time a read miss operation was performed by the volume. A miss occurs when the requested data is not found in cache.</td>
</tr>
<tr>
<td>Write Miss RT (ms)</td>
<td>The average time a write miss operation was performed by the volume. A miss occurs when the write operation has to wait while data is destaged from cache to disks.</td>
</tr>
<tr>
<td>RDF/S Write RT (ms)</td>
<td>The average time it took the volume to serve one write IO.</td>
</tr>
<tr>
<td>% Reads</td>
<td>The percentage of IO operations that were reads.</td>
</tr>
<tr>
<td>% Writes</td>
<td>The percentage of IO operations that were writes.</td>
</tr>
<tr>
<td>% Read Hit</td>
<td>The percentage of read operations, performed by the Symmetrix volume, that were immediately satisfied by cache.</td>
</tr>
</tbody>
</table>
### Table 71 Volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Write Hit</td>
<td>The percentage of write operations, performed by the Symmetrix volume, that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Read Miss</td>
<td>The percentage of read miss operations performed each second by the Symmetrix volume. A miss occurs when the requested read data is not found in cache or the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>% Write Miss</td>
<td>The percent of write miss operations performed each second by the Symmetrix volume. A miss occurs when the write operation had to wait while data was destaged from cache to the disks.</td>
</tr>
<tr>
<td>WP Count</td>
<td>The number of tracks currently in write pending mode for the volume.</td>
</tr>
<tr>
<td>Seq IOs/sec</td>
<td>The number of IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Reads/sec</td>
<td>The number of read IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Writes/sec</td>
<td>The number of write IO operations performed each second that were sequential.</td>
</tr>
<tr>
<td>Seq Read Hits/sec</td>
<td>The number of sequential read operations performed each second by the Symmetrix volume that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Read Miss/sec</td>
<td>The number of sequential read operations performed each second by the Symmetrix volume that were misses.</td>
</tr>
<tr>
<td>Seq Write Hits/sec</td>
<td>The number of sequential write operations performed each second by the Symmetrix volume that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>Seq Write Misses/sec</td>
<td>The number of sequential write operations performed each second by the Symmetrix volume that were misses.</td>
</tr>
<tr>
<td>Random IOs/sec</td>
<td>The number of IOs from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Reads/sec</td>
<td>The number of read IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Writes/sec</td>
<td>The number of write IO commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Random Read Hits/sec</td>
<td>The number of random read IOs that were satisfied from the cache.</td>
</tr>
<tr>
<td>Random Write Hits/sec</td>
<td>The number of random write IOs that were immediately placed in cache because space was available.</td>
</tr>
<tr>
<td>Random Read Misses/sec</td>
<td>The number of random read IOs that were misses.</td>
</tr>
<tr>
<td>Random Write Misses/sec</td>
<td>The number of random write IOs that were misses.</td>
</tr>
<tr>
<td>Avg IO Size (KB)</td>
<td>Calculated value: (HA Kbytes transferred per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Avg Read Size (KB)</td>
<td>Calculated value: (Kbytes read per sec / total reads per sec)</td>
</tr>
<tr>
<td>Avg Write Size (KB)</td>
<td>Calculated value: (Kbytes written per sec / total writes per sec)</td>
</tr>
<tr>
<td>% Sequential IO</td>
<td>Calculated value: 100 * (total seq IOs per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read</td>
<td>Calculated value: 100 * (seq reads per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Read Hit</td>
<td>The percent of the sequential read operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Read Miss</td>
<td>The percent of the sequential read operations that were misses.</td>
</tr>
<tr>
<td>% Seq Writes</td>
<td>Calculated value: 100 * (seq writes per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Seq Write Hit</td>
<td>The percent of the sequential write operations that were immediately satisfied from cache.</td>
</tr>
<tr>
<td>% Seq Write Miss</td>
<td>The percent of the sequential write operations that were misses.</td>
</tr>
<tr>
<td>% Random IO</td>
<td>The percent of IO operations that were random.</td>
</tr>
<tr>
<td>% Random Read Hit</td>
<td>Calculated value: 100 * (random read hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Read Miss</td>
<td>Calculated value: 100 * (random read misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Hit</td>
<td>Calculated value: 100 * (random write hits per sec / total IOs per sec)</td>
</tr>
<tr>
<td>% Random Write Miss</td>
<td>Calculated value: 100 * (random write misses per sec / total IOs per sec)</td>
</tr>
<tr>
<td>Max WP Threshold</td>
<td>The maximum number of write-pending slots available for the Symmetrix volume.</td>
</tr>
</tbody>
</table>
Table 71 Volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE MBs Transferred/sec</td>
<td>The number of MBs read per sec + MBs written per sec.</td>
</tr>
<tr>
<td>BE MBs Read/sec</td>
<td>The number of MBs read by the disk directors from the disk each second.</td>
</tr>
<tr>
<td>BE MBs Written/sec</td>
<td>The number of MBs written to the disk from the disk director each second.</td>
</tr>
<tr>
<td>BE Prefetched Tracks/sec</td>
<td>The total prefetched tracks each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Prefetched Tracks Used/sec</td>
<td>The number of prefetched tracks used each second from the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Read Request Time (ms)</td>
<td>The average time it takes to make a request by the disk directors to the cache.</td>
</tr>
<tr>
<td>BE Disk Read RT (ms)</td>
<td>The average time it takes cache to respond to a read request by the disk directors.</td>
</tr>
<tr>
<td>BE Read Task Time (ms)</td>
<td>The time from the point when the HA puts the read request on the queue and the DA picks it up - can be considered queue time.</td>
</tr>
<tr>
<td>% Random Reads</td>
<td>The percent of read commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>Random Hits/sec</td>
<td>The total number of hits per second that were not sequential.</td>
</tr>
<tr>
<td>% Random Writes</td>
<td>The percent of write commands from a host not identified as part of a sequential stream.</td>
</tr>
<tr>
<td>% Hit</td>
<td>The percent of operations that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>% Miss</td>
<td>The percent of operations that were misses. A miss occurs when the operation cannot be immediately satisfied from cache because the data is not there or the operation has to wait while data is destaged from cache to disks.</td>
</tr>
<tr>
<td>BE % Reads</td>
<td>The percent of read operations from the back-end directors that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>BE % Writes</td>
<td>The percent of write operations from the back-end directors that were immediately satisfied by cache.</td>
</tr>
<tr>
<td>BE Prefetched MBs/sec</td>
<td>The number of MBs prefetched from disk to cache per second.</td>
</tr>
<tr>
<td>Number of RDF Invalid Tracks</td>
<td></td>
</tr>
<tr>
<td>RDF Response Time (ms)</td>
<td></td>
</tr>
<tr>
<td>IO Density</td>
<td>The number of BE requests per GB of disk.</td>
</tr>
</tbody>
</table>
## Table 71 Volume metrics (continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE Partial Sector Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Optimize Writes (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE XOR Reads (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Copy (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Reads For VLUN Migration</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For VLUN Migration (MB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE Writes For Rebuild (KB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>BE RDF Copy (MB)</td>
<td>Internal metric.</td>
</tr>
<tr>
<td>Allocated Capacity (GB)</td>
<td>The allocated volume capacity.</td>
</tr>
<tr>
<td>Total Capacity (GB)</td>
<td>The total capacity of the volume.</td>
</tr>
<tr>
<td>Device Block Size</td>
<td>The block size of the volume.</td>
</tr>
<tr>
<td>Optimized Read Misses/sec</td>
<td>Number of read requests each second performed directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Optimized MBs Read Miss/sec</td>
<td>Number of host megabytes read each second directly from disks bypassing the cache.</td>
</tr>
<tr>
<td>Avg Optimized Read Miss Size (KB)</td>
<td></td>
</tr>
<tr>
<td>Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>Avg. Write Paced Delay (ms)</td>
<td></td>
</tr>
<tr>
<td>RDF Reads/sec</td>
<td></td>
</tr>
<tr>
<td>RDF Writes/sec</td>
<td></td>
</tr>
<tr>
<td>RDF MBs Read/sec</td>
<td></td>
</tr>
</tbody>
</table>
### Setting the time range for viewing data

In both the Monitor view and the Analyze view, you can configure a custom time range for which data is displayed.

To set the time range for viewing data:

**Procedure**

1. In either the Monitor or Analyze view, click the custom time range button.
2. Configure a start date and a start time for the time range.
3. Configure an end date and an end time for the time range.
4. Click OK.

### Creating a template dashboard from an Analyze view

To create a dashboard template from an Analyze view:

**Procedure**

1. Select component(s) from the table in an Analyze view.
2. Click Navigate to Charts

   The selected components are displayed in a New Chart view.
3. Select the metrics to be displayed.
4. Click Create.
5. Click Save as Template.

   The Save as Template dialog box displays.
6. Specify a template name.
7. Click OK to save the template.

### Filtering performance data

Unisphere includes different ways to filter performance data depending on the situation:

- Filter heatmaps by context. This allows you to filter according to an instance of a particular object. For example, a particular storage group or database.
- Filter arrays and metrics by name when creating charts.
- Filter analyze views, reports, and traces by any of the headings in the object list.
Filtering object lists

Procedure
1. Click the filter icon .
2. Do one of the following:
   • In any of the fields displayed, type all or part of the value for which you want to filter.
   • To change the fields displayed, click and select the Columns to display for filtering purposes.
   • To clear the filtering criteria, click and select one of the following options:
     ▪ Reset to Defaults
     ▪ Clear all filters

Filtering heatmaps

Procedure
1. Click the filter icon to open the filter dialog box.
2. From the Context menu, select an object type. The instances list updates to show the objects of that type.
3. Select an object from the instances list. You can filter the instances list by typing all or part of the object's name in the search field.
4. Click OK.
CHAPTER 8
Database Storage Analyzer

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Introduction

Database Storage Analyzer (DSA) is a feature that provides a database to storage performance troubleshooting solution for Oracle and MS SQL Server databases running on storage systems. No extra licensing cost is required in order to use DSA.

DSA is accessible by any Unisphere user. A DSA only user can also be created that has read only Unisphere access and can only view Databases section and Performance. Details on how to create users can be found at Creating local users on page 77.

The main database list view presents I/O metrics such as response time, Input/Output Operations per second (IOPS) and throughput from both the database and the storage system which helps to immediately identify any gap between the database I/O performance and the storage I/O performance.

DSA offers the following benefits:

- Provides a unified view across database and storage.
- Quickly identifies when a database is suffering from high I/O response times.
- Reduces troubleshooting time for database and/or storage performance issues—DBAs and SAs can look at a unified database and storage I/O metrics view and quickly identify performance gaps or issues on both layers.
- Identifies database bottlenecks that are not related to the storage.
- Maps DB objects to storage devices
- Allows better coordination between the SA and DBA.
- Reduces repetitive manual drill downs for troubleshooting.

DSA supports the mapping of database files located on VMware virtual disks to their storage system volumes. With full database mapping, DSA can actively monitor 15-30 databases per Unisphere installation, depending on database size. Registering a database or instance with no extents mapping option allows the user to monitor hundreds of databases.

RAC and ASM are supported for Oracle, for CDB DSA guest user name should be started with c##. An Oracle diagnostic pack license is required for monitoring Oracle databases.

In addition, DSA supports FAST hinting capabilities for Oracle and MS SQL databases on storage systems running HYPERMAX OS 5977 or higher that allows users to accelerate mission-critical database processes in order to achieve improved response time. The user provides the timeframe, the database objects that should be hinted and the business priority. DSA then sends hints to the array in advance so that the FAST internal engine promotes those Logical Block Addresses (LBAs) to the right tier at the right time.

---

**Note**

FAST hinting is only supported on hybrid arrays running HYPERMAX OS 5977 or higher.

Database collection and retention policy

For Oracle

DSA collects information by connecting directly to the monitored database through a database user. This read-only user only has select permissions on a fixed list of Oracle dictionary tables. DSA fetches data every five minutes and sends it back to the
Unisphere repository database where it aggregates the data into hourly and daily aggregations. By default, DSA saves the fetched data for fifteen days; however, this can be extended to thirty days. DSA saves the hourly aggregations for fifteen months and the daily aggregations for two years. To connect to the monitored database, verify that the database TNS port (usually 1521 or 1525) between the Unisphere repository server and the monitored database server is open.

For MS SQL Server
DSA collects information by connecting directly to the monitored database through a database user. This read-only user only has select permissions on a fixed list of MS SQL Server dictionary tables. DSA fetches the data directly from the MS SQL Server tables every second. The read only user can be created during the installation process or DBAs can create it manually prior to running the “Add database” option. The DSA user needs to have SYSADMIN privileges.

Note: a SYSADMIN role is required in order to collect object data. However, DSA login can be created with read only privileges, yet any functionality associated with object collection is disabled. DSA works with either MS SQL Server local user or as a Windows authenticated user.

Mapping files

The mapping process is responsible for mapping the Oracle and MS SQL Server files to the storage system devices. By default, the process runs once a week, however, it can be configured to run at different times.

An executable called Mapper is copied to the remote database server with a list of Oracle or MS SQL Server data files to map. This process identifies the host physical devices associated with the Oracle or MS SQL Server files, and then sends the list of storage devices back to be loaded into the Unisphere DSA repository.

For Oracle databases running on Linux or Unix OS, DSA requires a read only user on the database host that has sudo privileges to run the mapper script. A user is root or full root privileges can also be used. For MS SQL Server databases, the user needs to install a DSA Listener on the monitored environment. The listener should be manually installed before adding the new monitored database. In order to install the DSA listener on the monitored environment, go to the administration tab in DSA, click Register and then select the MS SQL Server option. Click DSA Listener to download it, copy it to the monitored environment and then follow the instructions in the readme.txt file. Note that the default port for the DSA listener is 22200. This is configurable from the DSA client. DSA mapper should not impact database activity on the monitored server.

In order to run the mapping on a database that is running on VMware virtual disks, make sure to add the virtual server to Unisphere. On the Unisphere client, go to HOME and then select VMware. Click Register vCenter/ESXi to register an ESXi server. In addition, set the parameter disk EnableUUID = "TRUE" in the ESXi server.

Virtual environments other than VMware are not supported, for example Solaris containers, AIX VIO and VPLEX.

Viewing Databases page

This view lists the monitored databases that have been registered. Both MS SQL Server and Oracle are displayed on the same list. This view allows you to quickly
identity a potential problem with a database by comparing the storage and database KPIs.

For an introduction to Database Storage Analyzer, see Introduction on page 728

Procedure

1. Click HOME.

2. Select DATABASES > Databases to view the full list of monitored environments and their associated properties.

   The following properties display for each monitored environment:
   - **Environment Name**—Name of the monitored environment.
   - **DB Type**—Type of database or instance.
   - **DB RT Status**—Percentage of occurrences where the response time was as expected, over, poor or missing samples. Hovering over the DB RT Status gives a breakdown of the percentage of occurrences where the database read response time was as expected, over, poor or missing samples.
   - **Status**—Status of database that takes into account collections, mapper, synchronizer and statistics status.
   - **DB Read RT (ms)**—Average database read response time in milliseconds.
   - **Storage Read RT (ms)**—Average storage read response time in milliseconds.
   - **DB IOPs**—Average Database Input/Output (I/O) per second (IOPS) is the number of reads from data file and temporary files and the number of writes to data files, temporary files, redo logs and archive files per second.
   - **Storage IOPs**—Average Storage IOPS is the number of reads and writes per second to the storage volumes that are associated with the database files.

3. Optional: Click and drag the properties columns to rearrange the column order.

4. Optional: Click the drop down menu to select the time range for the monitoring activity.

5. Optional: Create a filter for the list by clicking \( \text{filter} \) and typing any combination of properties.

6. Optional: Click \( \text{reset} \) to reset the filters to defaults setting, clear all filters or change the displayed columns.

7. Optional: Click \( \text{details} \) to open the details panel. Click an environment name instance to view summary Database, Storage and Statistics information about the environment.

   The following properties display for each monitored environment:
   - **Database**—the following properties display:
     - **Environment Name**—Name of the monitored environment.
     - **DB Host**—Hostname or IP address of the server the database is running on.
     - **DB Type**—Type of database or instance.
     - **DB Version**—Version of database software the database is running on the monitored environment.
- **Database Size (GB)** — Size of database.
- **DB Collection status** — Status of database collection. Clicking on the status icon brings you to the Administration tab where information about the status is displayed.
- **DB Mapping Status** — Status of database mapping. Clicking on the status icon brings you to the Administration tab where information about the status is displayed.
- **Storage Collection Status** — Status of storage collection. Clicking on the status icon brings you to the Administration tab where information about the status is displayed.

**Storage** — the following properties display:
- **Array** — Identity of the storage system that the database or instance is running on.
- **Storage Groups** — Storage Groups associated with the database. Click the number next to **Storage Groups** to go to the Storage Section.
- **SG Compliance** — Status indicating if the associated Storage Groups are in compliance with its service level.
- **Front End** — Displays the worst performing FE port or director port busy threshold status.
- **Capacity (GB)** — Database capacity in Gigabytes.
- **Number of Volumes** — Number of volumes in storage groups.
- **Masking Views** — Number of masking views.

**Statistics** — the following properties display:
- **DB Redo RT (ms)** — Average database Redo Write response time for the selected period of time based on Oracle statistics.
- **Storage Redo Write RT (ms)** — Average storage write response time for storage volumes where the database redo files are located.
- **DB IOPs Reads** — Average instance Input/Output (I/O) per second (IOPS) reads.
- **DB IOPs Writes** — Average instance Input/Output (I/O) per second (IOPS) writes.
- **DB IOPs Log Writes** — Average instance Input/Output (I/O) per second (IOPS) log writes.
- **DB Reads (MB/s)** — Average DB reads in milliseconds.
- **DB Writes (MB/s)** — Average DB writes from in milliseconds.
- **DB Log Writes (MB/s)** — Average DB log writes from in milliseconds.
- **DB Instance R/W Ratio** — Read to Write ratio for the database.

8. Optional: Click to open the details panel. Click **VIEW ALL DETAILS** to go to the Performance section for the monitored environment.

9. Optional: Double click an environment name instance to go the Performance section for the monitored environment.

**Viewing Database Administration page**

This task allows you to view the environment instances being monitored by DSA.
Note

To ensure that storage performance statistics are collected you need to enable Performance collection in Unisphere (see Registering storage systems on page 596).

For an introduction to Database Storage Analyzer, see Introduction on page 728

Procedure

1. Click HOME.

2. Select DATABASES > Administration to view the full list of monitored environments and their associated properties.

   The following properties display for each monitored environment:
   - **DB Name**—Name or IP address of the monitored environment or instance host.
   - **DB Type**—Type of database.
   - **DB Version**—monitored environment or instance version.
   - **Array**—Identity of the storage system that the database or instance is running on.
   - **Status**—Icon indicating the status of the system.

3. Optional: Create a filter for the list by clicking and defining any combination of Environment Name, Database Host, Database Type, Database Version, Array, System Status and Mapper Status.

4. Optional: Click to reset the filters to defaults setting, clear all filters or change the displayed columns.

   The following controls are available:
   - **Register**—Registering a monitored environment on page 733
   - **Edit**—Editing monitored Oracle databases on page 737 or Editing monitored MS SQL server instances on page 738
   - **Run Mapping**—Running device mapping on page 739
   - **Start Collection**—Starting statistics collection on page 739
   - **Stop Collection**—Stopping statistics collection on page 739
   - **Unregister**—Removing monitored environment instance on page 740
   - **Schedule Mapping Configuration**—Schedule device mapping on page 739

5. Optional: Select an environment instance and click to view details about the environment.

   The following properties display:
   - **Environment Name**—Name of the monitored environment.
   - **Last Mapping Date**—Date of last mapping of environment.
   - **Installation Date**—Date the environment was installed.
   - **Oldest Date**—Oldest date.
• Latest Available Data—Date of latest available data.
• Mapper Host—Host where the mapping process is executed.
• Mapper State—Pass or Fail status of mapping process.
• DB Collection State—Database collection state.
• DB Collection Status—Status of database collection.
• DB Mapping Status—Status of database mapping.
• Storage Collection Status—Status of storage collection.

Registering a monitored environment

• Registering an Oracle database (see Adding an Oracle database on page 733).
• Registering a MS SQL server (see Adding monitored MS SQL server instances on page 735).

Adding an Oracle database

This task allows you to add an Oracle database to be monitored by DSA. For discovery of a new database a user on the database will be required to be given read only GRANTs to certain v$ tables. Details of the GRANTS script can be found at (<Unisphere server IP address>/univmax/database/Oracle/create_emc_unisphere_guest_user.sql ). A user on the database host needs to be supplied with sudo access to run the mapper script. Details of what to update in the sudoers files are supplied on the mapping step of the wizard.

Procedure

1. Click HOME, then click DATABASES and then click Administration to view the full list of monitored environments and their associated attributes.
2. Click Register.
3. Select Oracle and click NEXT.
4. Enter values for the following parameters:
   • DB Host Name or IP Address—Name or IP address of the database host.
   • Service—Service name that may contain up to 16 alpha numeric characters.
   • SID—System identifier (SID) is a unique name for an Oracle database instance on a specific host.
   • Database Port—Database listener port number.
5. Click NEXT.
6. Select one of the following:
   • Create DB User—Creating a DSA user is used when a new DSA database user is added by the installation process. The sys user must be provided in SYS Password.
   • Existing DB User—Using an existing DSA user requires creating the user manually prior to the installation using the script provided.
7. Enter values for the following parameters:
- **DB Username**—Name of the database user.
- **DB Password**—User password for the database.

If you select the **Create DB User** option to create a new DSA user, the user can only connect to the database via the MS SQL server authentication mode. If you select **Existing DB Login**, the user also has the option to connect using Windows authentication mode.

Creating a DSA user is used when a new DSA login is added by the installation process. A SYSADMIN login must be provided during the next step of the installation.

Using an existing DSA login requires creating the user manually prior to the installation by running Create User Script (click **Create User Script** to access the script) provided using the SYSADMIN login, and then manually entering the new user during the installation. Note that SYSADMIN role is required in order to collect object data. However, DSA login can be created with read only privileges, yet any functionality associated with object collection is disabled. In order to map database files to Symmetrix devices, DSA needs to install a DSA Listener on the monitored environment. The listener can be installed by the installation process or manually. In order to install the DSA listener manually on the monitored environment, click **DSA Listener** to download it, copy it to the monitored environment host, extract to `C:\EmcDBAgent` and follow the instructions in the readme.txt file.

8. Click **NEXT**.

9. For non-root users, enter values for the following parameters:
   - **Mapper Host Name or IP Address**—Host name or IP address where the mapping process is executed.
   - **SSH Port**—Port where the mapping process is executed.
   - **SSH Username**—SSH username.

   **Note**
   
   SSH needs to be configured on your system and you need to confirm that the appropriate permissions are set for the sudo login user in the sudoers file.

   - **Login User**—Sudo user name (mandatory field).
   - **Login Password**—Sudo user password (mandatory field).
   - **SSH Password**—SSH password.

10. Click **NEXT**.

11. Click **Advanced Options** (see **Registering Monitored Environment - Advanced Options** on page 734)

12. Click **NEXT**.

13. Review details and click **FINISH**.

### Registering Monitored Environment - Advanced Options

#### Procedure

1. Oracle only: Enter or select values for the following parameters:
• **Use <login user id> home directory to store mapping files**— Select this option to use the login user's home directory to store the mapping files. The temporary mapping files are stored by default in temp directories. Copy the mapper command line information by clicking on the "i" button and edit the user entry in the sudoers file. For example: test ALL=NOPASSWD:/home/test/UnisphereMapper_hostname_SID_on_*/.*./mapper_agent.sh map -file dbfiles.dat -log_file dbc_mapper.log. Ensure that the user has permissions for the /home/user directory.

• **Alternative path to sudo**— Use an alternative path to sudo if sudo is not available by default or you would like to specify a different sudo path.

• **Run sudo interactively**— Select this option to run substitute user do (sudo) interactively. This allows users to run Use login user home directory to store mapping files programs with the security privileges of another user (normally the superuser, or root).

• **Disable mapping extents**— Select this option for extremely large databases, when you wish to monitor a large number of databases, or if there are issues mapping a database. With mapping extents disabled, database objects with not be mapped to storage devices. As a result, the Database Objects list view on the Analytics Tab will not contain database objects. Hinting will be disabled but all other functionality will work as normal.

2. **MS SQL server only:** Select a value for the following parameter:

   **Disable mapping extents**— Select this option for extremely large databases, when you wish to monitor a large number of databases, or if there are issues mapping a database. With mapping extents disabled, database objects with not be mapped to storage devices. As a result, the Database Objects list view on the Analytics Tab will not contain database objects. Hinting will be disabled but all other functionality will work as normal.

   It is recommended to disable mapping extents if you have a MS SQL Server instance with a large number of databases.

3. Click **OK**.

### Adding monitored MS SQL server instances

This task allows you to add MS SQL server instances to be monitored by DSA. For discovery of a new database a user on the database will be required to be given read only GRANTs to certain tables. Details of the GRANTS script can be found at (<Unisphere server IP address>/univmax/database/ MSSQLServer/ create_emc_unisphere_guest_user.sql ).

**Procedure**

1. Click **HOME**, then **DATABASES** and then **Administration** to view the full list of monitored environments and their associated attributes.

2. Click **Register**.

3. Select **MS SQL Server** and click **NEXT**.

4. Enter values for the following parameters:

   • **DB Host Name or IP Address**— Name or IP address of the database host.
- **Database Name**—Name of database.
- **Instance**—Instance name or ID.
- **Database Port**—Database listener port number.

5. Click NEXT.

6. Enter values for the following parameters:
   - **Create DB User**—Create a new database user.
   - **Existing DB User**—Login as an existing database user.
   - Click Learn More about creating a DB User to learn more about creating a DB user or using an existing DB user.
   - **Windows Authentication Mode**—Windows Authentication Mode or SQL Server Authentication Mode.
   - **SQL Server Authentication Mode**—SQL Server Authentication Mode.
   - **DB Username**—Database username. This is the user running the mapping executable. This user needs to be part of the Administrator group on the database server.
   - **DB Password**—Database Password. This is the windows password of the user running the mapping executable.
   - **Sys Admin Login**—SYSADMIN login name. A SYSADMIN login is temporarily used to set up the DSA login.
   - **SYS Password**—SYSADMIN password.

If you select the Create DB User option to create a new DSA user, the user can only connect to the database via the SQL server authentication mode. If you select Existing DB Login, the user also has the option to connect using Windows authentication mode.

Creating a DSA user is used when a new DSA login is added by the installation process. A SYSADMIN login must be provided during the next step of the installation.

Using an existing DSA login requires creating the user manually prior to the installation by running Create User Script (click Create User Script to access the script) provided using the SYSADMIN login, and then manually entering the new user during the installation. Note that SYSADMIN role is required in order to collect object data. However, DSA login can be created with read only privileges, yet any functionality associated with object collection is disabled. In order to map database files to Symmetrix devices, DSA needs to install a DSA Listener on the monitored environment. The listener can be installed by the installation process or manually. In order to install the DSA listener manually on the monitored environment, click DSA Listener to download it, copy it to the monitored environment host, extract to C:\EmcDBAgent and follow the instructions in the readme.txt file.

7. Click NEXT.

8. Modify any number of the following values:
   - **Mapper Host Name or IP Address**—Host name or IP address where the mapping process is executed.
   - **SSH Port**—Port where the mapping process is executed.
   - **SSH Username**—SSH username.
Editing monitored Oracle databases

This task allows you to edit Oracle database records already being monitored by the Database Storage Analyzer (DSA) application.

Procedure

1. Click HOME, then DATABASES and then Administration tab to view the full list of monitored environments and their associated attributes.
2. Select an Oracle database and click Edit.
3. Modify any number of the following values:
   - **DB Host Name or IP Address**—Name or IP address of the database host.
   - **DB Username**—Database username. This is the user running the mapping executable. This user needs to be part of the Administrator group on the database server.
   - **Service**—Service name that may contain up to 16 alpha numeric characters.
   - **SID**—System identifier (SID) is a unique name for an Oracle database instance on a specific host.
   - **DB Password**—Database Password. This is the windows password of the user running the mapping executable.
   - **Database Port**—Database listener port number.
4. Click NEXT.
5. Modify any number of the following values:
   - **Mapper Host Name or IP Address**—Host name or IP address where the mapping process is executed.
   - **SSH Port**—Port where the mapping process is executed.
   - **SSH Username**—SSH username.
   - **SSH Password**—Secure SSH password.

**Note**

SSH needs to be configured on your system and you need to confirm that the appropriate permissions are set for the sudo login user in the sudoers file.

6. Click NEXT.
7. Modify any number of the following values:
   - **Use home directory to store mapping files**—Select this option to use the login user's home directory to store the mapping files. The temporary mapping files are stored by default in temp directories.
   - **Sudo access for account**—Select this option if sudo access needed for the account.
   - **Alternative path to sudo**—Use an alternative path to sudo if sudo is not available by default or you would like to specify a different sudo path.
- Run sudo interactively—Select this option to run substitute user do (sudo) interactively. This allows users to run programs with the security privileges of another user (normally the superuser, or root).

8. Click NEXT.
9. Review details and click FINISH.

Editing monitored MS SQL server instances

This task allows you to edit MS SQL server instances already being monitored by the Database Storage Analyzer (DSA) application.

Procedure
1. Click HOME, then DATABASES and then Administration to view the full list of monitored environments and their associated attributes.
2. Select an instance of MS SQL Server and click Edit to open a dialog.
3. Modify any number of the following values:
   - DB Host Name or IP Address—Name or IP address of the database host.
   - Database Name—Name of database.
   - Instance—Instance or ID.
   - Database Port—Database listener port number.
4. Click NEXT.
5. Modify any number of the following values:
   - Windows Authentication Mode—Windows Authentication Mode or SQL Server Authentication Mode.
   - SQL Server Authentication Mode—SQL Server Authentication Mode.
   - DB Username—Database username. This is the user running the mapping executable. This user needs to be part of the Administrator group on the database server.
   - DB Password—Database Password. This is the windows password of the user running the mapping executable.
6. Click NEXT.
7. Modify any number of the following values:
   - Mapper Host Name or IP Address—Host name or IP address where the mapping process is executed.
   - SSH Port—Port where the mapping process is executed.
   - SSH Username—SSH username.
   - SSH Password—Secure SSH password.
8. Click NEXT.
9. Review details and click FINISH.
Starting statistics collection

This task allows you to start statistics collection for the monitored environment instance.

Procedure
1. Click HOME.
2. Select DATABASES > Administration to view the full list of monitored environments and their associated properties.
3. Select an environment instance and click Start Collection to start statistics collection for the database or instance.
4. Click OK to confirm.

Stopping statistics collection

Procedure
1. Click HOME.
2. Select DATABASES > Administration to view the list of monitored environments and their associated attributes.
3. Select an environment instance and click Stop Collection to stop statistics collection for the database or instance.
4. Click OK to confirm.

Running device mapping

This task allows you to manually run device mapping for a monitored database or instance. During device mapping, the list of database or instance files is copied using ssh to the monitored database or instance host. A process executing on the monitored database or instance host identifies the list of host physical devices associated with those files. The list is sent back and loaded into the DSA repository.

Procedure
1. Click HOME.
2. Select DATABASES > Administration to view the full list of monitored environments and their associated properties.
3. Select an environment and click Run Mapping to run device mapping for the database record.
4. Click OK to confirm.

Schedule device mapping

This task allows you to schedule device mapping for a monitored database or instance. During device mapping, the list of database or instance files is copied using ssh to the monitored database or instance host. A process executing on the monitored database or instance host identifies the list of host physical devices associated with those files. The list is sent back and loaded into the DSA repository.
Procedure

1. Click HOME.
2. Select DATABASES > Administration to view the full list of monitored environments and their associated properties.
3. Select an environment, click and then click Schedule Mapping Configuration.
4. Select day(s) of the week and the time.
5. Click OK.

Removing monitored environment instance

This task allows you to remove environment instances so that they are no longer monitored by DSA.

Procedure

1. Click HOME.
2. Select DATABASES > Administration to view the full list of monitored environments and their associated properties.
3. Select an environment instance and click and then click Unregister to remove the selected database or instance.
4. Click OK to confirm.

Viewing the Performance Page

The Performance page provides database and storage information in a single view allowing Database Administrators and Storage Administrators to troubleshoot performance issues in a more timely manner.

Procedure

1. Click HOME.
2. Select DATABASES > Databases to view the full list of monitored environments and their associated properties.
3. Do one of the following:
   • Double click on a database name instance to navigate to the view all details section. The performance tab is displayed.
   • Click on a database name instance and click to open the details panel. Click VIEW ALL DETAILS to go to the Performance section for the monitored environment.
4. Optional: Click the Analytics tab to navigate to the Analytics area where you can analyze the I/O characteristics of specific business processes running in the database.
5. Optional: Click the Storage tab to navigate to the Storage area where you can view database related information.
6. Optional: Click the **Hinting** tab to navigate to the **Hinting** area where you can view hint related information.

7. Optional: For MS SQL Server databases only. Click the **Database** tab to navigate to the **Databases** area where you can view the list of monitored environments.

8. Optional: On the **Performance** tab, click the **Dashboard** button to navigate to the **PERFORMANCE** area where you can view the **Performance** details for each database.

9. Optional: On the **Performance** tab, click the **Heatmap** button to view a Heatmap related to the storage associated with the selected monitored environment.

10. Click the drop-down menu to select the time range for the monitoring activity.

11. For Oracle environments, view the performance chart for **I/O Wait minutes**. The x-axis represents time and the y-axis represents the following:
   - **I/O Wait**—Time spent waiting for I/O operations to complete.
   - **Non-I/O Wait**—Time spent waiting for non-I/O operations to complete.
   - **Redo**—Time spent waiting for redo operations to complete.
   - **Background**—Time spent by background process waiting for a database resource.

12. For pre-Oracle 12 environments, view the performance chart for **Average Active Session Wait**. The x-axis represents time and the y-axis represents the accumulative time the sessions in the database are waiting for each event/class. The Oracle wait classes are listed below:
   - **Administrative**—Waits resulting from DBA commands (for example, an index rebuild).
   - **Application**—Waits resulting from user application code (for example, lock waits caused by row level locking or explicit lock commands).
   - **Cluster**—Waits related to Real Application Cluster resources (for example, global cache resources such as ‘gc cr block busy’).
   - **Commit**—This wait class only comprises one wait event - wait for redo log write confirmation after a commit (that is, 'log file sync').
   - **Concurrency**—Waits for internal database resources (for example, latches).
   - **Configuration**—Waits caused by inadequate configuration of database or instance resources (for example, undersized log file sizes, shared pool size).
   - **Network**—Waits related to network messaging (for example, 'SQL*Net more data to dblink').
   - **ORA CPU**—Sessions that are consuming CPU.
   - **ORA Wait CPU**—Waits for CPU – Sessions waiting in the CPU queue.
   - **OS CPU**—Displays the non-database process waiting/consuming CPU on the host.
   - **Other**—Waits which should not typically occur on a system (for example, 'wait for EMON to spawn').
   - **Scheduler**—Resource Manager related waits (for example, 'resmgr: become active').
• **System I/O**—Waits for background process I/O (for example, DBWR wait for 'db file parallel write').

• **User I/O**—Waits for user I/O (for example 'db file sequential read').

13. For MS SQL server instances, view the performance chart for **I/O Wait vs. Non-I/O Wait**.

14. For MS SQL server instances, view the performance chart for **Wait Classes over Time**.

   There are filters for the response time, IOPs, throughput and I/O size kb charts referred to in the next steps. You can turn on or off database reads, writes and redo writes (Oracle), Log Writes (MS SQL Server) and storage reads, writes and redo writes (Oracle) Log Writes (MS SQL Server) for all four charts at the same time. For MS SQL Server environments, a filter icon is visible that allows the four charts listed above to be filtered to a database rather than at the instance level.

15. **View the performance chart for Response Time.**

   The x-axis represents time and the y-axis represents the response time for Reads, Writes and Redo Writes (Oracle only) or Log Writes (SQL server only) for both Database and Storage. All of the Storage statistics represents the storage devices that are associated with the database rather than the entire array. Clicking DB Read Response Time Thresholds enables the display of threshold lines on the chart. The thresholds are based on the database thresholds as defined in the system. If you hover over the line, you will see the threshold information. The first threshold for database response time is 20ms. The second threshold for database response time is 30ms.

   The DB Read Response Time Thresholds can be turned on or off for the response time chart. (Thresholds are configured per environment - see [Managing Database Storage Analyzer (DSA) environment preferences](#) on page 86).

   There are filters (EFD, 15k, 10k, 7.2k and DX) that can turned on or off on IOPS and throughput MB/s charts.

   The charts can be filtered to show reads or writes using the drop down.

16. **View the performance chart for IOPS.**

   The x-axis represents time and the y-axis represents IOPS for Reads, Writes and Redo Writes for both Database and Storage. Note that for Oracle12 PDB, the redo statistics can be seen at the CDB level only.

   A IOPS Density check box will display IOPS density in the IOPS chart.

17. **View the performance chart for Throughput.** The x-axis represents time and the y-axis represents Throughput for Reads, Writes and Redo Writes for both Database and Storage.

18. **View the performance chart for I/O Size kb.** The x-axis represents time and the y-axis represents I/O size for reads, writes and redo writes for both database and storage. Information about the average IO size for reads, writes and redo writes (for both database and storage).

19. **View the performance chart for IOPS for the Storage Back-end Activity and Tier Capacity.** The x-axis represents time and the y-axis represents IOPS for Reads or Writes (displayed with or without Density) for EFD, FC or SATA drives.
20. View the performance chart for **Throughput** for the Storage Back-end Activity and Tier Capacity. The x-axis represents time and the y-axis represents Throughput for Reads or Writes (displayed with or without Density) for EFD, FC or SATA drives.

21. View the performance chart for **Tier Capacity** for the Storage Back-end Activity and Tier Capacity. The x-axis represents time and the y-axis represents Tier Capacity for Reads or Writes (displayed with or without Density) for EFD, FC or SATA drives.

**Viewing the Analytics Page**

The Analytics page provides a means to analyze the I/O characteristics of specific business processes running in the database. Oracle wait events represent the various event types that Oracle sessions are waiting for. This information is helpful in the analysis of database bottlenecks. Wait classes are a way of grouping events to logical groups for high level analysis. There is a filter icon on the top of the Analytics view that filters the chart and the list below it.

**Procedure**

1. Click HOME.

2. Select DATABASES > Databases to view the full list of monitored environments and their associated properties.

3. Do one of the following:
   - Double click on a database name instance to navigate to the view all details section. The performance tab is displayed.
   - Click on a database name instance and click ✖️ to open the details panel. Click VIEW ALL DETAILS to go to the Performance section for the monitored environment.

4. Click the Analytics tab.

5. Click the drop-down menu to select the time range for the monitoring activity.

6. For an Oracle database, click the drop down menu and select the performance chart for **IO Wait Classes**. The x-axis represents time and the y-axis represents the following wait classes:
   - **Single Block Read**—Wait class associated with Single Block read operations.
   - **Multi-Block Read**—Wait class associated with Multi-Block read operations.
   - **Direct I/O**—Wait Class that represents an I/O operation where the data is asynchronously read from the database files. It comprises of the following wait events: direct path read temp, direct path write temp, direct path write, and direct path read.
   - **Other I/O**—Wait Class that comprises of I/O events where the type of I/O (for example, random or sequential scan) is unknown.
   - **System I/O**—Wait Class associated with system I/O operations.
   - **Commit**—Wait Class associated with database commit.

7. For an Oracle database, click the drop down menu and select the performance chart for **IO Wait Events**. The x-axis represents time and the y-axis represents the following wait classes:
- **Application**—Waits resulting from user application code (for example, lock waits caused by row level locking or explicit lock commands).
- **Commit**—This wait class only comprises one wait event - wait for redo log write confirmation after a commit (that is, 'log file sync').
- **Concurrency**—Waits for internal database resources (for example, latches).
- **Configuration**—Waits caused by inadequate configuration of database or instance resources (for example, undersized log file sizes, shared pool size).
- **CPU + Wait for CPU**—Sessions that are consuming CPU or waiting in the CPU queue.
- **System I/O**—Waits for background process I/O (for example, DBWR wait for 'db file parallel write').
- **User I/O**—Waits for user I/O (for example 'db file sequential read').
- **Other**—Waits which should not typically occur on a system (for example, 'wait for EMON to spawn').
- **Direct I/O**—Wait class that represents an I/O operation where the data is asynchronously read from the database files. It comprises of the following wait events: direct path read temp, direct path write temp, direct path write, and direct path read.
- **Single Block I/O**—Wait class associated with Single Block I/O operations.
- **Commit**—Wait class associated with database commit.
- **Multi-Block I/O**—Wait class associated with Multi-Block I/O operations.
- **Other I/O**—Wait class that comprises of I/O events where the type of I/O (for example, random or sequential scan) is unknown.

8. For an Oracle database, click the drop down menu and select the performance chart for All Wait Classes. Wait events represent the exact wait type the Oracle process is waiting on. Every wait event belongs to a class of wait event. The x-axis represents time and the y-axis represents the accumulative time the sessions in the database are waiting for each event/class.

9. For an Oracle database, click the drop down menu and select the performance chart for All Wait Events. Wait events represent the exact wait type the Oracle process is waiting on. Every wait event belongs to a class of wait event. The x-axis represents time and the y-axis represents the accumulative time the sessions in the database are waiting for each event/class.

10. For a MS SQL server instance, select the **Wait Classes** context and view the performance chart for Analytics Wait Classes. The x-axis represents time and the y-axis represents the accumulative time the sessions in the database where waiting for each wait event/class. The SQL server wait classes are listed below:

- **Buffer I/O**
- **Buffer Latch**
- **CPU**
- **Latch**
- **Locks**
- **Logging**
- **Memory**
- **Network I/O**
• Waiting for CPU
• Other

11. For a MS SQL server instance, select the Wait Events context, and view the performance chart for Analytics Wait Events. Wait events represent the exact wait type the MS SQL server process is waiting on. Every wait event belongs to a class of wait event. The x-axis represents the date and the y-axis represents the accumulative time the sessions in the database where waiting for each wait event/class.
  • Running
  • PAGEIOLATCH_SH
  • Runnable
  • LCK_M_U
  • LATCH_EX
  • Null event
  • LCK_M_IX
  • PREEMPTIVE_OS_DECYPRTMESSAGE
  • LCK_M_X
  • OTHERS
  • PREEMPTIVE_OS_ENCRYPTMESSAGE

12. View the properties of the Oracle Database Objects.
  • Owner—Owner of object, for example, SYSTEM.
  • Object Name—in the case of a partition object, the partition name is displayed.
  • Sub-Object Name—in the case where the object is partitioned, the sub-object name contains the partition name.
  • Object Type—Type of object, for example, table or index.
  • Object Size—Size of the object in MB.
  • IO Wait Time—I/O Wait time in seconds.
  • IO Type—I/O Type is one of the following:
    • Single Block Read
    • Multi Block Read
    • Direct I/O
    • System I/O
    • Commit I/O
    • Other I/O
    • Row I/O
  • Hints—Database Hints.

13. View the properties of the MS SQL server instance objects.
  • Database name—Name of the database.
  • Schema name—Name of the schema.
  • Object Name—in the case of a partition object, the partition name is displayed.
- **Partition**—Partition name.
- **Type**—Type of object, for example, table or index.
- **Object Size**—Size of the object in MB.
- **File Group**—Associated file group.
- **IO Wait Time**—I/O Wait time in seconds.

14. View the properties of the Oracle **Array Devices**.
- **Host Device**—Host devices that are associated with the monitored environment.
- **Array Device**—storage system devices associated with the monitored environment.
- **IO Wait Time**—I/O Wait time in seconds.
- **IO Type**—I/O Type is one of the following:
  - Single Block Read
  - Multi Block Read
  - Direct I/O
  - System I/O
  - Commit I/O
  - Other I/O
  - Row I/O

You can also view Oracle database session contextual information. The following is the list of session context types:
- Program Names
- Login Users
- Machines
- Modules
- Services
- Nodes

You can also view MS SQL server database session contextual information. The following is the list of session context types:
- Hosts
- Program Names
- NT Domains
- NT Users
- Login Names
- Original Login Names
- Login Databases

The following controls are available:
- **Details**—Viewing analytics details on page 747
- **Add to Hint**—Adding hints on page 748
Viewing analytics details

Procedure
1. Click HOME.
2. Select DATABASES > Databases to view the full list of monitored environments and their associated properties.
3. Do one of the following:
   - Double click on a database name instance to navigate to the view all details section. The performance tab is displayed.
   - Click on a database name instance and click to open the details panel. Click VIEW ALL DETAILS to go to the Performance section for the monitored environment.
4. Click the drop-down menu to select the time range for the monitoring activity.
5. Click the Analytics tab.
   You can also view Oracle database session contextual information. The following is the list of session context types:
   - Program Names
   - Login Users
   - Machines
   - Modules
   - Services
   - Nodes
   You can also view MS SQL server database session contextual information. The following is the list of session context types:
   - Hosts
   - Program Names
   - NT Domains
   - NT Users
   - Login Names
   - Original Login Names
   - Login Databases
6. After selecting the context type and an instance of it, click Details.
   A dialog is displayed showing session/object details on one tab and device details on another tab.

Viewing database storage details

Procedure
1. Click HOME.
2. Select DATABASES > Database.
3. Select an environment, click 🔄, and then click VIEW ALL DETAILS.
   A screen is displayed with five tabs. The contents of the Performance tab are displayed by default.

4. Click the Storage tab.
   The Storage tab consist of three panels: a Database Properties panel displaying Instance, version and last mapping date information; a Database Array Properties panel displaying the allocated capacity of the array; and a Devices panel listing the devices and their associated storage group, service level, capacity (in GB) and host device.

Viewing database details

Procedure
1. Click HOME.
2. Select DATABASES > Database.
3. Select an environment, click 🔄, and then click VIEW ALL DETAILS.
   A screen is displayed with five tabs. The contents of the Performance tab are displayed by default.
4. Click the drop-down menu to select the time range.
5. Click the Databases tab.
   The Databases tab consists of a view displaying a list of environment names and their associated properties: DB RT Status, DB Read RT(ms), DB IOPs and DB MB/s.

Adding hints

Before you begin
- The storage system must be a hybrid array running HYPERMAX OS 5977 or higher.
- The database must be an Oracle or MS SQL Server database.
- DSA is accessible by users as described in Roles on page 70.

A hint helps to assure the best response time for mission critical processes or database objects.

Procedure
1. Click HOME.
2. Select DATABASES > Databases to view the full list of monitored environments and their associated properties.
3. Do one of the following:
   - Double click on a database name instance to navigate to the view all details section. The performance tab is displayed.
   - Click on a database name instance and click 🔄 to open the details panel.
     Click VIEW ALL DETAILS to go to the Performance section for the monitored environment.
4. Click the Analytics tab.
5. Select one, more than one, or all database objects and click Add to Hint to open the Hint wizard.
6. Select New or Existing Hint Type and click Next.
7. Type the hint name.
8. Select the Hint Priority. Possible values are 1 through 3, with 1 being the highest.
   - Priority 1—Simulates a diamond service level. It marks all extents as active including the inactive ones and move data to EFD ahead of time. The primary use case for this priority is a periodic process such as end of month process where the assumption is that most of the data is inactive during the month.
   - Priority 2—Simulates a Platinum (OLTP) service level. It marks all extents as active (even the inactive ones) but there is no immediate promotion. The primary use case is ensuring that a given process receives better response time than other processes in the storage group even if the data was inactive.
   - Priority 3—Simulates a Platinum (DSS) service level change response time target without marking the inactive extents. The primary use case is to ensure that a given process receives better response time than other processes in the storage, yet it is less powerful than priority 2 as it only promotes active data.
9. Select the Hint Type. Possible values are:
   - One Time—Type a value for the start date and time and the end date and time.
   - Ongoing—Hints are applied for the selected objects on an ongoing 24/7 basis.
   - Recurrence — Select the recurrence pattern.
     - Daily—Occurs on a daily basis.
     - Weekly—Select one or more days of the week.
     - Monthly—Type the day of the month.
10. Type the values for the recurrence range—the start date and time and the end date and time.
11. Optional: Deselect database objects to add to the hint.
    Note: there has to be at least one database object associated with the hint.
12. Click FINISH.

**Viewing hints**

**Before you begin**
To view hint logs, refer to Viewing hint logs on page 752.
- The storage system must be a hybrid array running HYPERMAX OS 5977 or higher.
- The database must be an Oracle or MS SQL Server database.
- DSA is accessible by users as described in Roles on page 70.

A hint helps to assure the best response time for mission critical processes or database objects.
For an introduction to Database Storage Analyzer, see Introduction on page 728

Procedure

1. Click HOME.
2. Select DATABASES > Hinting to view the hints relating to all environments.
   You can also view hints for a specific environment by navigating to the view all details section and clicking on the Hinting tab.
3. Click Hinting to view all the hints relating to all the environments and their associated properties.
   The following properties display for each hint:
   - **Hint Name**—Name of the hint.
   - **Environment Name**—Name of the database associated with the hint.
   - **Host**—Name of the database host associated with the hint.
   - **Priority**—Priority associated with the hint.
   - **Status**—Status of the hint when it was last run.
   - **Symmetrix ID**—Identity of the current Symmetrix that the database is running on.
   The following controls are available:
   - **Modify**—Editing hints on page 750
   - **Enable**—Enabling hints on page 751
   - **Disable**—Disabling hints on page 751
   - **Remove**—Removing hints on page 752

Editing hints

Before you begin
- The storage system must be a hybrid array running HYPERMAX OS 5977 or higher.
- The database must be an Oracle or MS SQL Server database.
- DSA is accessible by users as described in Roles on page 70.

A hint helps to assure the best response time for mission critical processes or database objects.

Procedure

1. Click HOME.
2. Select DATABASES > Hinting to view the hints relating to all environments.
3. Click the hint that you wish to edit and click **Modify** to open the Hint wizard.
4. Optional: Modify the hint name.
5. Optional: Modify the **Hint Priority**. Possible values are 1 through 3, with 1 being the highest.
6. Optional: Modify the **Hint Type**. Possible values are:
   - **One Time** — Type a value for the start date and time and the end date and time.
Enabling hints

Before you begin

- The storage system must be a hybrid array running HYPERMAX OS 5977 or higher.
- The database must be an Oracle or MS SQL Server database.
- DSA is accessible by users as described in Roles on page 70.
- The hint is disabled.

A hint helps to assure the best response time for mission critical processes or database objects.

Procedure

1. Click HOME.
2. Select DATABASES > Hinting to view the hints relating to all environments.
3. Select the hint that you wish to enable and click Enable.
4. Click OK to confirm the operation.

Disabling hints

Before you begin

- The storage system must be a hybrid array running HYPERMAX OS 5977 or higher.
- The database must be an Oracle or MS SQL Server database.
- DSA is accessible by users as described in Roles on page 70.
- The hint is enabled.

A hint helps to assure the best response time for mission critical processes or database objects.

Procedure

1. Click HOME.
2. Select DATABASES > Hinting to view the hints relating to all environments.
3. Select the hint that you wish to enable and click Disable.
4. Click OK to confirm the operation.

Removing hints

**Before you begin**

- The storage system must be a hybrid array running HYPERMAX OS 5977 or higher.
- The database must be an Oracle or MS SQL Server database.
- DSA is accessible by users as described in Roles on page 70.

A hint helps to assure the best response time for mission critical processes or database objects.

**Procedure**

1. Click HOME.
2. Select DATABASES > Hinting to view the hints relating to all environments.
3. Select the hint that you wish to remove and click Remove.
4. Click OK to confirm the operation.

Viewing hint logs

**Before you begin**

- The storage system must be running HYPERMAX OS 5977 or higher.
- The database must be an Oracle or MS SQL Server database.

A hint helps to assure the best response time for mission critical processes or database objects.

**Procedure**

1. Click HOME.
2. Select DATABASES > Hinting to view the hints relating to all environments.
   
   You can also view hint logs for a specific environment by navigating to the view all details section and clicking on the Hinting tab.
3. Select Logs from the drop down menu to view the full list of view the full list of hint logs and their associated properties.
   
   You can also view hints for a specific environment by navigating to the view all details section and clicking on the Hinting tab.

   The following properties display for each hint log:

   - **Sent Time**—Time that the hint was sent to the storage system.
   - **Hint Name**—Name of the hint.
   - **Environment Name**—Name of the database associated with the hint.
   - **Host**—Name of the database host associated with the hint.
   - **Priority**—Priority associated with the hint.
   - **Symmetrix ID**—Identity of the current Symmetrix that the database is running on.
• **Start Date**—Start date and time.
• **End Date**—End date and time.
• **Status**—Status of the hint when it was last run.
• **Description**—This lists the name of the user that created the hint.
• **Size(GB)**—The size of the log.
• **Hint ID**—Hint identity received from the storage system.

**Hint operations**

- Viewing hints (see Viewing hints on page 749).
- Viewing hint logs (see Viewing hint logs on page 752).
CHAPTER 9

VMware

Topics include:

- **Understanding Unisphere support for VMware**............................. 756
- **Viewing vCenters and ESXi information**........................................ 756
- **Registering vCenter/ESXi**.............................................................. 757
- **Editing vCenter/ESXi**................................................................. 758
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- **Viewing ESXi server details**.......................................................... 759
- **Viewing ESXi server masking views**............................................. 760
- **Viewing ESXi server performance details**....................................... 760
- **Viewing ESXi server virtual machines details**............................... 761
- **Viewing ESXi server virtual machine disks**.................................... 762
Understanding Unisphere support for VMware

Unisphere support for VMware provides the storage admin access to all the relevant storage related objects to an ESXi server and also provides the ability to help troubleshooting storage performance related issues to the ESXi server.

You can, as a read only user, discover at the vCenter level as well as discovering an individual ESXi server. If a vCenter is discovered, then all ESXi servers under that vCenter are discovered. All ESXi servers, that do not have local storage on the Unisphere performing the discovery, are filtered out.

Once VMware information is added by a user, all other users of Unisphere are able to access this information.

The minimum version number supported by vCenter is version 5.5.

Viewing vCenters and ESXi information

For an overview of Unisphere support for VMware, see Understanding Unisphere support for VMware on page 756.

This view displays a list view containing all the ESXi Hosts that will have relationships with a local storage system discovered by Unisphere.

A relationship between a storage system and a ESXi Host is defined as the storage system having a masking view configured with a storage group that is visible in ESXi Host Storage Adapters (Port Group configuration).

Procedure

1. Select **VMWARE > vCenters and ESXi** from the menu bar on the left side of the screen.

   The vCenters and ESXi list view is displayed. It displays the following properties:

   - **ESXi** - ESXi name.
   - **vCenter** - IP address of the vCenter.
   - **SG Compliance** - Displays the value of Storage Group (SG) compliance of the worst performing SG that's associated with the ESXi Server.
   - **Front End** - Displays the value of the worst performing Front End (FE) Port Busy for all arrays associated with the ESXi Server.
   - **Discovered Time** - Date and time of discovery.

2. Click ![icon](image)

   The vCenters and ESXi details view is displayed. It displays the following properties:

   - **Name** - ESXi name.
   - **Version** - ESXi server version.
   - **Build Number** - ESXi server build number.
   - **CPU Cores** - ESXi server hardware CPUs configuration.
   - **Service Console Memory** - ESXi server hardware service console memory configuration.
• **Memory** - ESXi server hardware total memory configuration.

The following controls are available:

• **Register vCenter/ESXi Server** - Registering vCenter/ESXi on page 757
• **Edit** - Editing vCenter/ESXi on page 758
• **Rediscover** - Rediscover vCenter/ESXi on page 759
• **Unregister vCenter/ESXi Server** - Unregistering vCenter/ESXi on page 758

3. Optional: Choose a day or time to retrieve performance related data to the FE Ports over the selected period.

Example: ESXi Server A has five storage groups that are associated with two arrays (Array 1 and Array 2). The 5 SGs have the following compliance status:

- Three are stable
- One is marginal
- One is underperforming

Array 1 and Array 2 have the following Front End (FE Port) status: Two are stable.

In the above scenario, the following is displayed for ESXi Server A:

- SG Compliance: Underperforming (Red icon)
- FE Port: Stable (Green icon)

### Registering vCenter/ESXi

For an overview of Unisphere support for VMware, see [Understanding Unisphere support for VMware](#) on page 756.

You can register a new vCenter/ESXi Server by selecting "Register vCenter/ESXi Server" action in the VMWare view or by clicking the link for "Register vCenter/ESXi Server" in the Get Started section (if no servers are added yet).

**Note**

This operation may take a considerable length of time for a large vCenter.

To register a vCenter/ESXi Server instance:

**Procedure**

1. Select **VMWARE > VCenters and ESXi** from the menu bar on the left side of the screen.

   The vCenters and ESXi list view is displayed or the Getting Started view is displayed.

2. Click **Register vCenter/EXSI Server**.

3. Type the fully qualified name or IP address of the server (Server/IP Address).

4. Type the username used to connect to the server.

5. Type the password used to connect to the server.

6. Do one of the following:
Editing vCenter/ESXi

To edit an existing vCenter/ESXi Server instance:

**Procedure**

1. Select **VMWARE > VCenters and ESXi** from the menu bar on the left side of the screen.
   
   The vCenters and ESXi list view is displayed.

2. Select a vCenter/ESXi Server and click **Edit**.

3. Edit the fully qualified name or IP address of the server (Server/IP Address).
   
   In case the user edits the server name to a totally new server, Unisphere removes the old server details and adds the new server details.

4. Edit the username used to connect to the server.
   
   The user must have root privileges on the server.

5. Edit the password used to connect to the server.

6. Do one of the following:

   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to [Scheduling jobs](#) on page 812 and [Previewing jobs](#) on page 812.

   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

Unregistering vCenter/ESXi

You can unregister an individually added ESXi but if you attempt to remove an ESXi that was discovered under a vCenter, then that whole vCenter and all associated ESXis will be removed.

To unregister an existing vCenter/ESXi Server instance:

**Procedure**

1. Select **VMWARE > VCenters and ESXi** from the menu bar on the left side of the screen.
   
   The vCenters and ESXi list view is displayed.

2. Select a vCenter/ESXi Server instance, click , and click **Unregister vCenter/ESXi Server**.

   A warning is displayed indicating that this operation will remove the ESXi or all ESXis under the selected vCenter.
3. Click OK.

Rediscover vCenter/ESXi

Procedure

1. Select **VMWARE > VCenters and ESXi** from the menu bar on the left side of the screen.
   
The vCenters and ESXi list view is displayed.

2. Click **Rediscover**

   A dialog is displayed asking you to confirm that you want to rediscover all vCenters/ESXi servers.

3. Do one of the following:
   - Click **Add to Job List** to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
   - Expand **Add to Job List**, and click **Run Now** to perform the operation now.

Viewing ESXi server details

This tabbed view contains properties of the ESXi Server and also contains information on important storage performance key performance indicators (KPIs).

Procedure

1. Select **VMWARE > VCenters and ESXi** from the menu bar on the left side of the screen.

2. Select a vCenter/ESXi Server instance and click 

3. Click **VIEW ALL DETAILS**.

   A view with multiple tabs is displayed.

   For information on the **Details** tab, see below.

   For information on the **Masking View** tab, see Viewing ESXi server masking views on page 760.

   For information on the **Virtual Machines** tab, see Viewing ESXi server virtual machines details on page 761.

   For information on the **Performance** tab, see Viewing ESXi server performance details on page 760.

4. Click the **Details** tab.

   The following properties are displayed:

   - **Name** - ESXi name.
   - **Discovered time** - Date and time of discovery.
   - **Build Number** - ESXi server build number.
   - **Version** - ESXi server version.
   - **CPU Count** - ESXi server hardware CPU count.
- **Service Console Memory** - ESXi server hardware service console memory configuration.
- **Total Memory** - ESXi server hardware total memory configuration.
- **Virtual Machines** - Total number of virtual machines belonging to the ESXi Server

The following array related storage properties are displayed:

- **Masking Views** - The total number of masking views found for the ESXi server.
- **Storage Groups** - The total number of storage groups found for the ESXi server.
- **Capacity (GB)** - The capacity for all the Storage Groups found for the ESXi Server (this is calculated by doing a sum of all the SGs)
- **Allocated Capacity** - The allocated capacity for all the Storage Groups found for the ESXi Server (this is calculated by doing a sum of all the SGs)

### Viewing ESXi server masking views

This tabbed view contains all the masking views associated with the ESXi server.

**Procedure**

1. Select **VMWARE > VCenters and ESXi** from the menu bar on the left side of the screen.
2. Select a vCenter/ESXi Server and click ![Select Option](image). 
3. Click **VIEW DETAILS**.
   
   A view with multiple tabs is displayed.
4. Click the **Masking View** tab.
   
   The following properties are displayed:
   - **Masking View** - Name of the masking view.
   - **vCenter** - The name or IP address of the vCenter associated with ESXi server.
   - **Array** - The Array associated with the masking view.

   The following controls are available:
   - **Rediscover** - **Rediscover vCenter/ESXi** on page 759
   - **View Path Details** - Viewing masking view connections on page 313

### Viewing ESXi server performance details

This tabbed view contains the performance details for all the Storage Groups related with the ESXi Server.

There are two sections in this tab. The top section comprises a list view that displays all the Storage Groups found and their performance metrics. On the bottom section there is the noisy neighbor information that is displayed when you select a Storage Group from the top section.
Procedure

1. Select VMWARE > VCenters and ESXi from the menu bar on the left side of the screen.

2. Select a vCenter/ESXi Server and click.

3. Click VIEW ALL DETAILS.

   A view with multiple tabs is displayed.

4. Click the Performance tab.

   The top section is a list view containing the Storage Groups. The following properties are displayed:
   - **Storage Group** - Name of the storage group. Clicking on the name will take you to the Storage Group Performance dashboard.
   - **Array ID** - Array associated with the storage group.
   - **Host I/Os per sec** - Storage Group Host I/Os/sec
   - **Host MBs per sec** - Storage Group Host MBs/sec
   - **Read RT (ms)** - Storage Group Read RT time
   - **Write RT (ms)** - Storage Group Write RT time
   - **SG Compliance** - Displays the value of Storage Group (SG) compliance.

5. Select a storage group by clicking on the checkbox.

   The Noisy Neighbor section displayed. It is composed of the following performance data for the selected storage group:
   - **FE Directors** details - Name, % busy, and queue depth utilization.
   - **FE Port** details - Name, % busy, and host I/Os per second.
   - **Related SGs** - Name, response time, host I/Os per second, and host MBs per second.

   The following control is available:
   - **Rediscover** - Rediscover vCenter/ESXi on page 759

Viewing ESXi server virtual machines details

This tabbed view contains details about the virtual machines (VMs) under the ESXi Server.

Procedure

1. Select VMWARE > VCenters and ESXi from the menu bar on the left side of the screen.

2. Select a vCenter/ESXi Server instance and click.

3. Click VIEW ALL DETAILS.

   A view with multiple tabs is displayed.

4. Click the Virtual Machines tab.

   The following properties are displayed:
   - **Name**
- Powered
- CPU Count
- Total Memory (MB)
- OS Name

The following control is available:

- Rediscover - Rediscover vCenter/ESXi on page 759

5. Click to view the following additional VM properties:

- Address - IP address.
- Host Name - Host name.
- Virtual Disks - A number indicating the number of virtual disks of this virtual machine. You can click the link in order to navigate to a list showing all the disks associated with the virtual machine.

**Viewing ESXi server virtual machine disks**

This tabbed view contains details about the virtual machine (VMs) disks under the ESXi Server.

**Procedure**

1. Select VMWARE > VCenters and ESXi from the menu bar on the left side of the screen.

2. Select a vCenter/ESXi Server instance and click .

   The vCenters and ESXi details view is displayed. It displays the following properties:

3. Click VIEW ALL DETAILS.

   A view with multiple tabs is displayed.

4. Click the Virtual Machines tab.

5. Select a virtual machine, click , and click the number next to Virtual Disks.

6. Select a virtual disk and click to view the following additional physical disk properties.

   - Capacity - Physical Disk capacity.
   - Model - Physical disk model.
   - WWN - Physical disk WWN.
   - Name - Physical disk name.
   - Vendor - Physical disk vendor name.
   - Path - Physical Disk Path.
   - Datastore - Datastore for physical disk.
   - Type - Physical Disk type.
CHAPTER 10
System Management

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Viewing Storage System details

This procedure explains how to view storage system details. You can also view this information by clicking Dashboard > System Health > Actions > VIEW SYMMETRIX PROPERTIES.

Procedure

1. Select the storage system.
2. Select System > Symmetrix Properties.

The following properties display:

- **Array Display Name** — Custom nice name assigned to storage system, if any. To assign a name, or change an existing name, click . Array names must be unique from other array names and cannot exceed 32 characters. Only alphanumeric characters, underscores (_), and (-) are allowed. Array names are case-insensitive.
- **Product Model** — The product model.
- **HyperMax OS or Enginuity or PowerMaxOS** — The microcode version number.
- **Microcode Date/Patch Date** — The microcode date or patch date.
- **Capacity** — Capacity of the storage system.
- **Used Capacity** — not applicable to storage systems running HYPERMAX OS 5977 or greater.
- **Free capacity** — not applicable to storage systems running HYPERMAX OS 5977 or greater.
- **Actual Capacity** — not applicable to storage systems running HYPERMAX OS 5977 or greater.
- **Cache Size (Mirrored)** — Cache size.
- **Number of Front End Directors** — Number of Front End Directors.
- **Number of Back End Directors** — Number of Back End Directors.
- **Number of RDF Directors** — Number of RDF Directors.
- **Max Number of Hypers per Disk** — Maximum number of hypers per disk.
- **Device Masking (VCM) Config State** — Device Masking VCM configuration state.
- **VCMDB Access Restricted State** — VCMDB Accesss Restricted State.
- **Device Masking (ACLX) Config State** — Device Masking ACLX configuration state.
- **ACLX Volume LUN Address** — ACLX Volume LUN Address.
- **Access Control Configuration State** — Access Control Configuration state.
- **Configuration Change State** — Configuration Change state.
- **Disk Group Assignments** — Disk Group Assignments.
- **Parity RAID Configuration** — Parity RAID configuration.
- **RAID Configuration** — RAID configuration.
- **Pav Mode**—PAV Mode.
- **Pav Alias Limit**—PAV Alias Limit.
- **SDDF Configuration State**—SDDF Configuration state.
- **WORM Configuration Level**—WORM configuration level.
- **WORM Characteristics**—WORM characteristics.
- **Switched RDF Configuration State**—Switched RDF configuration state.
- **Concurrent RDF Configuration State**—Concurrent RDF configuration state.
- **Dynamic RDF configuration State**—Dynamic RDF configuration state.
- **Concurrent Dynamic RDF State**—Concurrent Dynamic RDF state.
- **RDF Data Mobility Configuration State**—RDF Data Mobility Configuration State.
- **SRDF/A Maximum Host Throttle (Secs)**—SRDF/A Maximum Host Throttle (seconds).
- **SRDF/A Maximum Cache Usage (Percent)**—SRDF/A Maximum Cache Usage (Percent).
- **Multi LRU Device Assignment**—Multi LRU Device Assignment.
- **Number of Available Cache Slots**—# of Available Cache Slots.
- **Max Number of DA Write Pending Slots**—Max # of DA Write Pending Slots.
- **Max Number of System Write Pending Slots**—Max # of System Write Pending slots.
- **Max Number of Device Write Pending Slots**—Max # of Device Write Pending slots.
- **Max Number of Replication Slots**—not applicable to storage systems running HYPERMAX OS 5977 or greater.
- **Symmetrix Last IPL Time (Cold)**—Symmetrix Last IPL Time (Cold).
- **Symmetrix Last Fast IPT Time (Hot)**—Symmetrix Last Fast IPT Time (Hot).
- **Symmetrix Alerts (Enabled/Disabled)**—Symmetrix Alerts (Enabled/Disabled).
- **Max Capacity of DSE reservation**—not applicable to storage systems running HYPERMAX OS 5977 or greater.
- **Symmetrix Priority Controls**—not applicable to storage systems running HYPERMAX OS 5977 or greater.
- **Hot Swap Policy**—Hot Swap Policy.
- **Symmetrix Disk Library**—Symmetrix Disk Library.
- **FBA Geometry Emulation**—FBA Geometry Emulation.
- **3 Dynamic Mirrors**—3 Dynamic Mirrors.
- **Cache Partitioning**—Cache Partitioning.
- **Auto Meta**—Auto Meta.
- **Minimum Auto Meta Size (Cyl)**—Minimum Auto Meta Size (Cyl).
Setting system attributes

Before you begin

Depending the storage system operation environment, some of the following attributes may not apply.

To set system attributes:

Procedure

1. Select to open the Settings panel.
2. Select Management > Symmetrix Attributes to open the Symmetrix Attributes page.
   The Symmetrix attributes information is displayed for the first of the listed storage arrays.
3. Select the ID of the storage system to be updated from the drop down menu.
   Depending on the storage system environment, some might not apply.
4. Modify any number of the attributes.
   Attributes are organized into the following panels:
   - General:
     Hot Swap Policy
     Specify whether to use global sparing:
     Permanent
     Specifies that the spare drive become the active (permanent) drive. In this case, the data is not moved back to the drive that experienced the failure.
   - Enable Auto Meta:
     This panel only displays for storage systems running Enginuity 5876.
     Enable Auto Meta
     Select to enable, or clear to disable. If Auto Meta is enabled, set the following properties:
     Minimum Meta Capacity
     Type the minimum volume size that will trigger the creation of a meta volume. For Enginuity 5876 or higher, this value must be less...
than or equal to 525336 cylinders, if running in 32K compatibility mode; or 262669 cylinders, if running in native mode.

**Member Capacity**
Type the size of the meta members to use when creating meta volumes.

**Configuration**
Type the meta configuration as either Concatenated or Striped when creating meta volumes. When enabled and attempting to create a volume larger than the value specified in the Minimum Meta Capacity field, or larger than 59 GB, it automatically triggers the creation of a meta volume according to the values specified in the Member Capacity and Configuration fields.

- **PAV:**
  This panel only displays for storage systems with either ESCON or FICON directors.
  
  Set the following parameters (z/OS only):
  
  **Alias Limit**
  Type the maximum number of aliases that can be assigned to a volume.
  
  **Mode**
  Select one of the following PAV types:
  
  **NoPAV**
  PAV not configured for the storage system.
  
  **StandardPAV**
  Volumes with static aliasing.
  
  **DynamicStandardPAV**
  Standard PAV volumes with dynamic aliasing.

- **SRDF/A:**
  
  **Maximum Cache Usage (Percent)**
  Type the maximum percentage of system write-pending cache slots for all SRDF/A sessions. Valid values are 0 to 100.
  
  **Maximum Host Throttle (Secs)**
  Type the maximum percentage of system write-pending cache slots for all RDF/A sessions. Valid values are 0 to 65535.

- **SRDF DIRECTORS:**
  These attribute settings control mixed I/O workloads on the same SRDF director.
  
  **SRDF Director CPU Resource Distribution**
  Indicates whether the director CPU resource distribution feature is enabled or disabled.
  
  **Synchronous I/O Percent**
  Type the percentage of director resources to allocate for SRDF synchronous I/Os.
Asynchronous I/O Percent
Type the percentage of director resources to allocate for SRDF asynchronous I/Os.

Copy I/O Percent
Type the percentage of director resources to allocate for copy I/Os.

Percentages for synchronous, asynchronous, and copy I/O must add up to 100. Percentage values can be set even if the SRDF Director CPU Resource Distribution is disabled.

• DCP:

Cache Partition Status
Whether the dynamic cache partition feature is enabled, disabled, or in analyze mode. Analyze mode is a tool for determining the amount of cache your applications are consuming, prior to enabling the cache partitioning feature. For more on analyze mode, see Running in analyze mode on page 838.

Empty Partition Status
Whether to preserve or automatically remove empty cache partitions. By default, all empty partitions are removed if there is no partition configuration activity for 4 hours.

Maximum number of Partitions
Lists the maximum number of partitions.

Minimum Allowed Target %
Lists the minimum allowed target percentage.

Maximum Allowed Target %
Lists the maximum allowed target percentage.

XRC Partition State
Lists the state of the XRC partition.

XRC Partition Name
Displays the XRC partition name.

Time of Last Modification
Displays the time that the last modification occurred.

• PowerPath

Host Registration
Checkbox used to select host registration for PowerPath.

Initiator Registration
Checkbox used to select initiator registration for PowerPath.

5. Click APPLY.
Using the Emulation Management wizard

Before you begin

- The storage system must be running HYPERMAX OS 5977 Q1 2016, or higher.
- StorageAdmin or Admin authorization rights are required.
- A free director must be available at the required slot.
- The addition of directors of following types is not supported:
  - IM—Infrastructure Management
  - ED—Enginuity Data Services
  - DS—SAS back-end
  - DA—Fibre back-end
  - DX—External storage back-end
  - EF—FICON front-end

You can use the Emulation Management wizard to add and remove director emulations.

Procedure

1. Select the storage system.
2. In the Dashboard, click the System Health tab.
3. In the Actions panel, click Manage Emulation.
4. On the Options page, select one of the following:
   - Add Director Emulation
     a. Click Next.
     b. On the Configure page, select values for the following:
        - Director Slot
        - Director Emulation
     c. Click Next.
   - Remove Director Emulation
     a. Click Next.
     b. On the Configure page, select the emulation to remove.
     c. Click Next.
5. On the Review page, review the details and do one of the following:
   - Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.

   Expand Add to Job List, and click Run Now to perform the operation now.

Setting CPU I/O resource distribution

The following explains how to set parameters to control mixed I/O workloads on an SRDF director. Note that values specified here will override the default values defined in Setting system attributes on page 766.
**Setting logging level preferences**

This procedure explains how to configure the level of message to maintain in the Unisphere log.

**Procedure**

1. Select Support and in the Actions panel, click Modify Server Logging.
2. Select a Logging Level.
3. Click OK.

**Understanding eNAS**

Embedded NAS (eNAS) integrates the file-based storage capabilities of VNX arrays into storage systems running HYPERMAX OS 5977 or higher.

With this integrated storage solution, Unisphere StorageAdmin provision storage to eNAS data movers, which triggers the creation of storage pools in VNX. Unisphere for VNX users then use the storage pools for file-level provisioning (for example, creating file systems, file shares, etc.)

Unisphere provides the following features to support eNAS:

**File System dashboard**

Provides a central location from which to monitor and manage integrated VNX file services.

**Provision Storage for File wizard**

Allows you to provision storage to eNAS data movers.

**Launch Unisphere for VNX**

Allows you to link and launch Unisphere for VNX.
Discovering eNAS control stations

Before you begin

- To perform this operation, you must be an Administrator.
- The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to connect to an eNAS control station for the first time.

Procedure

1. Select the storage system.
2. Select System > File to open the File Dashboard.
3. If eNAS is not authenticated, click the Open Authentication dialog link.
4. Type the username and password you use to access the eNAS control station and click OK.

Managing File storage

Before you begin

- To perform this operation, you must be a Monitor or higher.
- The storage system must be running HYPERMAX OS 5977 or higher.

The File dashboard provides you with a single place from which to monitor and manage integrated VNX file services.

Procedure

1. To access the File dashboard:
   1. Select the storage system.
   2. Select System > File.
3. If prompted, type the username and password you use to access the eNAS control station, and click OK.

   The File dashboard provides a point-in-time view of the eNAS instance. To refresh the information displayed in the dashboard, click refresh storage system in the status bar, or exit/return to the dashboard.

   For more information about the elements of the File dashboard, refer to The File Dashboard.

The File dashboard

The File dashboard is organized into the following panels:

- Summary
- Actions
- Capacity
- Control Stations
- Data Movers
- File Storage Alerts
Summary

- **File Systems**—File systems associated with the file storage groups.
- **File Storage Groups**—File storage groups associated with the file systems.
- **File Masking Views**—Masking views associated with the file storage groups.
- **File Storage Pools**—File storage pools associated with the file storage groups.

Actions

Links to common file storage tasks, including:

- [Provisioning storage for file](#)
- [Launching Unisphere for VNX](#)

Capacity

Displays the following capacity information:

- **Usable Capacity**—Free versus total capacities of the file storage groups.
- **File Capacity**—Free versus total capacities for the file systems associated with the file storage groups on the storage system.

Control Stations

Displays the name and status of the control stations.

Data Movers

Displays the status of the control station's data movers:

- **Name**—Data mover name.
- **Status**—Health status of the data mover.

File Storage Alerts

Details all alerts associated with the eNAS instance (file systems, storage groups, masking views), including:

- **State**—State of the alert.
- **Severity**—Alert severity. Possible values are:
  - (1) Fatal
  - (2) Critical
  - (3) Warning
  - (4) Information
  - (5) Normal
- **Type**—State of the alert.
- **Description**—Description of the alert.
- **Created**—Date/time the alert was issued.

Provisioning storage for file

**Before you begin**

- To perform this operation, you must be a StorageAdmin.
- The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to provision storage to eNAS datamovers.

To provision storage for file:
Procedure

1. Select the storage system.
2. Select System > File to open the File Dashboard.
3. If prompted, type the username and password you use to access the eNAS control station, and click OK.
4. In the Actions panel, click Provision Storage for File to open the Provision Storage for File wizard.
5. Supply a Storage Group Name.

Each storage group name is unique among the storage groups on the storage system and has up to 64 characters. Use only alphanumeric characters, underscores (_), and dashes (-) in the name. Storage group names are case-insensitive.

6. To select a Storage Resource Pool other than the default (DEFAULT_SRP), click on the drop-down menu and select one. To create the storage group outside of FAST control, select None.
7. Select the Service Level to set on the SG.

Service levels specify the characteristics of the provisioned storage, including average response time, workload type, and priority. This field defaults to None if you set the Storage Resource Pool to None. Available values are:

<table>
<thead>
<tr>
<th>Service level</th>
<th>Performance type</th>
<th>Use case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamond</td>
<td>Ultra high</td>
<td>HPC, latency sensitive</td>
</tr>
<tr>
<td>Platinum</td>
<td>Very high</td>
<td>Mission critical, high rate OLTP</td>
</tr>
<tr>
<td>Gold</td>
<td>High</td>
<td>Very heavy I/O, database logs, datasets</td>
</tr>
<tr>
<td>Silver</td>
<td>Price/Performance</td>
<td>Database datasets, virtual applications</td>
</tr>
<tr>
<td>Bronze</td>
<td>Cost optimized</td>
<td>Backup, archive, file</td>
</tr>
<tr>
<td>Optimized (default)</td>
<td></td>
<td>Places the most active data on the highest performing storage and the least active on the most cost-effective storage.</td>
</tr>
</tbody>
</table>

For all-flash storage systems, the only service level available is Diamond and it is selected by default.

8. Refine the service level by selecting the Workload Type to assign to it.
9. Type the number of Volumes and select the Capacity of each.
10. (Optional) Click Edit (_edit) and set any number of the following advanced options for the storage group:

- To have FAST factor the R1 volume statistics into move decisions made for the R2 volume, select RDF Coordination.
  You can set this attribute on a storage group, even when there are no SRDF volumes in the storage group. This feature is only available if the storage system is part of an SRDF setup.
- To allocate capacity for each SG volume, select Allocate capacity for each volume.
- To persist preallocated capacity through reclaim or copy, select that checkbox.
11. (Optional) To add a child storage group, do one of the following: click and 
   • On all-flash storage systems, click Add Storage Group.
   • On all other storage systems, click Add Service Level.

   Specify a Name, Service Level, Workload Type, Volumes and Capacity. Repeat this step for each additional child storage group. The maximum number of allowed child storage groups is 64.

12. (Optional) To set host I/O limits for the storage groups, click Set Host I/O Limits in the Summary tab to open the Host I/O Limits dialog box. For information about setting the limits, refer to the dialog's help page.

13. Click Next.

14. (Optional) On the Review page of the wizard, follow these steps to manually set the LUN addresses for the masking operation:

   a. Click Set Dynamic LUNs to open the Set Dynamic LUN Addresses dialog.

   b. Note the address displayed in the Starting LUN field:
      • To accept this automatically generated address, click Apply Starting LUN.
      • To move to the next available, click Next Available LUN.

   c. Optional: Click Enable compliance alerts.

   d. Click OK.

15. Click Run Now or Add To Job List.

Launching Unisphere for VNX

Before you begin
   • To perform this operation, you must be a StorageAdmin or higher.
   • The storage system must be running HYPERMAX OS 5977 or higher.

Procedure
   1. Select the storage system.
   2. Select System > File.
   3. If prompted, type the username and password you use to access the eNAS control station, and click OK.
   4. In the Actions panel, click Launch Unisphere for VNX.

Managing file storage groups

Before you begin
   • To perform this operation, you must be a StorageAdmin or higher.
   • The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to manage file storage groups.

Procedure
   1. Select the storage system.
2. Select System > File to open the File Dashboard.

3. In the Summary panel, click File Storage Groups.

4. Select one or more storage groups and click one of the following, depending on the operation you want to perform:
   - Viewing storage group details on page 140
   - Modifying storage groups on page 121
   - Provisioning storage for file on page 772
   - FAST Array Advisor
   - Changing Storage Resource Pools for storage groups on page 131
   - Deleting storage groups on page 133
   - Managing thin pool allocations on page 247
   - Converting storage groups to cascaded on page 131
   - Setting volume status on page 439

Managing file masking views

Before you begin
- To perform this operation, you must be a StorageAdmin or higher.
- The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to manage file masking views.

Procedure

1. Select the storage system.
2. Select System > File to open the File Dashboard.
3. In the Summary panel, click File Masking Views.
4. Select one or more masking views and click one of the following, depending on the operation you want to perform:
   - Viewing masking view details on page 315
   - Viewing masking view connections on page 313
   - Deleting masking views on page 312

Viewing file systems

Before you begin
- To perform this operation, you must be a Monitor or higher.
- The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to view VNX file systems.
Procedure

1. Select the storage system.
2. Select System > File to open the File Dashboard.
3. In the Summary panel, click File Systems to open the File Systems list view.

The following properties display:

- **File System Name** — Name of the file system.
- **Storage Group(s)** — Storage group(s) to which the file system belongs.
- **Storage Pool** — Storage pool to which the file system belongs. If the file system does not belong to a storage pool, the default name, Meta Volume, will display in this column.
- **Allocated %** — Allocated capacity of the file system in GB.
- **Capacity (GB)** — Total capacity of the file system in GB.

The following control is available:

[Viewing file system details on page 776]

Viewing file system details

**Before you begin**

- To perform this operation, you must be a Monitor or higher.
- The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to view details on VNX file systems.

Procedure

1. Select the storage system.
2. Select System > File to open the File Dashboard.
3. In the Summary panel, click File Systems to open the File Systems list view.
4. Select a file system and click [ ] to open its Details view.

For more information about the File Systems details view, refer to File System Details on page 776.

File System Details

The File System Details view displays the following properties.

- **File System Name** — Name of the file system.
- **File System Unique ID** — Unique VNX ID for the file system.
- **File System Total Capacity (GB)** — Size of the file system.
- **File System Free Capacity (GB)** — Available space on the file system.
- **File System Block Size (Bytes)** — Size of a block on the file system.
- **File System Type** — Type of file system and its conventions (for example, NTFS).
- **Operational Status** — Current operational status of the local file system.
- **Storage Groups** — Storage groups on the file system.
- **Storage Pool** — Storage pools on the file system.

**Viewing file system storage pools**

**Before you begin**
- To perform this operation, you must be a StorageAdmin or higher.
- The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to view storage pools associated with VNX file systems.

**Procedure**

1. Select the storage system.
2. Select **System > File** to open the **File Dashboard**.
3. In the **Summary** panel, click **File Storage Pools**.

   The following properties display:
   - **Storage Pool Name** — Name of the storage pool.
   - **Instance ID** — Long name description of the storage pool.
   - **#File Systems** — File system using the storage pool in a VNX context.
   - **Health State** — Health state of the storage pool.
   - **Storage Group** — Name of the storage group.
   - **Allocated %** — Percentage allocated for the storage pool.
   - **Capacity (GB)** — Capacity of the storage pool in gigabytes.

   The following controls are available:
   - ![Viewing file system storage pool details](#) on page 777
   - **Expand SG for File** — Modifying storage groups on page 121

**Viewing file system storage pool details**

**Before you begin**
- To perform this operation, you must be a StorageAdmin or higher.
- The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to view storage pools associated with VNX file systems.

**Procedure**

1. Select the storage system.
2. Select **System > File** to open the **File Dashboard**.
3. In the **Summary** panel, click **File Storage Pools**.
4. Select a file storage pool and click ![Viewing file system storage pool details](#).

**File system storage pool details**

The following properties are displayed:
• **Storage Pool Name** — Name of the storage pool.
• **Instance ID** — Long name description of the storage pool.
• **Health State** — Current health of the storage pool. Values for this property are:
  - Unknown
  - OK
  - Degraded/Warning
  - Minor Failure
  - Major Failure
  - Non recoverable error
• **Total Managed Space (GB)** — Amount of capacity usable for allocation of storage volumes, logical disks, or child storage pools.
• **Remaining Managed Space (GB)** — Remaining usable capacity after allocation of storage volumes, logical disks, or child storage pools.
• **Operational Status** — Status for the operational condition of the pool. Values for this property are:
  - Unknown
  - Not Available
  - Servicing
  - Starting
  - Stopping
  - Abandoned
  - Dormant
  - Completed
  - Migrating
  - Emigrating
  - Immigrating
  - Snapshotting
  - Shutting Down
  - In Test
  - Transitioning
  - In Service
• **Pool ID** — Unique ID of the storage pool.
• **Primordial** — Whether the storage pool can be created by consumers of this model.

**Usage**
• **Number of File Systems** — Click on the link in this field to see the file systems in the storage pool. The following properties display:
  - **File System Name** — Name of the file system.
  - **Storage Group(s)** — Storage groups mapped to the file system.
Manage file storage alerts

Viewing file storage alerts

Before you begin

- To perform this operation, you must be a Monitor or higher.
- The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to view alerts related to file storage.

Procedure

1. Select the storage system.
2. Select System > File to open the File Dashboard.
3. The File Storage Alerts panel displays the following properties:
   - **State**—State of the alert. Available values are **New** or **Acknowledged**.
   - **Severity**—Alert severity. Values of this property are:
     - (1) Fatal
     - (2) Critical
     - (3) Warning
     - (4) Information
     - (5) Normal
   - **Type**—Type of alert. In this view, this property always contains File.
   - **Symmetrix**
   - **Object**—Object to which the alert is related.
     This field is blank for server alerts; server alerts are specific to the server or runtime environment and so are not associated with a specific object or storage system.
   - **Description**—Description of the alert.
   - **Created**—Date/time the alert was created.
   - **Acknowledged**—Date/time the alert was acknowledged.

To see all alerts, click View All Alerts.

Viewing file storage alert details

Before you begin

- To perform this operation, you must be a Monitor or higher.
- The storage system must be running HYPERMAX OS 5977 or higher.

This procedure explains how to view details on alerts related to file storage.

Procedure

1. Select the storage system.
2. Select System > File to open the File Dashboard.
3. In the File Storage Alerts panel, click View All Alerts.
4. Select an alert and click to open the file storage Alert Details view.

The following properties display:
- Alert ID—Unique number assigned by Unisphere.
- State—State of the alert. The value of this property is New or Acknowledged.
- Severity—Alert severity. Values are:
  - (1) Fatal
  - (2) Critical
  - (3) Warning
  - (4) Information
  - (5) Normal
- Type—Type of alert. The values of this property are Array, Performance, and System.
- Symmetrix—ID of the storage system generating the alert.
- Object—Object to which the alert is related. For more information, click the object to open its details view.
- Created—Date/time the alert was created.
- Description—Description of the alert.

Deleting file storage alerts

You can delete file storage alerts from the main Alerts list view or the File Storage Alerts view.

Procedure

1. Do one of the following:
   - To delete a file storage alert from the main Alerts list view, complete the following steps:
     a. Select the storage system.
     b. Select EVENTS > Alerts to open the Alert list view.
     c. Select one or more File type alerts and click .
   - To delete a file storage alert from the File Storage Alerts view, complete the following steps:
     a. Select the storage system.
     b. Select System > FileeNAS to open the File Dashboard.
     c. In the File Storage Alerts panel, click View All Alerts to open the File Storage Alerts list view.
     d. Select one or more alerts and click .
Viewing the system audit log

Before you begin
Because system audit logs can be very large, the list view opens pre-filtered to display the most recent 512 records.

The user must have Auditor or higher permissions.

The storage system audit records come from the SYMAPI database and include all actions taken on that storage system. The audit log resides on the storage system and currently has a maximum size of 40 MB. Once the 40 MB limit is reached, the log begins to overwrite itself.

To view the system audit log:

Procedure
1. Select the storage system.
2. Select **Events > Audit Log** to open the Audit Log list view.

The following properties are displayed:

- **Record**
  Unique identifier for the audit entry.

- **Date**
  Date the audit entry was made.

- **Application**
  Application operating on the storage system.

- **Action Code**
  Specific audit code for the operation on the storage system.

- **Username**
  Name of the user operating on the storage system.

- **Host**
  Host operating on the storage system.

- **Function Class**
  Generic audit category for the operation on the storage system.

- **OS Type**
  Operating system running on the host.

- **Activity ID**
  Activity ID for audit record.

To filter the log records, click 

To view details of a specific audit log record, click **Viewing Symmetrix audit log details on page 781**.

Viewing Symmetrix audit log details

To view details on a specific audit log record:
Procedure

1. Select the storage system.
2. Select Events > Audit Log.
3. Select a record and click to open its Details view.

The following properties display:

**Record Number**
Unique identifier for the audit entry.

**Text**
Summary of the Symmetrix operation.

**Time**
Date the audit entry was made.

**Application ID**
Application operating on the storage system.

**Username**
Name of the user operating on the storage system.

**Function Class**
Generic audit category for the operation on the storage system.

**Action Code**
Specific audit code for the operation on the storage system.

**Host**
Host operating on the storage system.

**Records in Seq**
One Symmetrix operation can be represented by a sequence of audit records. This is the total number of records in this particular audit sequence.

**Offset in Seq**
Audit entry number within the audit sequence.

**Vendor ID**
Vendor of the application operating on the storage system.

**Application Version**
Version of the application operating on the storage system.

**API Library**
SYMAPLI library type.

**API Version**
SYMAPI version number.

**OS Name**
Operating system running on the host.

**OS Revision**
Specific revision of the operating system.
Client Host
Client/Server only.

Activity ID
Activity ID for audit record.

Process ID
ID of the process that logged the record.

Task ID
ID of the task that logged the record.

Viewing system hardware
By selecting a storage system and clicking System > Hardware, you can view directors and available ports.

Viewing available ports

Before you begin

Note
The Available Ports tab is not available on systems running Enginuity 5876.

Procedure
1. Select the storage system.
2. Select System > Hardware.
3. Click the Available Ports tab to open the Available Ports list view.
   This view allows you to view and associate available ports with directors.
   The following properties are displayed:
   Slot
   Slot number.
   Port
   Port ID.
   Type
   Port type.
   Speed GB/sec
   Transmission rate (input/output channel).

The following control is available:
- Associate—Associating directors and ports on page 804
Viewing back-end directors

Procedure

1. Select the storage system.
2. Select System > Hardware.
3. Click the BE Directors tab to open the Back End Directors list view.

   Use this view to view and manage the back-end directors.

Note

Some of the following properties and controls are environment-specific and therefore may appear in a different order or not at all.

The following properties display:

- **Director**
  Director name.

- **% Busy**
  Percent of time the director is busy. This field only displays when the storage system is registered with the Performance component.

- **Type**
  Director type.

- **Hypers**
  Number of hyper volumes serviced by the director. This field only displays for storage systems running Enginuity 5876.

- **Protocol**
  Transmission protocol for the director port.

- **Cores**
  Number of director cores. This field only displays for storage systems running HYPERMAX OS 5977 or higher.

- **Director Status**
  Director status.

- **Port Interface**
  Port interface ID. This field only displays for storage systems running Enginuity 5876.

- **Port**
  Port ID. This field only displays for storage systems running HYPERMAX OS 5977 or higher.

- **Port Status**
  Indicates whether the port is online or offline.

- **Alerts**
  Indicates if there are alerts associated with the director.
To see more information on a director’s details and performance, select it and click "Viewing back-end director details"

**Viewing back-end director details**

**Procedure**

1. Select the storage system.
2. Select System > Hardware.
3. Click the BE Directors tab to open the Back End Directors list view.
4. Select a director from the list and click to open the Back End Director details view.

The following properties display under the Details tab:

- **Director**
  - Director name.
- **Port Interface**
  - Port interface ID.
- **Type**
  - Director type.
- **Director Status**
  - Director status.
- **Director Serviced Hypers**
  - Number of hyper volumes serviced by the director.
- **Port Status**
  - Indicates port status, ON or OFF.
- **Port Serviced Hypers**
  - Number of hyper volumes serviced by the port.

The Performance tab links you to the performance monitor and analyze views for the director. This panel displays only when the Performance option is installed. Inactive links will be displayed if the selected storage system is not registered for data collection.

**Viewing external directors**

**Before you begin**

External directors are supported only on storage systems running HYPERMAX OS 5977 or higher.

**Procedure**

1. Select the storage system.
2. In the Dashboard, click the System Health tab.
3. In the Actions panel, click View Other Hardware and then click the External tab to open the External Directors list view.
Some of the following properties and controls are environment-specific and therefore may appear in a different order or not at all.

The following properties display:

**Director**
- Director name.

**Port**
- Port ID.

**Director Status**
- Director status.

**Cores**
- Number of available director cores.

**Hypers**
- Number of hyper volumes serviced by the director.

**Alerts**
- Director alert status, as indicated by icon color:
  - 🚨 One or more fatal alerts
  - 🔴 One or more critical alerts, with none higher
  - 🚨 One or more warning alerts, with none higher
  - 📣 One or more informational alerts, with none higher
  - 📣 No alerts

The following controls are available:

- **Associate**—[Associating directors with ports](#) on page 802(This control only displays when the storage system is running HYPERMAX OS 5977 or higher.)
- **Disassociate**—[Disassociating directors and ports](#) on page 805(This control only displays when the storage system is running HYPERMAX OS 5977 or higher.)

### Viewing external director details

**Procedure**

1. Select the storage system.
2. In the **Dashboard**, click the **System Health** tab.
3. In the **Actions** panel, click **Other Hardware** and then click the **External** tab to open the External Directors list view.
4. Select the director and click \(\text{1}\) to open its details view.

The external director details view allows you to view details on an external director.

The following properties display:

- **Director**
  - Director name.

- **Port**
  - Port ID.

- **Type**
  - Director type.

- **Director Status**
  - Director status.

- **Port Status**
  - Indicates port status, ON or OFF.

- **Number of Volumes**
  - Number of volumes serviced by the director.

- **WWN**
  - Port WWN.

The **Performance** panel links you to the performance analyze views for the director.

This panel only displays when the Performance option is installed. Inactive links will be displayed if the selected storage system is not registered for data collection.

### Viewing system front-end directors

**Procedure**

1. Select the storage system.
2. Select **System > Hardware**.
3. Click the **FE Directors** tab to open the Front End Directors list view.

Use this view to view and manage the front-end directors.

**Note**

Some of the following properties and controls are environment-specific and therefore may appear in a different order or not at all.

The following properties display:

- **Director**
  - Director name.

- **Port**
  - Port number.
Alerts
Director alert status, as indicated by icon color:

- 🔴 One or more fatal alerts.
- 🔴 One or more critical alerts, with none higher.
- ⚠️ One or more warning alerts, with none higher.
- 📢 One or more informational alerts, with none higher.
- 🤔 No alerts.

% Busy
Percent of time the director is busy. This field only displays when the storage system is registered with the Performance component.

Type
Director transmission protocol.

Director Status
Whether the director is online or offline.

Port Status
Indicates whether the port is online or offline.

Port ID
Port ID.

ACLX
Indicates whether access control logic is enabled or disabled.

Cores
Number of cores. This field appears only when the storage system is running HYPERMAX OS 5977 or higher.

Speed GB/Sec
The speed of the individual cores on the system (applicable only to storage systems running HYPERMAX OS 5977 or higher).

To see more information on a director’s details and performance, select it and click 🔗.

The following controls are available:

- **Enable**—Enabling and disabling director ports on page 805
- **Disable**—Enabling and disabling director ports on page 805
- **Set Port Attributes**—Setting director port attributes on page 802
- **Convert FA to RF**—Converting directors on page 801 (not applicable to storage systems running HYPERMAX OS 5977 or higher.)
- **Set ORS Ceiling**—Setting Open Replicator ceiling on page 498
Viewing system front end director details

Procedure
1. Select the storage system.
2. Select System > Hardware.
3. Click the FE Directors tab to open the Front End Directors list view.
4. Select a director and click to open the Front End Director details view.

The Front End Director details view allows you to view and manage a front end director.

The following properties display under the Details tab:

- **Director**
  - Director name

- **Port**
  - Port ID

- **Type**
  - Director transmission protocol

- **Director Status**
  - Director status

- **Port Status**
  - Indicates port status, ON or OFF

- **Director Connection Status**
  - Connection status.

- **Volumes**
  - Number of volumes mapped to the port.

- **Mapped Devices (including meta members)**
  - Number of mapped volumes, including any meta members.

- **Port ID**
  - Port ID.

- **Fibre Channel Loop**
  - Fibre channel loop.

- **ACLX**
  - Indicates whether ACLX is enabled or disabled.
Common Serial Number
Indicates whether Common Serial Number feature is enabled or disabled.

Unique WWN
Indicates whether Unique WWN feature is enabled or disabled.

Init Point to Point
Indicates whether Init Point to Point is enabled or disabled.

Volume Set Addressing
Indicates whether Volume Vet Addressing is enabled or disabled.

VNX Attached
Indicates whether VNX Attached is enable or disabled.

Avoid Reset Broadcasting
Indicates whether Avoid Reset Broadcasting feature is enabled or disabled.

Negotiate Reset
Indicates whether Negotiate Reset feature is enabled or disabled. This feature is used for AS/400 systems only (default is off).

Enable Auto Negotiate
Indicates whether Enable Auto Negotiate feature is enabled or disabled.

Environ Set
Indicates whether environmental error reporting feature is enabled or disabled.

Disable Q Reset on UA
Indicates whether the Disable Q Reset on UA (Unit Attention) is enabled or disabled.

Soft Reset
Indicates whether Soft Reset feature is enabled or disabled for a Bull/GCOS-7 host.

SCSI 3
Indicates whether SCSI-3 protocol is enabled or disabled. When disabled, the SCSI 2 protocol is supported.

SCSI Support1(OS2007)
Indicates whether SCSI Support1 is enabled or disabled.

No Participating
Indicates whether Non Participate feature is enabled or disabled.

SPC2 Protocol Version
Indicates whether SPC Protocol Version feature is enabled or disabled. This feature is used for Windows 2003 environment running Microsoft HCT test version 12.1.

HP 3000 Mode
Indicates whether HP 3000 Mode is enabled or disabled. This feature is used for HP MPE 5.0 and Enginuity levels 5062 and earlier.
Sunapee
Indicates whether Sunapee feature is enabled or disabled. This feature is used for SUN PDB clusters.

Siemens
Indicates whether Siemens feature is enabled or disabled. This feature is used for Siemens R-series platforms.

Sequent
Indicates whether the Sequent feature is enable or disabled. This feature is used for Sequent platforms.

Server on AS400
Indicates whether Server of AS400 feature is enabled or disabled. This feature is used for AS/400 platforms.

Enable AS400
Indicates whether Enable AS400 is enabled or disabled.

OpenVMS
Indicates whether OpenVMS is enabled or disabled.

Open Replicator Maximum Ceiling (MB)
Maximum recopy ceiling value.

Open Replicator Ceiling (%)
Recopy ceiling value.

Open Replicator Actual Ceiling (MB)
Recopy actual ceiling value.

Negotiated Speed (GB/Second)
Negotiated speed in GB/Second.

The Performance panel links you to the performance monitor and analyze views for the director. This panel displays only when the Performance option is installed. Inactive links will be displayed if the selected storage system is not registered for data collection.

Viewing RDF directors

Procedure
1. Select the storage system.
2. Select System > Hardware.
3. Click the RDF Directors tab to open the RDF Directors list view.
   Use this view to view and manage the RDF directors.

Note
Some of the following properties and controls are environment-specific and therefore may appear in a different order or not at all.

The following properties display:
**Director**
Director ID.

**% Busy**
Percent of time the director is busy. This field only displays when the storage system is registered with the Performance component.

**Type**
Director type.

**RDF groups**
Number of RDF groups.

**Port**
Port ID.

**Director Status**
Director status.

**RDF Protocol**
Director transmission protocol.

**IPSec Policies**
Number of IPSec Policies.

**Port Status**
Indicates whether the port is online or offline.

**Cores**
Number of cores. This field only displays when the storage system is running HYPERMAX OS 5977 or higher.

**Alerts**
Director alert status, as indicated by icon color:

- ⚡ One or more fatal alerts.
- ⚠ One or more critical alerts, with none higher.
- ⚠️ One or more warning alerts, with none higher.
- 📣 One or more informational alerts, with none higher.
- 📦 No alerts.

To see more information on a director’s details and performance, select it and click ⬇️.

The following controls are available:

- **Enable**—Enabling and disabling director ports on page 805
- **Disable**—Enabling and disabling director ports on page 805
• **Convert RF to FA**—Converting directors on page 801 (not applicable to storage systems running HYPERMAX OS 5977 or higher)

• **CPU I/O Setting**—Setting CPU I/O resource distribution on page 769

• **Associate**—Associating directors and ports on page 804 (only applicable to storage systems running HYPERMAX OS 5977 or higher)

• **Disassociate**—Disassociating directors and ports on page 805 (only applicable to storage systems running HYPERMAX OS 5977 or higher)

**Viewing RDF director details**

**Procedure**

1. Select the storage system.
2. Select **System > Hardware**.
3. Click the **RDF Directors** tab to open the RDF Directors list view.
4. Select a director from the list and click  to open its details view.

   The RDF Director details view allows you to view RDF director details and performance.

   The following properties display in the **Details** panel:

   - **Director Identifier**
     - Director name.

   - **Type**
     - Director type.

   - **Director Status**
     - Director status.

   - **Port**
     - Port ID.

   - **WWN**
     - World wide name.

   - **RDF Groups**

     - **RDF (RA) Group Attributes - Farpoint**
       - Farpoint — Indicates whether this attribute is true or false.

     - **Prevent Automatic RDF Link Recovery**
       - Indicates whether preventing automatic link recovery is enabled or disabled.

     - **Prevent RAs Online on Power Up**
       - Indicates whether preventing RA to be online on power up is enabled or disabled.

   - **Protocol Type**
     - Director transmission protocol type.
RDF Software Compression Supported
Indicates whether RDF Software Compression is supported or not supported.

RDF Software Compression
Indicates whether RDF Software Compression is enabled or disabled.

RDF Hardware Compression Supported
Indicates whether RDF Hardware Compression is supported or not supported.

RDF Hardware Compression
Indicates whether RDF Hardware Compression is enabled or disabled.

Port Status
Indicates port status, ON or OFF.

IPV4 Address
IPV4 Address.

IPV6 Address
IPV6 Address.

IPV6 Prefix
IPV6 Prefix.

IPV4 Default Gateway
IPV4 Default Gateway.

IPV4 Domain Name
IPV4 Domain Name.

IPV4 Netmask
IPV4 Netmask.

iSCSI Initiator Session
SCSI Initiator session.

Negotiated Speed (GB/Second)
Negotiated speed in GB/second.

Synchronous I/O Percent
Percentage of SRDF director CPU resources allocated to synchronous I/Os.

Asynchronous I/O Percent
Percentage of SRDF director CPU resources allocated to asynchronous I/Os.

Copy I/O Percent
Percentage of SRDF director CPU resources allocated to copy I/Os.

The Performance panel links you to the performance monitor and analyze views for the RDF director. This panel displays only when the Performance option is installed. Inactive links will be displayed if the selected storage system is not registered for data collection.
Viewing RDF director SRDF groups

Procedure

1. Select the storage system.
2. Select System > Hardware.
3. Click the RDF Directors tab to open the RDF Directors list view.
4. Select a director from the list and click to open its details view.

The RDF Director details view allows you to view RDF director details and performance.

The following properties display in the Details panel:

Director Identifier
Director name.

Type
Director type.

Director Status
Director status.

Port
Port ID.

WWN
World wide name.

RDF Groups

RDF (RA) Group Attributes - Farpoint
Farpoint — Indicates whether this attribute is true or false.

Prevent Automatic RDF Link Recovery
Indicates whether preventing automatic link recovery is enabled or disabled.

Prevent RAs Online on Power Up
Indicates whether preventing RA to be online on power up is enabled or disabled.

Protocol Type
Director transmission protocol type.

RDF Software Compression Supported
Indicates whether RDF Software Compression is supported or not supported.

RDF Software Compression
Indicates whether RDF Software Compression is enabled or disabled.

RDF Hardware Compression Supported
Indicates whether RDF Hardware Compression is supported or not supported.
RDF Hardware Compression
Indicates whether RDF Hardware Compression is enabled or disabled.

Port Status
Indicates port status, ON or OFF.

IPV4 Address
IPV4 Address.

IPV6 Address
IPV6 Address.

IPV6 Prefix
IPV6 Prefix.

IPV4 Default Gateway
IPV4 Default Gateway.

IPV4 Domain Name
IPV4 Domain Name.

IPV4 Netmask
IPV4 Netmask.

iSCSI Initiator Session
SCSI Initiator session.

Negotiated Speed (GB/Second)
Negotiated speed in GB/second.

Synchronous I/O Percent
Percentage of SRDF director CPU resources allocated to synchronous I/Os.

Asynchronous I/O Percent
Percentage of SRDF director CPU resources allocated to asynchronous I/Os.

Copy I/O Percent
Percentage of SRDF director CPU resources allocated to copy I/Os.

The Performance panel links you to the performance monitor and analyze views for the RDF director. This panel displays only when the Performance option is installed. Inactive links will be displayed if the selected storage system is not registered for data collection.

5. Click on the number in the RDF Groups field to open the RDF Groups list view.
Use this view to view the SRDF groups mapped to the front-end director.
The following properties display:

SRDF Group
RDF group number.

SRDF Group Label
RDF group label.
Remote SRDF group
Remote RDF group number.

Online

Volume Count
Number of volumes in the group.

SRDF Mode

Type
Whether volumes in the group are dynamic or static.

Transmit Idle
Time the transmit cycle has been idle.

Viewing IM directors

Before you begin
Infrastructure Manager (IM) directors are only supported on storage systems running HYPERMAX OS 5977 or higher.

Procedure
1. Select the storage system.
2. In the Dashboard, click the System Health tab.
3. In the Actions panel, click View Other Hardware and then click the IM Directors tab.

The following properties display in the IM Directors list view:

Note
Some of the following properties are environment-specific and therefore may appear in a different order or not at all.

- Director—Director name.
- Director Type—Director type.
- Director Status—Director status.
- Cores—Number of available director cores.
- Associated Ports—Number of associated ports.
- % Busy—
- Cores—
- Alerts — Director alert status, as indicated by icon color:
  - One or more fatal alerts
  - One or more critical alerts, with none higher
  - One or more warning alerts, with none higher
  - One or more informational alerts, with none higher
Viewing EDS directors

**Before you begin**

Enginuity Data Services (EDS) directors are only supported on storage systems running Enginuity version 5977 or higher.

**Procedure**

1. Select the storage system.
2. In the **Dashboard**, click the **System Health** tab.
3. In the **Actions** panel, click **Other Hardware** and then click the **EDS** tab to open the EDS list view.

The following properties display:

---

**Note**

Some of the following properties are environment-specific and therefore may appear in a different order or not at all.

- **Director**
  - Director name.
- **% Busy**
  - Percent of time the director is busy. This field only displays when the Symmetrix system is registered with the Performance component.
- **Director Type**
  - Director type.
- **Director Status**
  - Director status.
- **Cores**
  - Number of available director cores. This field only displays when the Symmetrix system is running Enginuity version 5977 or higher.
- **Associated Ports**
  - Number of associated ports.
- **Alerts**
  - Director alert status, as indicated by icon color:
    - One or more fatal alerts.
    - One or more critical alerts, with none higher.
    - One or more warning alerts, with none higher.
    - One or more informational alerts, with none higher.
No alerts.

Viewing failed drives

Procedure
1. Select the storage system.
2. Select the System Health tab.
3. In the Actions panel, click Run Drive Replacement.
   Use this view to view and replace failed disk drives.
   The following properties display:
   - **Disk Technology**
     Type of disk.
   - **Capacity**
     Usable disk capacity.
   - **Speed (RPM)**
     Physical disk revolutions per minute.
   - **Failed Spare Drive Counts**
     Number of available spares.
   - **Block Size**
     Size of each disk block.
   The following control is available:
   - Replace—Replacin failed drives on page 806

Viewing mapped front-end volumes

Procedure
1. Select the storage system.
2. Select System > Hardware > FE Directors.
3. Select a director and click 
4. In the Details tab, click on the number next to the Volumes field.
   The following properties display:
   - **Name**
     Assigned volume name.
   - **Type**
     Type of volume.
   - **Allocated %**
Capacity (GB)
Volume capacity in Gigabytes.

Status
Volume status.

Emulation
Emulation type for the volume.

SRDF Group

Host Paths

To see more details of the volume, click

Enginuity Warning dialog box

This dialog box displays when one or more storage systems on which you have admin rights is running an Enginuity version below the minimum suggested version. In which case, you should contact your service provider to schedule an upgrade.

In addition to this dialog box, an alert will also display for each storage system not running the minimum suggested Enginuity version. For more information on viewing alerts, refer to Viewing alerts on page 52.

This dialog displays the following properties:

Symmetrix
Storage system ID.

Enginuity
Enginuity version currently running on the storage system.

Date
Date the current Enginuity version was released.

Target Enginuity
Minimum suggested Enginuity version for the storage system.*

Hide Warning
Select this option to no longer view this warning for the corresponding storage system.

* This field will appear empty when the:
  - Enginuity version currently running on the storage system is the same as the Target Enginuity version and it is more than 180 Days Old.
  - Enginuity version currently running on the storage system is lower than 5876 or higher than HYPERMAX OS 5977.
  - Enginuity version currently running on the storage system is at the end of life (EOL). For more information on the EOL Enginuity versions, refer to the release notes.

** This field will appear empty when the Enginuity version currently running on the storage system is lower than the Target Enginuity.
When the Enginuity version currently running on the storage system is more than 180 days older than the Target Date, Days Old displays the exact days old and the Target Date displays the target date.

Converting directors

This procedure explains how to convert directors (FA to RF and from RF to FA).

Before you begin

This procedure requires Enginuity 5876.

Procedure

1. Select a storage system.
2. Select System > Hardware.
3. Depending on the type of director you are converting, do the following in the Hardware panel:
   Front end directors:
   a. Click FE Directors to open the Front End Directors list view.
   b. Select a director, click and then click Convert FA to RF to open the Convert FA to RDF dialog.
   c. Do either of the following:
      • Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
      • Expand Add to Job List, and click Run Now to convert the director now.
   RDF directors:
   a. Click RDF Directors to open the RDF Directors list view.
   b. Select a director and click Convert RF to FA to open the Convert RDF to FA dialog box.
   c. Do either of the following:
      • Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.
      • Expand Add to Job List, and click Run Now to convert the director now.
4. (Optional) Open the Alerts list view (Events > Alerts) to monitor the conversion process.

The following alerts are typical during a conversion:
• Director status has changed to Failed.
• Port state has changed to Offline.
• Port state has changed to Offline.
• Director state has changed to Online.
• Port state has changed to Not Present.
Port state has changed to Online.

Associating directors with ports

Procedure
1. Select the storage system.
2. Select System > Hardware.
3. Click either the FE Directors or RDF Directors tab.
4. Select a port, click Associate to open the Port Association dialog.
5. Select a director and click OK.

Setting director port attributes

Procedure
1. Select the storage system.
2. Select System > Hardware.
3. In the Hardware panel, click the type of director to open its list view.
4. Select the director, click and then click Set Port Attributes to open the Set Port Attributes dialog box.
5. (Optional) Select the port with the flag settings you want to copy.
6. Select or clear any number of the following attributes:

   **Note**

   The following attributes are for all port types. Therefore, depending on the port type, some of the attributes may not be available to you.

   **ACLX**
   Enables the port to be added to a port group.

   **Show ACLX Volume**
   Enables the display of ACLX volume.

   **Common Serial Number**
   Enables multi-path configurations or hosts that need a unique serial number to determine which paths lead to the same volume.

   **Unique WWN**
   Ensures unique World Wide Names (WWNs) within the fiber environment (uses Symmetrix serial numbers and port numbers). This is enabled by default for all environment configuration changes and new environments. When disabled, you don't have to change WWNs.

   **Init Point to Point**
   Specifies a point-to-point (direct or switched) topology in the initialization sequence. When disabled (default), it is initialized as an arbitrated loop.

   **Volume Set Addressing**
   Enables the volume set addressing mode. When using volume set addressing, you must specify a 4-digit address in the following range:
Avoid Reset Broadcast
Enables a SCSI bus reset to only occur to the port that received the reset (not broadcast to all channels).

Negotiate Reset
When enabled for AS/400 hosts, this flag forces a SCSI negotiation by the Symmetrix system after a SCSI reset, an error, or a bus volume reset.

Enable Auto Negotiate
Allows two fibre ports to handshake and settle on an optimal speed for data transfer.

Environ Set
Enables the environmental error reporting by the Symmetrix system to the host on the specific port.

Disable Q Reset on UA
When enabled, a Unit Attention (UA) that is propagated from another director does not flush the queue for this volume on this director. Used for hosts that do not expect the queue to be flushed on a 0629 sense (only on a hard reset).

Soft Reset
Supports SCSI soft reset on a Symmetrix port when enabled for a Bull/GCOS-7 host.

SCSI 3
Alters the inquiry data (when returned by any volume on the port) to report that the Symmetrix system supports the SCSI-3 protocol. When disabled, the SCSI-2 protocol is supported.

SCSI Support1 (OS2007)
Provides a stricter compliance with SCSI standards for managing volume identifiers, multi-port targets, unit attention reports, and the absence of a volume at LUN 0.

Non Participating
Non participating.

SPC2 Protocol Version
This flag should be enabled (default) in a Windows 2003 environment running Microsoft HCT test version 12.1. When setting this flag, the port must be offline.

Server on AS400
Indicates the port is to behave as a server returning server inquiry data, rather than AS/400 data (applies to AS/400 platforms only).

Enable AS400
Indicates whether AS/400 is enabled.
OpenVMS
   Enables an Open VMS fiber connection.

iSCSI IPv4 Address
   Identifies the port's iSCSI IP address (IPv4).

iSCSI IPv4 Default Gateway
   Identifies the port's default gateway address (iSCSI).

iSCSI IPv4 Netmask
   Identifies the port's netmask address (iSCSI).

iSCSI Initiator Session
   Identifies the port's initiator session ID (iSCSI).

iSCSI IPv6 Address
   Identifies the port's iSCSI IP address (IPv6).

iSCSI IPv6 Net Prefix
   Identifies the port's iSCSI net prefix (IPv6). Possible values range from 0 to 127. The default value is 64.

7. Click Add to Job List to add this task to the job list, from which you can schedule or run the task at your convenience. For more information, refer to Scheduling jobs on page 812 and Previewing jobs on page 812.

Associating directors and ports

Before you begin

The storage system must be running HYPERMAX OS 5977 or higher.

When associating directors and ports, you can associate directors with ports, or ports with directors.

Procedure

1. Do one of the following:
   • To associate directors with ports:
     a. Select the storage system.
     b. Select System > Hardware.
     c. In the Hardware panel, click Available Ports to open the Available Ports list view.
     d. Select one or more ports.
     e. Click Associate to open the Associate Director dialog box.
     f. Select a director and click Associate.
   • To associate ports with directors:
     a. Select the storage system.
     b. Select System > Hardware.
     c. In the Hardware panel, click the director emulation type to open its list view.
     d. Select the director.
Disassociating directors and ports

Before you begin

The storage system must be running HYPERMAX OS 5977 or higher.

Procedure

1. To disassociate ports with directors:
   1. Select the storage system.
   2. Select System > Hardware.
   3. Click the tab for the appropriate director emulation type to open its list view.
   4. Select the director.
   5. Click Disassociate.
   6. Click OK.

Enabling and disabling director ports

Procedure

1. Select the storage system.
2. Select System > Hardware.
3. Click either the FE Directors or RDF Directors tab.
4. Select one or more ports, and click Enable to enable them, or Disable to disable them.
5. Click OK in the confirmation message.

Performing system health checks

Before you begin

- To perform this procedure you must be an Administrator or Storage Admin.
- The storage system must be running Enginuity 5876 or higher.

This procedure explains how to inspect the general state of a storage system.

Health check performs the following tests:

- **Vault State Test**—Verifies the ability of the system to save data in case of a power failure.
- **Spare Drive Test**—Verifies that spare drives are available in case of a drive failure.
- **Memory Test**—Verifies that the memory is reporting no errors or disabled banks.
- **Locks Test**—Verifies that there are no software locks present.
- **Emulations Test**—Verifies that all directors are loaded with the same Enginuity release as that on the service processor.
- **RDF Test**—Verifies that all SRDF links are online.
• **Environmental Test** — Verifies that internal environmental components (power supplies, fans, batteries, etc.) are reporting no errors.

• **Battery Test** — Verifies that the most-recent battery test reported no errors.

• **General Tests** — Checks for any abnormal conditions in the following areas: volume status, director status, hung upgrade, code table integrity, directors running same code.

To perform a health check on a storage system:

**Procedure**

1. Select a storage system.
2. Select the **System Health** tab.
3. In the **Actions** panel, click Run Health Check.
   
   The Health Check view opens displaying results of previously run health checks, if any.
4. Click **Run Now** or **Add to Job List**.
5. Determine the health of the storage system by examining the **Status** and **Results** fields.

**Naming storage systems**

This procedure explains how to assign custom *nice names* to storage systems:

**Procedure**

1. Select a storage system.
2. Select **System > Symmetrix Properties** (alternatively, click on **View Symmetrix Properties** in the **Actions** panel in the **System** view).
3. In the **Array Display Name** field, click on the field.
4. Type an Array Display Name. Array names must be unique from other array names and cannot exceed 32 characters. Only alphanumeric characters, underscores (_), and (-) are allowed. Array names are case-insensitive.
5. Click the checkmark to apply the name or the X symbol to discard it.

**Replacing failed drives**

**Before you begin**

• To perform this procedure you must be an Administrator or Storage Admin.

• The storage system with the failed disk drive must be locally attached to the SMAS server, running Enginuity 5876.163.105 or higher, and have the CRU flag enabled. This feature is not supported on storage systems running HYPERMAX OS 5977 or higher.

• Ensure that there are no other disk replacements occurring on the storage system.

• Ensure that you have the replacement drive and storage system's door key.

**Note**

Once you run the disk replacement job, you must replace the failed drive within 30 minutes to complete the disk replacement process. If you do not replace the drive within this time frame, the job will end, and you will need to restart the process.
The following are the high-level steps for completing this procedure:

Step 1: Locate the failed drive

Procedure

1. Select the storage system.
2. Select the System Health tab.
3. In the Actions panel, click RUN DISK REPLACEMENT.
4. Do one of the following:
   - Click Run Now to replace the drive now.
   - Expand Run Now and click Add to Job List to replace the drive at a later time, as described in .

Note

Regardless of the method you use to run the task, you have 30 minutes to locate and replace the failed drive. If you do not replace the drive within this time frame, the job ends, and you need to restart the process.

After you run the job, the Spare Drive Replacement Instructions dialog opens, displaying instructions and a map for locating the drive.

5. Print or Export the dialog contents, and then click Close.

6. Carefully follow the spare drive replacement instructions you just printed/exported to locate the drive.

Step 2: Replace the failed drive

Before you begin

It is recommended that before you begin any of the following procedures that you attach the clip of an ESD wristband to bare metal on the storage bay, and secure the wristband around your wrist with the metal button against your skin.

Procedure

1. To replace a failed disk drive:
   1. Access the disk drive. Do one the following, depending on the storage system model:
      - Storage Series system:
        a. Open the front door of the storage system and press the two spring latches on the DAE cover. Pull the cover outward and remove.
        b. Place the DAE cover aside for reinstallation later.
• Storage SE system:
  a. Open the front door of the storage system.

• Storage 10K system:
  a. Remove EMI front panel by pressing the side tabs and pulling straight forward.

2. Remove the disk drive:
   a. Release the latch on front of the disk you want to remove.
   b. Gently pull the disk out 1 inch and wait 30 seconds for the disk to stop spinning.
   c. Remove the disk and place it on an anti-static surface.
3. Install the disk drive:
   a. Align the drive with the guides in the slot.
   b. With the disk drive latch fully open, gently push the drive into the slot.
   c. Push the handle down to engage the latch. After the latch is engaged, push firmly on the bottom of the drive to verify that the disk is properly seated.

4. Reinstall the DAE cover or EMI front panel, or close the door, depending on the storage system model:
   - storage series system:
     a. Press the two spring latches on the DAE cover and align them with the slots on the chassis.
     b. Release the tabs to secure the cover. Close the front door of the storage bay.
   - storage SE system:
     a. Close the door.
   - storage 10K system:
     a. At the front of the cabinet, install the EMI front panel by pressing the side tabs and snapping into place.
Step 3: Verify the drive replacement

After you have completed the disk drive replacement, the lights will return to normal after several seconds. At this point, return to the Unisphere console to ensure that the disk replacement completed without issues.

To verify that you successfully replaced the drive, look for the following message in the job list (for instructions on viewing the job list, refer to Viewing the job list on page 815):

Spare Drive Replacement SUCCEEDED

If any other messages appear, follow the instructions.

Managing jobs

When you perform certain configuration tasks on the storage system, they are not immediately processed, but are kept in a job list for you to review and submit in batches. One way to identify these tasks is from the dialog boxes; they have a button named Add to Job List.

Unisphere includes a job list view, from which you can view and manage the job list for a storage system.

Making configuration changes safely

Before making configuration changes, you must thoroughly understand your storage system configuration. The following guidelines establish safe disciplines as you begin any change that can impact stored data:

Verify that the current configuration is a viable configuration for making changes.

Before creating new volumes, check for free physical disk space. New storage volumes are created first on physical disks that have no prior allocations, causing these disks to be committed to that emulation type.

No configuration change is activated in the storage system until you commit the action.
Some classes of change operations may or may not impact current I/O. When possible, before you commit any action, stop I/O activity on the volumes to be altered during a configuration change session.

Ensure that all your critical data is preserved and safe when creating new or changing volume configurations. Do not store data on any volume that is not mirrored.

After committing a mapping operation, you must update the volume mapping information within the host system environment. Attempting host activity with a volume after it has been removed or altered, but before you have updated the host’s volume information, can cause host errors.

If I/O activity on an affected volume occurs before or during a commit action, the commit action might fail. At the very least, heavy I/O activity on unaffected volumes impacts how long it takes to commit changes.

Contact Customer Service for assistance in reverting to your previous configuration should there be unforeseen problems with the new configuration.

---

**Understanding task persistence**

Active Unisphere configuration tasks persists across a server shutdown and subsequent restart. Inactive configuration tasks do not persist.

When the SMAS server is restarted, it restores all persisted tasks the task list, based on the user and the storage system.

The status of each restored task is determined by its status prior to the server shutdown, as detailed in the following table:

<table>
<thead>
<tr>
<th>Task status prior to server shutdown</th>
<th>Task status post server shutdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Created</td>
<td>Created</td>
</tr>
<tr>
<td>Aborted</td>
<td></td>
</tr>
<tr>
<td>Validated</td>
<td></td>
</tr>
<tr>
<td>Running</td>
<td></td>
</tr>
<tr>
<td>Successfully</td>
<td></td>
</tr>
<tr>
<td>Run has error</td>
<td></td>
</tr>
<tr>
<td>Prepare has error</td>
<td></td>
</tr>
<tr>
<td>Submit has error</td>
<td></td>
</tr>
<tr>
<td>Define has error</td>
<td></td>
</tr>
<tr>
<td>Validate has error</td>
<td></td>
</tr>
<tr>
<td>Done</td>
<td></td>
</tr>
<tr>
<td>Failed</td>
<td></td>
</tr>
<tr>
<td>Prepare in progress</td>
<td></td>
</tr>
<tr>
<td>Abort in progress</td>
<td></td>
</tr>
<tr>
<td>Submitted</td>
<td></td>
</tr>
<tr>
<td>Prepared</td>
<td></td>
</tr>
<tr>
<td>Defined</td>
<td></td>
</tr>
<tr>
<td>Pending</td>
<td></td>
</tr>
</tbody>
</table>
Table 72 Task status before and after server shutdown (continued)

<table>
<thead>
<tr>
<th>Task status prior to server shutdown</th>
<th>Task status post server shutdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>Unknown</td>
</tr>
<tr>
<td>Acquiring lock</td>
<td></td>
</tr>
<tr>
<td>Lock acquire failed</td>
<td></td>
</tr>
<tr>
<td>Running</td>
<td></td>
</tr>
<tr>
<td>During run</td>
<td></td>
</tr>
<tr>
<td>During preview</td>
<td></td>
</tr>
<tr>
<td>Commit in progress</td>
<td></td>
</tr>
</tbody>
</table>

Note
Configuration tasks that were in a Commit in progress state prior to server shutdown are restored in an Unknown state, since there is no way for the server to determine whether the task completed successfully. Therefore, to ensure that you are not committing a duplicate task, you should attempt to determine whether the original task completed successfully, prior to recommitting it.

Previewing jobs

Procedure
1. Select the storage system.
2. Select Events > Job List to open the Job List view.

Scheduling jobs

This option can be used to schedule one-off jobs.

In addition, this option can be used to create a recurring daily SnapVX snapshot for a given time. There is also an option to cancel a recurring snapshot. In the event of a failed recurring snapshot, an Alert will be raised to notify the user. The schedule continues to run in the event of a failed snapshot, issuing alerts to the user. The alerts list view retains a record of the failed snapshots (unless the alert is deleted). A warning level alert is issued.

Note the following for SnapVX snapshot jobs:

- If the job is already scheduled to be recurring, then the job cannot be grouped.
- Unscheduled jobs can be grouped together and then a single recurring schedule can be applied to that group.
- You cannot edit a recurring schedule once it has been created. If you want to change a recurring schedule, you must delete the existing recurring schedule and set up a new recurring schedule.
- If you want to create more than one daily snapshot, for example, every Monday at 9AM create a snapshot and every Monday at 5PM create a snapshot, you have to...
schedule multiple jobs for the desired times, that is, re-run the Protection Wizard with SnapVX and add to job list and schedule the jobs for the additional times.

- When scheduling a weekly snapshot, it is recommended that you choose one day of the week and time to take the snapshot, for example, selecting Wednesday at 8AM in order for the snapshot to occur every Wednesday at 8AM.

**Procedure**

1. Select the storage system.
2. Select **Events > Job List** to open the Job List view.
3. Select a job and click **Schedule** to open the **Schedule** dialog box.
4. Select an **Execution Time** and an **Execution Date**.
5. SnapVX Hourly snapshots only: Do one of the following: Select the **Occurrence** option—Daily, Hourly, or Run Once.
   - **Daily**: Select the **Execution Time** and select the days you want the job to reoccur on at the selected time.
   - **Hourly**: Select an **Execution Time** and an **Execution Date**.
   - **Run Once**: Select an **Execution Time** and an **Execution Date**.
6. Click **OK**.
7. Optional: Deleting a scheduled job
   - Select the job, click and then click **Delete**.
   - Click **OK** to confirm.

**Running jobs**

**Procedure**

1. Select the storage system.
2. Select **Events > Job List** to open the Job List view.
3. Select a job and click **Run**.
4. Click **OK**.

**Rescheduling jobs**

**Before you begin**

You cannot reschedule a single task in a job, only the entire job.

If the volumes involved in a configuration change were originally reserved, rescheduling the tasks without reservation does not release the reservations. You need to manually release the reservations.

To reschedule a job:

**Procedure**

1. Select the storage system.
2. Select **Events > Job List**.
3. Select a job and click **Schedule** to open the **Schedule** dialog box.
4. Select a new **Execution Date** and **Execution Time**.
5. Click **OK**.

**Modifying jobs**

**Procedure**
1. Select the storage system.
2. Select **Events > Job List** to open the Job List view.
3. Select a job and click **Modify**.
4. Modify the name, schedule or the occurrence and click **OK**.
   
   *Note: Job names must be unique from other jobs on the storage system.*

**Reordering tasks within a job**

**Procedure**
1. Select the storage system.
2. Select **Events > Job List** to open the Job List view.
3. Select a job and click ![Status](https://example.com), then click on the link in the **Status** field.
4. In the task list table, select the task, and click **Move Up** or **Move Down**.

**Grouping jobs**

This procedure explains how to group two or more jobs into one job.

**Procedure**
1. Select the storage system.
2. Select **Events > Job List** to open the Job List view.
3. Select two or more jobs and click **Group** to open the **Group Jobs** dialog box.
4. Specify a name for the new job by doing one of the following:
   - Typing a name for the new job. Job names must be unique from other jobs on the storage system.
   - Selecting the name of one of the jobs to be grouped.
   - Use the default name, which is the next available short job ID selected by Unisphere.
5. Use the calendar drop-down menu to schedule the date and time of the job.
6. Click **OK**.

**Un-grouping jobs**

When un-grouping a job, Unisphere creates an individual job for each of the tasks in the original job.

**Procedure**
1. Select the storage system.
2. Select **Events > Job List** to open the Job List view.
3. 
   
   Select a job and click ![Group](https://example.com).
4. In the task list, select **Ungroup** for each of the tasks you want to un-group from the job.

**Stopping jobs**

**Procedure**

1. Select the storage system.
2. Select **Events > Job List** to open the Job List view.
3. Select an active job and click **Stop**.
   
   If Unisphere successfully stops the job, the state of the job changes to **Stopped**.

**Deleting jobs**

This procedure explains how to group two or more jobs into one job.

**Procedure**

1. Select the storage system.
2. Select **Events > Job List** to open the Job List view.
3. Select one or more jobs, click and then click **Delete**.
4. Click **OK**.
   
   Unisphere removes the jobs from the job list view.

**Viewing the job list**

**Procedure**

1. Select the storage system.
2. Select **Events > Job List** to open the Job List view.
3. The Job List view allows you to view and manage a job list for a storage system.
   
   The following properties display:

   **Name**
   
   User-defined name for the job or an assigned ID, and an arrow icon indicating if the job contains one or more tasks.

   **Status**
   
   Status of the job. Possible values are:

   - **SCHEDULED**
     
     Job is scheduled for execution.

   - **UNSCHEDULED**
     
     Job is not scheduled for execution.

   - **CREATED**
     
     Job is created.

   - **RUNNING**
     
     Job is running. For jobs containing multiple tasks, this field will also display the job's progress. For example, Running (2 of 10).
SUCCEEDED
Job finished running.

ABORTED
Job was running and a user aborted it.

FAILED
Job failed.

User Name
Host from which the job was created and the ID of user who created it.

Last Modified Time
Date and time the job was moved to the job list.

Scheduled Time
Date and time the job is scheduled to run.

Completed Time
Date and time the job completed. This field is blank for incomplete jobs.

Recurring
Indicates whether the job is recurring.

The following controls are available:
- Modify—Modifying jobs on page 814
- Run—Running jobs on page 813
- Stop—Stopping jobs on page 815
- Schedule—Scheduling jobs on page 812
- Group—Grouping jobs on page 814
- Ungroup—Un-grouping jobs on page 814
- Delete — Deleting jobs on page 815
- Viewing job details on page 816

Viewing job details

Procedure
1. Select the storage system.
2. Select Events > Job List to open the Job List view.
3. Select a job and click .

The following properties are displayed:

Status
Status of the job. Possible values are:

SCHEDULED
Job is scheduled for execution.
Understanding licenses

Unisphere supports electronic licensing (eLicensing). eLicensing is an end-to-end license management solution to help you track and comply with software license entitlement. eLicensing leverages embedded locking functions and back-office IT systems and processes. It provides you with better visibility into software assets, easier upgrade, and capacity planning and reduced risk of non-compliance, while still adhering to a strict “do no harm” policy to your operations.

When installing licenses with eLicensing, you obtain license files from customer service, copy them to a Solutions Enabler or a Unisphere host, and load them onto storage systems.

Each license file fully defines all of the entitlements for a specific system, including its activation type (Individual or Enterprise), the licensed capacity, and the date the license was created. If you want to add a product title or increase the licensed capacity of an entitlement, obtain a new license file from online support and load it onto the storage system.

When managing licenses, Solutions Enabler, Unisphere, z/OS Storage Manager (EzSM), MF SCF native command line, TPF, and IBM i platform console, provide detailed usage reports that enable you to better manage capacity and compliance planning.
There are two types of eLicenses: host-based and array-based. Host-based licenses, as the name implies, are installed on the host. And, array-based licenses are installed on the storage system. For information on the types of licenses and the features they activate, refer to the Solutions Enabler Installation Guide.

Unisphere allows you to add and view array-based licenses, and add, view, and remove host-based licenses.

Unisphere uses array-based eLicensing.

---

### Note

For more information on eLicensing, refer to the Solutions Enabler Installation Guide.

---

## Installing licenses

### Before you begin

- To perform this operation, you must be an Administrator or StorageAdmin.
- Before you can use Unisphere to manage a storage system, you must first install a license on the storagesystem.
- To obtain array-based licenses from the support website you will need the License Authorization Code (LAC) identification number from the LAC letter emailed to you.

This procedure explains how to install storage system and host-based licenses.

To install licenses:

### Procedure

1. Select the storage system.
2. Click ![Settings](settings.png) in the title bar to open the **Settings** dialog, then click **System and Licences**.
3. Do the following, depending on the license type:

   **Array-based licenses:**
   
   a. Click *Symmetrix Entitlements* to open the Symmetrix Entitlements list view.
   
   b. Click *Get File* to open the support website, from which you can obtain new license files (by downloading or through email). Follow the instructions on the website. Be sure to download or copy the license file to a location on the SMAS server.
   
   c. Click *Load File* to open the **Load License File** dialog.
   
   d. Click *Choose File* and select the license file.
   
   The selected file's content loads for you to preview before loading it on the storage system.
   
   e. Click *OK* to load the license file on the storage system.

   **Host-based licenses:**
   
   a. Click *Solutions Enabler* to open the Solutions Enabler license key list view.
   
   b. Click *Load Key* to open the **Load License Key** dialog box.
c. Type the License Key.
d. Click OK.

Removing host-based licenses

Procedure
1. Select the storage system.
2. Click in the title bar to open the Settings dialog, then click System and Licences > Solutions Enabler to open the Solutions Enabler license view.
3. Select the license and click .

Viewing Symmetrix entitlements

Procedure
1. Select the storage system.
2. Click in the title bar to open the Settings dialog, then click System and Licences > Symmetrix Entitlements to open the Symmetrix Entitlements list view.

Use the Symmetrix Entitlement list to view all licensed features (including those licensed with array-based entitlements and host-based keys, which are still required) on storage systems running Enginuity 5876 or higher. In addition, you can obtain and install license files on storage systems running Enginuity 5876 or higher.

The License Usage information is displayed for the first of the listed storage arrays. You can select a storage system from the dropdown list to view its license usage information.

The following properties display:

**Feature Name**
Name of the feature.

**License**
Whether the license is host-based (SE) or array-based (EMCLM).

**Status**
Whether the license is Enabled or Disabled.

**Expiration Date**
Date an evaluation license expires. For permanent licenses, this field appears blank.

The following controls are available:

* — To view details of a license file installed on the storage system, hover over the entry and click (see Viewing license file on page 821).
• **Get File**—Opens the support website, from which you can obtain a license file (by downloading or through email). Download or copy a license file to the SMAS server before applying it to a storage system.

• **Load File**—[Installing licenses](#) on page 818

### Viewing host-based licenses

**Before you begin**

**Procedure**

1. Click ![settings_icon](image) in the title bar to open the **Settings** dialog, then click **System and Licences > Solutions Enabler** to open the **Solutions Enabler** license view.

The Solutions Enabler license view allows you to view and manage host-based licenses.

The following properties display:

- **License Key**
  - License key.

- **Licensed Features**
  - Name of the licensed feature.

The following controls are available:

- **Load Key**—[Installing licenses](#) on page 818

- ![delete_icon](image) — [Removing host-based licenses](#) on page 819

### Viewing license usage

**Procedure**

1. Click ![settings_icon](image) in the title bar to open the **Settings** dialog, then click **System and Licences > License Usage** to open the license usage list view.

The License Usage view shows the results of a query to the storage system’s feature registration database (Enginuity 5876 or higher).

The License Usage information is displayed for the first of the listed storage arrays. You can select a storage system from the dropdown list to view its license usage information.

The following properties display:

- **Feature Name**
  - Name of the feature.

- **Activation Type**
  - How the product title was activated. Possible values are:
    - **Entitlement**
      - Indicates that product title was activated through an entitlement.
Manual Override
Indicates that the product title was manually activated by customer service.

Product titles activated manually (MAN) or because they were in use (USE) are not considered properly entitled, in which case contact customer service for proper entitlement.

Capacity Type
Qualifies the licensed capacity. Valid values are:

- **R-TB-Non-SATA**
  Indicates that the capacity licensed applies to the raw capacity of all volumes on the system, excluding SATA.

- **R-TB-SATA**
  Indicates that the capacity licensed applies to the raw capacity of all SATA volumes on the system.

- **REG-TB**
  Indicates that the capacity licensed applies to the registered capacity of the storage system.

- **R-TB External**
  Indicates that the capacity licensed applies to the raw capacity of the virtualized LUNs in external storage.

Licensed Capacity (TB)
Maximum quantity of data for which the functionality of the software is licensed to use, in Terabytes.

Used Capacity (TB)
Amount of licensed capacity currently in use.

Viewing license file

**Procedure**

1. Select the storage system.
2. Click in the title bar to open the Settings dialog, then click System and Licences > Symmetrix Entitlements to open the Symmetrix Entitlements list view.
   
   Use the Symmetrix Entitlement list to view all licensed features (including those licensed with array-based entitlements and host-based keys, which are still required) on storage systems running Enginuity 5876 or higher. In addition, you can obtain and install license files on storage systems running Enginuity 5876 or higher.

   The License Usage information is displayed for the first of the listed storage arrays. You can select a storage system from the dropdown list to view its license usage information.

3. Hover over the row whose license file you wish to see and click .
   The following properties are displayed:
<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Name of the feature.</th>
</tr>
</thead>
<tbody>
<tr>
<td>License</td>
<td>Whether the license is host-based (SE) or array-based (EMCLM).</td>
</tr>
<tr>
<td>Status</td>
<td>Whether the license is Enabled or Disabled.</td>
</tr>
<tr>
<td>Activation Type</td>
<td>Whether the feature's license is Permanent or an Evaluation copy. Evaluation licenses include an expiration date for reporting purposes only; the product title can still be used. Permanent licenses can be assigned to individual storage systems or to all the storage systems in the enterprise.</td>
</tr>
<tr>
<td>Activation Domain Type</td>
<td>Whether the permanent license is assigned to an individual storage systems or to all the storage systems in the enterprise. This column is blank for Evaluation type licenses.</td>
</tr>
<tr>
<td>Install Date</td>
<td>Date the license file was installed on the storage system.</td>
</tr>
<tr>
<td>Capacity Type</td>
<td>Qualifies the capacity licensed. Possible values are:</td>
</tr>
<tr>
<td>R-TB-Non-SATA</td>
<td>Indicates that the capacity licensed applies to the raw capacity of all volumes on the system, excluding SATA. This value only applies to storage systems running Enginuity 5876.</td>
</tr>
<tr>
<td>R-TB-SATA</td>
<td>Indicates that the capacity licensed applies to the raw capacity of all SATA volumes on the system. This value only applies to storage systems running Enginuity 5876.</td>
</tr>
<tr>
<td>REG-TB</td>
<td>Indicates that the capacity licensed applies to the registered capacity of the storage system. This value only applies to storage systems running Enginuity 5876.</td>
</tr>
<tr>
<td>R-TB External</td>
<td>Indicates that the capacity licensed applies to the raw capacity of the virtualized LUNs in external storage. This value only applies to storage systems running Enginuity 5876.</td>
</tr>
<tr>
<td>Usable-TB</td>
<td>Indicates that the capacity licensed applies to the usable capacity of the storage system. This value only applies to storage systems running HYPERMAX OS 5977 or higher.</td>
</tr>
</tbody>
</table>

4. Click **VIEW FILE** to view the formatted file or the raw output.

**Viewing license file details**

**Procedure**

1. Select the storage system.

2. Click ![settings_icon] in the title bar to open the *Settings* dialog, then click **System and Licences > Symmetrix Entitlements** to open the Symmetrix Entitlements list view.

3. Hover over the row whose license file you wish to see and click ![info_icon].

4. Click **VIEW FILE** to view the formatted file or the raw output.

   A dialog with two tabs (**Formatted File** and **Raw Output**) is displayed.

5. Click **Formatted File** to view the license file as a formatted file

6. Click **Raw Output** to view the raw output of the license file.
Understanding access controls

Administrators, StorageAdmins, and SecurityAdmins can set access controls on specific volumes within a storage system and assign those volumes to a specific host. When set, only that host can see the volumes, and perform the granted operations. Other hosts connected to that storage system will not see those volumes. This eliminates the possibility of one host inadvertently performing operations on volumes that belong to someone else.

Note

Refer to the Solutions Enabler Array Management CLI Product Guide for more information about Access Controls.

To set up access controls:

Procedure

1. Create an access control group. See Creating access groups on page 824.
2. Add to the group, one or more hosts (access name) and unique IDs.
   Each host has a unique ID; a group can contain one or more hosts. See Adding access ID to access groups on page 824.
3. Create one or more pools of volumes.
   Specific volumes can belong to only one pool. See Creating access groups on page 824.
4. Create one or more access control entries.
   An access control entry associates a pool with a group, and grants the access control types. See Creating access control entries on page 829.

Opening access controls

Before you begin

Access control dialogs and views are restricted and require you to enter a PIN provided by customer service.

To perform this operation, you must be an Administrator or SecurityAdmin.

To open access controls:

Procedure

1. Select a storage system.
2. Click in the title bar to open the Settings dialog, then click Symmetrix Access Control and select Access Control Entries, Access Groups or Access Pools.
3. To enable active management, click on the PIN link in the read-only warning or else on the lock icon next to the section title.
4. In the Enter PIN dialog, enter your Access Control PIN and click OK.
   Active management is now enabled and the read-only warning no longer appears.
Creating access groups

Typically various sets of users tend to use the same applications that utilize common features from a given host. They typically require the same volume resources and permissions of access to these shared volumes. For this reason, hosts are registered in groups identified with a group name, which serves as a root for all ACEs in the group. Access groups contain groups of access IDs and their ID names. Any ID and name must belong to just one group and are entered into the database together. For ease of management, it is highly recommended that you choose an access ID name that best associates with the particular host in use. For example, SunHost1 is more appropriate than a name such as JRSMITH.

Once the group is created, the group name can be used to create access control entries (ACEs).

To create an access control group:

Procedure

1. Select a storage system.
2. Click in the title bar to open the Settings dialog, then click Symmetrix Access Control > Access Groups.
3. To enable active management, enter your Access Control PIN: Opening access controls on page 823
4. Click Create to open the Create Access Group dialog box.
5. Type a Group Name.
   Access group names must be unique from other access pools on the system and cannot exceed 31 characters (Enginuity 5876 or higher). Only alphanumeric characters, underscores ( _ ), and dashes (-) are allowed. Access group names are case-sensitive.
6. Type the Host ID.
   This value is the name of the access ID (eight characters).
7. Type the host's Unique Access ID.
   To find this value, run the SYMCLI command symacl - unique on the host computer, (host ID example: 2C5E05B6-53408AC9-9C3F747C).
8. Click Add to add an access ID to the access group (see Adding access ID to access groups on page 824).
9. Click OK.

Adding access ID to access groups

Procedure

1. Select the storage system.
2. Click in the title bar to open the Settings dialog, then click Symmetrix Access Control > Access Groups.
3. To enable active management, enter your Access Control PIN: Opening access controls on page 823
4. Select the group and click .
5. In the **Properties** panel, click the number next to **Access IDs**.

6. Click **Add** to open the **Add Access ID** dialog box.

7. Do one of the following:
   - To add host access IDs to the group:
     a. Type the **Host ID**. This value is the host computer name.
     b. Type the host's **Unique Access ID**. To find this value, run the SYMCLI command `symacl -unique` on the host computer. Example host ID: 2C5E05B6-53408AC9-9C3F747C.
     c. Click **Add Host**.
   - To add user access IDs to the group:
     a. Type the **User ID name**. This value is the ID assigned by the access control administrator, must be between four and twelve characters long.
     b. Type the user's access control pin.
     c. Click **Add User**.

8. Click **OK**.

### Removing access IDs from access groups

**Procedure**

1. Select the storage system.

2. Click **in the title bar to open the **Settings** dialog, then click Symmetrix Access Control > Access Groups**.

3. To enable active management, enter your Access Control PIN: **Opening access controls on page 823**

4. Select the group and click **<**.

5. In the **Properties** panel, click the number next to **Access IDs** to open the Access ID list view.

6. Select one or more IDs and click **Remove**.

7. Click **OK**.

### Deleting access groups

**Procedure**

1. Select the storage system.

2. Click **in the title bar to open the **Settings** dialog, then click Symmetrix Access Control > Access Groups**.

3. To enable active management, enter your Access Control PIN: **Opening access controls on page 823**

4. Select one or more groups and click **Delete**.

5. Click **OK**.
Viewing access groups

Before you begin
A read only user can view access groups. You must enter a PIN in order to make changes.

Procedure
1. Select the storage system.
2. Click in the title bar to open the Settings dialog, then click Symmetrix Access Control > Access Groups.
3. To enable active management, enter your Access Control PIN: Opening access controls on page 823
4. Use the Access Groups list view to display and manage access groups on the storage system.
   The following properties display:
   Access ID Group
   Name of the access ID.
   Number of Access IDs
   Number of members (host access IDs) in the group.
   Number of Access Control Entries
   Number of access pools associated with the group.
   The following controls are available:
   • —Viewing access group details on page 826
   • Create—Creating access groups on page 824
   • —Deleting access groups on page 825

Viewing access group details

Procedure
1. Select the storage system.
2. Click in the title bar to open the Settings dialog, then click Symmetrix Access Control > Access Groups.
3. To enable active management, enter your Access Control PIN: Opening access controls on page 823
4. Select the group and click .
5. Use the access group details view to display and manage an access group. This view contains the following panel:
   Properties panel
   The following properties display:
Creating access pools

Procedure

1. Select the storage system.

2. Click in the title bar to open the Settings dialog, then click Symmetrix Access Control > Access Pools.

3. To enable active management, enter your Access Control PIN: Opening access controls on page 823

4. Click Create to open the Create Access Pool dialog box.

5. Type a Pool Name.

   Access pool names must be unique from other access pools on the system and cannot exceed 31 characters (Enginuity 5876 or higher). Only alphanumeric characters, underscores (_), and dashes (-) are allowed. Access pool names are case-sensitive.

6. Select one or more available volumes and click to select it.

   Note

   When adding a meta volumes to an access pool, you must select the meta head. Individual meta members do not appear in the volume lists.

7. Click OK.

Modifying access pools

The following explains how to add/remove volumes from an access pool:

Procedure

1. Select a storage system.

2. Click in the title bar to open the Settings dialog, then click Symmetrix Access Control > Access Pools.

3. To enable active management, enter your Access Control PIN: Opening access controls on page 823
4. Select the access pool and click to open its details view.

5. In the Properties panel, click the number next to Volumes to the access pool volumes list view.

- To add volumes to the pool:
  a. Click Add to open the Add Volume to Access Pool dialog box.
  b. Select one or more Available Volumes and click Add Volume.
  c. Click OK.

- To remove volumes from the pool:
  a. Select one or more volumes and click Remove.
  b. Click OK.

Deleting access pools

Procedure

1. Select the storage system.

2. Click in the title bar to open the Settings dialog, then click Symmetrix Access Control > Access Pools.

3. To enable active management, enter your Access Control PIN: Opening access controls on page 823

4. Select one or more pools and click Delete.

5. Click OK.

Viewing access pools

Before you begin

A read only user can view access pools. You must enter a PIN in order to make changes.

Procedure

1. Select the storage system.

2. Click in the title bar to open the Settings dialog, then click Symmetrix Access Control > Access Pools.

3. To enable active management, enter your Access Control PIN: Opening access controls on page 823

4. Use the Access Pools list view to display and manage access pools on the storage system. Select a storage system ID from the drop-down list.

The following properties display:

Access Controlled Volume Pool
   Name of the pool.

Number of Volumes
   Number of volumes in the pool.

Number of Access Control Entries
   Number of access control entries.
The following controls are available:

- **Viewing access pool details** on page 829
- **Create**—Creating access pools on page 827
- **Deleting access pools** on page 828

To view access pool volumes, see Viewing access pool volumes on page 832.

### Viewing access pool details

**Procedure**

1. Select the storage system.
2. Click in the title bar to open the Settings dialog, then click Symmetrix Access Control > Access Pools.
3. To enable active management, enter your Access Control PIN: Opening access controls on page 823
4. Select the access pool and click to open its details view.
5. Use the Access Pool details view to display and manage an access pool.

The following properties display:

**Access Controlled Volume Pool**
- Name of the pool.

**Number of Volumes**
- Number of volumes in the pool.

**Number of Access Controlled Entries**
- Number of access groups associated with the pool.

The following controls are available:

- **Create**—Creating access pools on page 827
- **Deleting access pools** on page 828

The Properties panel provides links to views for objects contained in and associated with the access pool. For example, clicking the number next to Volumes opens a view listing the volumes contained in the pool.

### Creating access control entries

**Procedure**

1. Select the storage system.
2. Click in the title bar to open the Settings dialog, then click Symmetrix Access Control > Access Control Entries.
3. To enable active management, enter your Access Control PIN: Opening access controls on page 823
4. Click Create.
5. Select/Create the access group to include in the ACE.
6. Select/Create the access pool to include in the ACE.
7. Select one or more available access types and click to select it.
8. Click OK.

Deleting access control entries

**Procedure**
1. Select the storage system.
2. Click in the title bar to open the Settings dialog, then click Symmetrix Access Control > Access Control Entries.
3. To enable active management, enter your Access Control PIN: Opening access controls on page 823
4. Select one or more entries and click Delete.
5. Click OK.

Viewing access control entries

**Before you begin**
A read only user can view access control entries. You must enter a PIN in order to make changes.

**Procedure**
1. Select the storage system.
2. Click in the title bar to open the Settings dialog, then click Symmetrix Access Control > Access Control Entries.
3. To enable active management, enter your Access Control PIN: Opening access controls on page 823
4. Use the Access Control Entries list view to display and manage access control entries on the storage system. Select a storage system ID from the drop-down list.

The following properties display:

**Access ID Group**
Associated access group.

**Access-controlled Volume Pool**
Associated access pool.

**Access Types**
Permissions assigned to the group/pool. For information about valid values, refer to Access types on page 833, Viewing access types on page 832, and Modifying access types on page 834.

The following controls are available:
Viewing access control entry details

Procedure
1. Select the storage system.
2. Click the gear icon in the title bar to open the Settings dialog, then click Symmetrix Access Control > Access Control Entries.
3. To enable active management, enter your Access Control PIN: Opening access controls on page 823.
4. Select the entry and click .
5. Use the details view to list and manage access control entries.

Properties panel
The following properties display:

Access ID Group
Associated access group.

Access-controlled Volume Pool
Associated access pool.

Access Type
Permissions assigned to the group/pool. For possible values, see Access types on page 833.

The Properties panel provides links to views for objects contained in and associated with the access control entry. For example, clicking Access IDs opens a view listing the access IDs associated with the entry.

Viewing access IDs

Procedure
1. Select the storage system.
2. Click the gear icon in the title bar to open the Settings dialog, then click Symmetrix Access Control > Access Groups.
3. To enable active management, enter your Access Control PIN: Opening access controls on page 823.
4. Select the group and click .
5. In the Properties panel, click the number next to Access IDs.
6. Use the Access ID list view to display and manage access IDs.

The following property displays:
Access ID

Access IDs assigned to the group.

The following controls are available:

- **Add**—Adding access ID to access groups on page 824
- **Remove**—Removing access IDs from access groups on page 825

Viewing access pool volumes

**Procedure**

1. Select the storage system.
2. Click in the title bar to open the **Settings** dialog, then click **Symmetrix Access Control > Access Pools**.
3. To enable active management, enter your Access Control PIN: Opening access controls on page 823
4. Select the access pool and click to open its details view.
5. In the **Properties** panel, click the number next to **Volumes**.
6. Use the Access Pool Volumes list view to display and manage the volumes in an access pool.

The following property displays:

**Volume ID**

Volume identifier.

The following controls are available:

- **Add**—Modifying access pools on page 827
- **Remove**—Modifying access pools on page 827

Viewing access types

**Procedure**

1. Select the storage system.
2. Click in the title bar to open the **Settings** dialog, then click **Symmetrix Access Control > Access Control Entries**.
3. To enable active management, enter your Access Control PIN: Opening access controls on page 823
4. Select the entry and click .
5. In the **Properties** panel, click the number next to **Access Types**.
6. Use the Access Types list view to display and manage the access types associated with an access control entry.

The following property displays:
Access Type
Permissions assigned to the group/pool. For more information about valid values, refer to Access types on page 833.

The following controls are available:
- Add—Adding access ID to access groups on page 824
- —Removing access IDs from access groups on page 825

Access types
This table lists/describes the possible access types. Access define the permissions assigned to access groups and pools.

Table 73 Access types

<table>
<thead>
<tr>
<th>Access type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADMIN</td>
<td>Grants administrator privilege to grant/deny access control entries to hosts and users.</td>
</tr>
<tr>
<td>ADMINRD</td>
<td>Grants read access only to all access control information.</td>
</tr>
<tr>
<td>ALL</td>
<td>All possible access types granted except ADMIN and ADMINRD. Must be directed to ALL volumes.</td>
</tr>
<tr>
<td>BASE</td>
<td>Allows the discovery of devices and to obtain states and statistics from the storage system (directors and volumes).</td>
</tr>
<tr>
<td>BASECTRL</td>
<td>Allows base control operations on volumes and device groups.</td>
</tr>
<tr>
<td>BCV</td>
<td>Allows TimeFinder (BCV) and clone control and status operations.</td>
</tr>
<tr>
<td>CACHCTRL</td>
<td>Allows cache control operations concerning LRU partition management.</td>
</tr>
<tr>
<td>CFGDEV</td>
<td>Allows powerful configuration control operations that manage various types of configuration changes on volumes in the storage system.</td>
</tr>
<tr>
<td>CFGSYM</td>
<td>Allows access to set storage system attributes, set port flags, and swap RA groups. Must be directed to ALL volumes.</td>
</tr>
<tr>
<td>CHECKSUM</td>
<td>Allows volume Double Checksum operations.</td>
</tr>
<tr>
<td>CREATEDV</td>
<td>Allows the creation and deletion of volumes.</td>
</tr>
<tr>
<td>DIRCTRL</td>
<td>Allows you to take directors and their ports offline and online. Must be directed to ALL volumes.</td>
</tr>
</tbody>
</table>
### Table 73 Access types (continued)

<table>
<thead>
<tr>
<th>Access type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECC</td>
<td>Allows the ECC agent to run on the requested host.</td>
</tr>
<tr>
<td>OPTMZR</td>
<td>Allows user-configurable attributes that may affect the Optimizer behavior.</td>
</tr>
<tr>
<td>POWRPATH</td>
<td>Access to PowerPath-directed devices in an RDF group. Must be directed to ALL volumes.</td>
</tr>
<tr>
<td>QOS</td>
<td>Allows the execution of Quality of Service (QOS) performance control operations to manage copy priorities. Excludes LRU cache control functionality.</td>
</tr>
<tr>
<td>RCOPY</td>
<td>Manages Open Replicator sessions.</td>
</tr>
<tr>
<td>RDF</td>
<td>Allows SRDF control and set operations.</td>
</tr>
<tr>
<td>SDDF</td>
<td>Allows the DeltaMark (Change Tracker) functionality that monitors track changes.</td>
</tr>
<tr>
<td>SDR</td>
<td>Allows mapping/unmapping of devices to directors/ports for the Symmetrix Disk Reallocation (SDR) feature.</td>
</tr>
<tr>
<td>SNAP</td>
<td>Allows the creation and management of virtual copy sessions between a source volume and multiple virtual (VDEV) target volumes.</td>
</tr>
<tr>
<td>VLOGIX</td>
<td>Enables access to volume Masking or Volume Logix volumes.</td>
</tr>
</tbody>
</table>

### Modifying access types

The following explains how to add/remove access types defined in an access control entry.

**Procedure**

1. Select the storage system.
2. Click in the title bar to open the Settings dialog, then click Symmetrix Access Control > Access Control Entries.
3. To enable active management, enter your Access Control PIN: Opening access controls on page 823
4. Select the entry and click .
5. In the Properties panel, click the number next to Access Types to open the Access Types list view.
   - To add access types:
     a. Click Add to open the Assign Access Types dialog box.
     b. Select one or more access types and click Add. For more on the available access types, see Access types on page 833
c. Click OK.

- To remove access types:
  a. Select one or more access types and click Remove.
  b. Click OK.

Understanding dynamic cache partitioning

Dynamic Cache Partitioning (DCP) divides the cache memory into multiple partitions with unique names and their device path assignments. Partition areas can be made static or dynamic in size. The dynamic partitioning provides flexibility to the amount of floating memory that can be allocated with a high and low watermark. This allows memory resources to be temporarily donated to other partitions when needed. The `symqos` command allows you to create partitions for different device groupings in addition to the default partition that all devices belong to initially. Each partition has a target cache percentage as well as a minimum and maximum percentage. In addition, you can donate unused cache to other partitions after a specified donation time.

---

**Note**

Enginuity 5876 is required for actively managing dynamic cache partitions. DCPs can be viewed on storage systems running HYPERMAX OS 5977 Q316SR or higher but they can't be actively managed.

Enabling/Disabling dynamic cache partitioning

**Before you begin**

This feature is not supported on HYPERMAX OS 5977 or higher.

**Procedure**

1. Select a storage system.

2. Click  in the title bar to open the Settings dialog, then click Management > Symmetrix Attributes.

3. In the DCP panel, set the Cache Partition Status to Enable or Disable.

4. Click Apply.

Creating dynamic cache partitions

**Before you begin**

- This feature is not supported on HYPERMAX OS 5977 or higher.
- There must be an available partition.
- There must be enough cache left in the default partition that it does not fall below the minimum required cache.
- The number of cache partitions allowed on a storage system is defined in the storage system's properties file. The maximum number allowed is 16.
- The sum of target % for all defined partitions must be 100%.

**Procedure**

1. Select the storage system.
2. Select the System Health tab.
3. In the Actions panel, click View Other Hardware and then Cache Partitions.
4. Click Create to open the Create Dynamic Cache Partition dialog box.
5. Type a Name for the dynamic cache partition.
   Dynamic cache partition names must be unique from other cache partition names on the storage system and cannot exceed 31 characters. Only alphanumeric characters and underscores are allowed. Note that underscores can only be used with the string; not on the ends of the string.
6. Type the minimum target percentage (Min Target %) for the partition. This value must be less than the Target %.
7. Type the target cache percentage (Target %) for the partition. This value must be less than the Max Target %.
8. Type the maximum cache percentage (Max Target %) for the partition.
9. Type the Donation Time in seconds.
   This value is the length of time before idle cache will be made available to other partitions. The default value is 300 seconds.
10. Type the write pending limit percentage (WP Limit %) for the cache partition.
    Possible values 40-80, with 80 being the default.
11. Click OK.

Modifying dynamic cache partitions

Before you begin
This feature is not supported on HYPERMAX OS 5977 or higher.

Procedure
1. Select the storage system.
2. Select the System Health tab.
3. In the Actions panel, click View Other Hardware and then Cache Partitions.
4. Select a dynamic cache partition and click Modify.
5. Modify the Name for the dynamic cache partition.
   Dynamic cache partition names must be unique from other cache partition names on the storage system and cannot exceed 31 characters. Only alphanumeric characters and underscores are allowed. Note that underscores can only be used with the string; not on the ends of the string.
6. Modify the minimum target percentage (Min Target %) for the partition. This value must be less than the Target %.
7. Modify the target cache percentage (Target %) for the partition. This value must be less than the Max Target %.
8. Modify the maximum cache percentage (Max Target %) for the partition.
9. Modify the Donation Time in seconds.
   This value is the length of time before idle cache will be made available to other partitions. The default value is 300 seconds.
10. Modify the write pending limit percentage (WP Limit %) for the cache partition.
Assigning dynamic cache partitions

This procedure explains how to assign dynamic cache partitions from the Volumes view. You can also perform this operation from other locations in the interface. Depending on the location, some of the steps may not apply.

Procedure
1. Select the storage system.
2. Select Storage > Volumes.
3. Click on the appropriate volume panel.
4. Select the volume, click , and select Assign Dynamic Cache Partition.
5. Select a Dynamic Cache Partition and click OK.
6. Click OK.

Deleting dynamic cache partitions

Before you begin
This feature is not supported on HYPERMAX OS 5977 or higher.

Procedure
1. Select the storage system.
2. Select the System Health tab.
3. In the Actions panel, click View Other Hardware.
   Use the Cache Partitions list view to display and manage dynamic cache partitions.
   The following properties display:
Name
Name of the partition.

Min %
Minimum target percentage.

Tgt %
Target cache percentage.

Max %
Maximum cache percentage.

Donation Time
Length of time before idle cache will be made available to other partitions.

WP Limit
Write pending limit percentage.

Slots Used
Number of cache slots used by the partition.

% Used
Percentage of cached used by the partition.

Alerts
Director alert status, as indicated by icon color:

- ⚠️ One or more fatal alerts.
- 🚨 One or more critical alerts, with none higher.
- ⚠️ One or more warning alerts, with none higher.
- ⚠️ One or more informational alerts, with none higher.
- ⚠️ No alerts.

The following controls are available:

- Create—Creating dynamic cache partitions on page 835
- Delete—Deleting dynamic cache partitions on page 837
- —Viewing dynamic cache partitions on page 839

4. Select a partition and click Delete.
5. Click OK in the confirmation message.

Running in analyze mode

Cache partitioning Analyze mode is a tool for helping you determine the amount of cache your applications are consuming, prior to enabling the cache partitioning feature. Once you have determined the amount of cache your applications are consuming, you can then modify the existing partitions, or add/delete partitions to achieve the required performance.
Enabling Analyze mode will automatically set the following cache partition settings:

- **Max %** = 100
- **Min %** = 0
- **Donation Time** = 0 (seconds)

These settings will allow cache to behave as if there are no partitions.

**Procedure**

1. Enable dynamic cache partitioning in Analyze mode under **Settings > Symmetrix Attributes > DCP**.
2. Create your dynamic cache partitions. See *Creating dynamic cache partitions* on page 835.
3. Assign volumes to the cache partitions.
5. Once you have gathered enough usage data, change the cache partitioning status from Analyze mode to Enable.
6. Make changes to the cache partitions based on the usage data.

**Viewing dynamic cache partitions**

**Procedure**

1. Select the storage system.
2. Select the **System Health** tab.
3. In the **Actions** panel, click **View Other Hardware**.

   Use the Cache Partitions list view to display and manage dynamic cache partitions.

   The following properties display:

   - **Name**
     - Name of the partition.
   - **Min %**
     - Minimum target percentage.
   - **Tgt %**
     - Target cache percentage.
   - **Max %**
     - Maximum cache percentage.
   - **Donation Time**
     - Length of time before idle cache will be made available to other partitions.
   - **WP Limit**
     - Write pending limit percentage.
   - **Slots Used**
     - Number of cache slots used by the partition.
   - **% Used**
     - Percentage of cached used by the partition.
Alerts
Director alert status, as indicated by icon color:

- ⚠️ One or more fatal alerts.
- ⚠️ One or more critical alerts, with none higher.
- ⚠️ One or more warning alerts, with none higher.
- ⚠️ One or more informational alerts, with none higher.
- No alerts.

The following controls are available:

- **Create**—Creating dynamic cache partitions on page 835
- **Delete**—Deleting dynamic cache partitions on page 837
- **View**—Viewing dynamic cache partitions on page 839

### Viewing dynamic cache partition details

**Procedure**

1. Select the storage system.
2. Select the **System Health** tab.
3. In the **Actions** panel, click **View Other Hardware**.

Use the Cache Partitions list view to display and manage dynamic cache partitions.

The following properties display:

- **Name**
  Name of the partition.

- **Min %**
  Minimum target percentage.

- **Tgt %**
  Target cache percentage.

- **Max %**
  Maximum cache percentage.

- **Donation Time**
  Length of time before idle cache will be made available to other partitions.

- **WP Limit**
  Write pending limit percentage.

- **Slots Used**
  Number of cache slots used by the partition.
% Used
Percentage of cached used by the partition.

Alerts
Director alert status, as indicated by icon color:

- 🚨 One or more fatal alerts.
- 🔴 One or more critical alerts, with none higher.
- 👤 One or more warning alerts, with none higher.
- 📢 One or more informational alerts, with none higher.
- 📣 No alerts.

The following controls are available:

- **Create**—Creating dynamic cache partitions on page 835
- **Delete**—Deleting dynamic cache partitions on page 837
- **Viewing dynamic cache partitions** on page 839

4. Select a partition and click 📦.

The Cache Partition details view allows you to view and manage a cache partition. This view contains **Details** and **Performance** panels. The following properties display:

**Name**
Name of the partition. To rename the partition, type a new name over the existing and click **Apply**. Dynamic cache partition names must be unique from other cache partition names on the storage system and cannot exceed 32 characters. Only alphanumeric characters and underscores are allowed. Note that underscores can only be used with the string; not on the ends of the string. You cannot modify the name of the DEFAULT_PARTITION.

**Min Target %**
Minimum target percentage. To change this value, type a new value over it and click **Apply**. This values must be less than the Target %. You cannot modify this value for the DEFAULT_PARTITION.

**Target %**
Target cache percentage. To change this value, type a new value over it and click **Apply**. This value must be less than the Max Target %. You cannot modify this value for the DEFAULT_PARTITION.

**Max Target %**
Maximum cache percentage. To change this value, type a new value over it and click **Apply**. You cannot modify this value for the DEFAULT_PARTITION.
Donation Time (Sec)
Length of time before idle cache will be made available to other partitions.
To change this value, type a new value over it and click Apply.

Write Pending Limit (%)
Write pending limit percentage. Possible values 40-80, with 80 being the default.

Write Pending Slot Count
Write pending slot count.

Cache Slots Used
Number of cache slots used by the partition.

Cache Percentage Used
Percentage of cached used by the partition.

Volumes

The Performance panel links you to the performance analyze views for the group.
This panel displays with inactive links if the selected storage system is not registered for data collection.

Viewing volumes assigned to dynamic cache partitions

Procedure
1. Select the storage system.
2. In the Dashboard, click the System Health tab.
3. In the Actions panel, click View Other Hardware.
4. In the Cache Partitions tab, select a partition and click to open it Details view.
5. Click on the number in the Volumes field to open the Volumes list view.
Use the Volumes list view to display and manage volumes assigned to the partition.
The following properties display:
   • Name—Assigned volume name.
   • Type — Type of volume.
   • Meta Config—Volume configuration.
   • Striped Size—Meta striped size.
   • Status—Volume status.
   • Reserved—Indicates whether the volume is reserved.
   • Capacity (GB)—Volume capacity in Gigabytes.
   • Emulation—Emulation type for the volume.
   • Paths—Number of masking records for the volume.
System management - iSCSI

Unisphere provides monitoring and management for Internet Small Computer Systems Interface (iSCSI) directors, iSCSI ports, iSCSI targets, IP interfaces, and IP routes on storage systems running HYPERMAX OS 5977 or higher.

iSCSI is a protocol that uses the TCP to transport SCSI commands, enabling the use of the existing TCP/IP networking infrastructure as a SAN. As with SCSI over Fibre Channel (FC), iSCSI presents SCSI targets and devices to iSCSI initiators (requesters). Unlike NAS, which presents devices at the file level, iSCSI makes block devices available via the network. Block devices are presented across an IP network to your local system. These can be consumed in the same way as any other block storage device.

The iSCSI changes address the market needs originating from cloud/service provider space, where a slice of infrastructure, for example, compute, network and storage, is assigned to different users (tenants). Control and isolation of resources in this environment is achieved by the iSCSI changes. In addition, more traditional IT enterprise environments also benefit from this new functionality. The changes also provide greater scalability and security.

The iSCSI dashboard provides you with a graphical view of the relationship between an iSCSI director and its associated iSCSI ports, iSCSI targets, IP interfaces and IP routes. From the dashboard, you can navigate to monitor and manage iSCSI directors, iSCSI ports, iSCSI targets, IP interfaces and IP routes.

To view the iSCSI dashboard

Procedure

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI to open the iSCSI dashboard.

   The following panels display:

   • iSCSI Directors—A panel
     - displaying the overall number of and relationships between the iSCSI objects - iSCSI Directors, unattached iSCSI Targets, attached iSCSI Targets, iSCSI Ports, IP Routes, and IP Interfaces. Clicking on an item opens the associated list view.
     - listing the iSCSI directors. The status of the iSCSI director is represented by an icon that is based on the alerts for the director. Clicking All Items results in the relationship panel displaying all iSCSI Directors. Selecting a specific director results in an update to relationship panel to display director information for the selected director.

   • Actions—A panel with the following controls:
     - Create iSCSI Target—Creating an iSCSI target on page 844
     - Create IP Interface—Creating an IP interface on page 846
     - Add IP Route—Adding an IP route on page 847

   • iSCSI Alerts—A panel listing the latest alerts listing the associated object, description and creation date/time. Click View All to view all alerts. The following properties display:

     State
     - The state of the alert.
Severity
The severity of the alert.

Type
The alert type.

Description
The description of the alert.

Created
Date/time the alert was created.

Acknowledged
The date and time that the alert was acknowledged.

Creating an iSCSI target

Procedure
1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI to open the iSCSI dashboard.
3. In the Actions panel, click Create iSCSI Target.
4. Select a director from the drop-down menu.
5. (Optional) (Optional) Select the Use custom name check box and then type a value for the Target Name.
   If you do not enter a value, the system generates a unique iqn for the target name. If you enter a value, it must start with 'iqn.' or 'eui.' strings, be composed of alphanumeric characters, colons, dashes, and periods, not be longer than 255 characters, and be unique on the storage system.
6. Type a value for the Network ID.
   Valid values range from 1 through 16383.
7. Type a value for the TCP Port.
   Default value is 3260. Valid values range from 0 through 65535.
8. (Optional) Click Advanced Options to view the port properties advanced section for the iSCSI target.
   a. Select one or more of the following Port Flags:

Volume Set Addressing
   Enables the volume set addressing mode. When using volume set addressing, you must specify a 4-digit address in the following range: (0)000-(0)007, (0)010-(0)017,... to a maximum of (0)FF0-(0)FF7. The first digit must always be set to 0 (the storage systems do not currently support the upper range of volume set).

Environ Set
   Enables the environmental error reporting by the storage system to the host on the specific port.

Avoid Reset Broadcast
   Enables a SCSI bus reset to only occur to the port that received the reset (not broadcast to all channels).
Disable Q Reset on UA
When enabled, a Unit Attention (UA) that is propagated from another director does not flush the queue for this volume on this director. Used for hosts that do not expect the queue to be flushed on a 0629 sense (only on a hard reset).

Soft Reset
Supports SCSI soft reset on a Symmetrix port when enabled for a Bull/GCOS-7 host.

SCSI 3
Alters the inquiry data (when returned by any volume on the port) to report that the Symmetrix system supports the SCSI-3 protocol. When disabled, the SCSI-2 protocol is supported.

SCSI Support1
Provides a stricter compliance with SCSI standards for managing volume identifiers, multi-port targets, unit attention reports, and the absence of a volume at LUN 0.

SPC2 Protocol Version
This flag should be enabled (default) in a Windows 2003 environment running Microsoft HCT test version 12.1. When setting this flag, the port must be offline.

Open VMS
Enables an Open VMS fiber connection.

ISID Protected
Protected initiator session identifier. This flag applies to iSCSI target only. It has no effect for FA/FCoE ports. When this flag is set on iSCSI target, the system uses the ISID and iSCSI name to calculate the World Wide Name (WWN) in the Persistent Group Registration (PGR) record.

9. Click OK.

Modifying an iSCSI target

Procedure
1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI to open the iSCSI dashboard.
3. Click iSCSI Targets to open the Attached iSCSI Targets list view.
4. Select a director and click Modify to open the Modify iSCSI Target dialog.
5. (Optional) Type a value for the Target Name.
   If you do not enter a value, the system generates a unique iqn for the target name. If you enter a value, it must start with ‘iqn.’ or ‘eui.’ strings, be composed of alphanumeric characters, colons, dashes, and periods, not be longer than 255 characters, and be unique on the storage system.
6. Type a value for the Network ID.
   Valid values range from 1 through 16383.
7. Type a value for the TCP Port.
   Default value is 3260. Valid values range from 0 through 65535.
8. Click OK.

Creating an IP interface

Procedure

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI to open the iSCSI dashboard.
3. In the Actions panel, click Create IP Interface.
4. Select a director and port combination from the drop-down menu.
5. Type a value for the IP Address.
   You specify the IPv4 address in dotted decimal notation. You specify the IPv6 address in colon-hexadecimal format. The IP address must be unique within a SE Director Emulation/Network ID combination.
6. Type a value for the Prefix.
   You specify an IPv4 prefix length value in the range of 1-30. You specify an IPv6 prefix length value in the range of 1-128.
7. Type the value for the Network ID.
   Valid values range from 1 through 16383.
8. Type a value for the VLAN ID.
   Valid values range from 0 through 4094. This setting fails if same VLAN id is used for more than one IP interface on a specified SE physical port.
9. (Optional) Type a value for the Maximum Transmission Unit.
   Default value is 1500. Valid values range from 1500 through 9000.
10. Click OK.

Editing an IP interface

Procedure

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI to open the iSCSI dashboard.
3. Click IP Interfaces.
4. Select an IP interface and click Modify.
5. Select a director and port combination from the drop-down menu.
6. Modify the value for the IP Address.
   You specify the IPv4 address in dotted decimal notation. You specify the IPv6 address in colon-hexadecimal format. The IP address must be unique within a SE Director Emulation/Network ID combination.
7. Modify the value for the Prefix.
   You specify an IPv4 prefix length value in the range of 1-30. You specify an IPv6 prefix length value in the range of 1-128.
8. Modify the value for the Network ID.
   Valid values range from 1 through 16383.
9. (Optional) Modify the value for the **Maximum Transmission Unit**.
   Default value is 1500. Valid values range from 1500 through 9000.

10. Click **OK**.

### Adding an IP route

**Procedure**

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select **System > iSCSI** to open the iSCSI dashboard.
3. In the **Actions** panel, click **Add IP Route**.
4. Select a director and port combination from the drop-down menu.
5. Type a value for the **Destination IP**:
   You specify the IPv4 address in dotted decimal notation. You specify the IPv6 address in colon-hexadecimal format.
6. Type a value for the **Prefix**.
   You specify an IPv4 prefix length value in the range of 1-30. You specify an IPv6 prefix length value in the range of 1-128.
7. Type a value for the **Gateway IP**.
   You specify an IPv4 or IPv6 address. You specify the IPv4 address in dotted decimal notation. You specify the IPv6 address in colon-hexadecimal format.
8. (Optional) Type the value for the **Network ID**.
   Default value is 1. Valid values range from 1 through 16383.
9. Click **OK**.

### Deleting an iSCSI target

Deleting iSCSI targets with IP interfaces attached detaches the IP interfaces before deleting the iSCSI target.

The deletion fails if the target is in a port group.

**Procedure**

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select **System > iSCSI** to open the iSCSI dashboard.
3. Click **iSCSI Targets** (Attached or Unattached).
4. Select an iSCSI target and click **Delete**.
5. Click **OK**.

### Deleting an IP interface

**Note**

An IP interface attached to an iSCSI target cannot be deleted.

**Procedure**

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI to open the iSCSI dashboard.
3. Click IP Interfaces to open the IP Interfaces list view.
4. Select an IP interface and click Delete.
5. Click Yes to confirm the operation.

Removing an IP route

Procedure

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI to open the iSCSI dashboard.
3. Click IP Routes to open the IP Routes list view.
4. Select an IP route and click Remove.
5. Click Yes to confirm the operation.

Attaching an IP interface to an iSCSI target

Procedure

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI to open the iSCSI dashboard.
3. Click IP Interface.
4. Select an IP interface and click Attach.
5. Select whether to attach to an existing or new iSCSI target, and do one of the following depending on your selection:
   - Existing:
     a. Select an iSCSI target from the list filtered by network ID and director.
   - New:
     a. Click Use Custom Name and type a value for the Target Name.
        If you do not enter a value, the system generates a unique iqn for the target name. If you enter a value, it must start with 'iqn.' or 'eui.' strings, be composed of alphanumeric characters, colons, dashes, and periods, not be longer than 255 characters, and be unique on the storage system.
     b. Optional: Type a value for TCP Port.
        The default value is 3260. Valid values range from 0 through 65535.
     c. Optional: Click Advanced Options to display the port flag properties for the target being created. Select one or more of the following Port Flags:
        Volume Set Addressing
        Enables the volume set addressing mode. When using volume set addressing, you must specify a 4-digit address in the following range: (0)000-(0)007, (0)010-(0)017,... to a maximum of (0)FF0-(0)FF7. The first digit must always be set to 0 (the storage systems do not currently support the upper range of volume set).
        Environ Set
        Enables the environmental error reporting by the storage system to the host on the specific port.
Avoid Reset Broadcast
Enables a SCSI bus reset to only occur to the port that received the reset (not broadcast to all channels).

Disable Q Reset on UA
When enabled, a Unit Attention (UA) that is propagated from another director does not flush the queue for this volume on this director. Used for hosts that do not expect the queue to be flushed on a 0629 sense (only on a hard reset).

Soft Reset
Supports SCSI soft reset on a port when enabled for a Bull/GCOS-7 host.

SCSI 3
Alters the inquiry data (when returned by any volume on the port) to report that the storage system supports the SCSI-3 protocol. When disabled, the SCSI-2 protocol is supported.

SCSI Support1
Provides a stricter compliance with SCSI standards for managing volume identifiers, multi-port targets, unit attention reports, and the absence of a volume at LUN 0.

SPC2 Protocol Version
This flag should be enabled (default) in a Windows 2003 environment running Microsoft HCT test version 12.1. When setting this flag, the port must be offline.

Open VMS
Enables an Open VMS fiber connection.

ISID Protected
Protected initiator session identifier. This flag applies to iSCSI target only. It has no effect for FA/FCoE ports. When this flag is set on an iSCSI target, the system uses the ISID and iSCSI name to calculate the World Wide Name (WWN) in the Persistent Group Registration (PGR) record.

6. Click OK.
If you toggle between the New and Existing selections, the system only applies the changes from within your last selection.

7. Click OK to confirm your changes.

Attaching an iSCSI target to an IP interface

Procedure
1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI to open the iSCSI dashboard.
3. Click iSCSI Targets (Attached or Unattached) to open the iSCSI Targets list view.
4. Select an iSCSI target and click Attach.
5. Select whether to use an existing or new IP interface(s), and do one of the following depending on your selection:
Existing:

a. Select an IP interface from the list.
   You can select a maximum of 8 interfaces (the total (8) includes the number of already attached interfaces).

New:

a. Select a director and port combination from the drop-down menu.

b. Type a value for the **IP Address**.
   You specify the IPv4 address in dotted decimal notation. You specify the IPv6 address in colon-hexadecimal format.

c. Type a value for the **Prefix**.
   You specify an IPv4 prefix length value in the range of 1-30. You specify an IPv6 prefix length value in the range of 1-128.

d. Type a value for the **VLAN ID**.
   Valid values range from 0 through 4094. This setting will fail if same VLAN id is used for more than one IP interface on a specified SE physical port.

e. View the value for the **Network ID**.
   Value displayed is based on the existing target selection.

f. Optional: Type a value for the **Max Transmission Unit**.
   The default value is 1500. Valid values range from 1500 through 9000.

g. Optional: Click **Add IP Interface** to add one or more IP interfaces.

6. Click **OK**.
   If you toggle between the **New** and **Existing** selections, the system applies only the changes from within your last selection.

7. Click **OK** to confirm your changes.

**Detaching an IP interface from an iSCSI target**

**Procedure**

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select **System** > **iSCSI** to open the iSCSI dashboard.
3. Click **IP Interfaces** to open the IP Interfaces list view.
4. Select an IP interface and click **Detach**.
5. Click **OK**.

**Disabling an iSCSI target**

**Procedure**

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select **System** > **iSCSI** to open the iSCSI dashboard.
3. Click **iSCSI Targets** to open the (Attached or Unattached) iSCSI Targets list view.
4. Select an iSCSI target and click **Disable**.
5. Click **OK**.
Enabling an iSCSI target

Procedure

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI to open the iSCSI dashboard.
3. Click iSCSI Targets to open the (Attached or Unattached) iSCSI Targets list view.
4. Select an iSCSI target and click Enable.
5. Click OK.

Setting port flags

Before you begin
The iSCSI target must be in an offline state before the flags can be modified.

Procedure

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI to open the iSCSI dashboard.
3. Click iSCSI Targets (Attached or Unattached).
4. Select an iSCSI target and click Set Port Flags.
5. Select one or more of the following Port Flags:

   - **Volume Set Addressing**
     Enables the volume set addressing mode. When using volume set addressing, you must specify a 4-digit address in the following range: (0)000-(0)007, (0)010-(0)017,... to a maximum of (0)FF0-(0)FF7. The first digit must always be set to 0 (the storage systems do not currently support the upper range of volume set).

   - **Environ Set**
     Enables the environmental error reporting by the storage system to the host on the specific port.

   - **Avoid Reset Broadcast**
     Enables a SCSI bus reset to only occur to the port that received the reset (not broadcast to all channels).

   - **Disable Q Reset on UA**
     When enabled, a Unit Attention (UA) that is propagated from another director does not flush the queue for this volume on this director. Used for hosts that do not expect the queue to be flushed on a 0629 sense (only on a hard reset).

   - **Soft Reset**
     Supports SCSI soft reset on a port when enabled for a Bull/GCOS-7 host.

   - **SCSI 3**
     Alters the inquiry data (when returned by any volume on the port) to report that the storage system supports the SCSI-3 protocol. When disabled, the SCSI-2 protocol is supported.
SCSI Support
Provides a stricter compliance with SCSI standards for managing volume identifiers, multi-port targets, unit attention reports, and the absence of a volume at LUN 0.

SPC2 Protocol Version
This flag should be enabled (default) in a Windows 2003 environment running Microsoft HCT test version 12.1. When setting this flag, the port must be offline.

Open VMS
Enables an Open VMS fiber connection.

ISID Protected
Protected initiator session identifier. This flag applies to iSCSI target only. It has no effect for FA/FCoE ports. When this flag is set on iSCSI target, the system uses the ISID and iSCSI name to calculate the World Wide Name (WWN) in the Persistent Group Registration (PGR) record.

6. Click OK.

Viewing the iSCSI directors list

Procedure
1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI to open the iSCSI dashboard.
3. Click iSCSI Directors to open the iSCSI Directors list view.

The following properties display, depending on the operating environment:

Director
The name of the iSCSI director.

Ports
The number of iSCSI physical ports associated with the director.

IP Interfaces
The total number of IP interfaces associated with each physical port on the director.

Attached iSCSI targets
The total number of unique iSCSI targets attached to the IP interfaces associated with the director.

Unattached iSCSI targets
The total number of unique iSCSI targets unattached to the IP interfaces associated with the director.

IP Routes
The total number of IP routes associated with the director.

Volumes
The total number of volumes mapped to all iSCSI targets on that director.

To see more information on a director, select it and click

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The following controls are available, depending on the operating environment:

- **Create iSCSI Target**—[Creating an iSCSI target](#) on page 844
- **Add IP Route**—[Adding an IP route](#) on page 847

### Viewing the iSCSI director details

**Procedure**

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select **System > iSCSI** to open the iSCSI dashboard.
3. Click **iSCSI Directors** to open the iSCSI Directors list view.
4. Select a row from the list and click ![ ] to open the iSCSI Directors details view.

The following panels and properties display, depending on the operating environment:

**Properties panel:**

- **Director**
  The name of the iSCSI director.

- **Ports**
  The number of the iSCSI physical ports associated with the director.

- **IP Interfaces**
  The total number of IP interfaces associated with each physical port on the director.

- **Attached iSCSI Targets**
  The total number of iSCSI targets attached to the IP interfaces associated with the director.

- **Unattached iSCSI targets**
  The total number of iSCSI targets unattached to the IP interfaces associated with the director.

- **IP Routes**
  The total number of IP routes associated with the director.

- **Volumes**
  The total number of volumes mapped to all iSCSI targets on that port.

### Viewing IP interfaces list

**Procedure**

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select **System > iSCSI** to open the iSCSI dashboard.
3. Click **IP Interfaces** to open the **IP Interfaces** list view and select a specific director to filter the list.

The following properties display, depending on the operating environment:
Dir:Port
The combination of the physical director and associated port of the IP interface.

Network ID
The network identity of the IP interface that provides isolated IP routes.

IP Address
The destination IPv4 or IPv6 address of the IP interface.

Prefix
The network mask IPv4 or IPv6 prefix value of the IP interface.

VLAN ID
The VLAN tag number of the IP interface.

Dir:Virtual Port
The combination of the physical director and assigned virtual port or iSCSI target alias of the IP interface.

Volumes
The total number of volumes mapped to the iSCSI target attached to the IP interface.

The following controls are available, depending on the operating environment:

- Viewing IP interfaces details on page 854
- Creating an IP interface on page 846
- Attaching an IP interface to an iSCSI target on page 848
- Detaching an IP interface from an iSCSI target on page 850
- Deleting an IP interface on page 847

Viewing IP interfaces details

Procedure
1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI to open the iSCSI dashboard.
3. Click IP Interface to open the IP Interface list view and select a specific director to filter the list.
4. Select a row from the list and click to open the IP Interfaces details view.

The following properties display, depending on the operating environment:

Dir:Port
The combination of the physical director and the associated port of the IP interface.

Network ID
The network identity of the IP interface that provides isolated IP routes. This can also be modified.
IP Address
The destination IPv4 or IPv6 address of the IP interface. This can also be modified.

Prefix
IPv4 or IPv6 prefix length. This can also be modified. You specify an IPv4 prefix length value in the range of 1-30. You specify an IPv6 prefix length value in the range of 1-128.

VLAN ID
The VLAN tag number of the IP interface.

Maximum Transmission Unit
The maximum transit size of the ethernet packet for this IP interface. This can also be modified.

Dir:Virtual Port
The combination of the physical director and the assigned virtual port or iSCSI target alias of the IP interface.

iSCSI Target
The iSCSI target IQN for the attached target.

Volumes
The total number of volumes mapped to the iSCSI target attached to the IP interface.

Volume Set Addressing
Enables the volume set addressing mode. When using volume set addressing, you must specify a 4-digit address in the following range: (0)000-(0)007, (0)010-(0)017,... to a maximum of (0)FF0-(0)FF7. The first digit must always be set to 0 (the storage systems do not currently support the upper range of volume set).

Environ Set
Enables the environmental error reporting by the storage system to the host on the specific port.

Avoid Reset Broadcast
Enables a SCSI bus reset to only occur to the port that received the reset (not broadcast to all channels).

Disable Q Reset on UA
When enabled, a Unit Attention (UA) that is propagated from another director does not flush the queue for this volume on this director. Used for hosts that do not expect the queue to be flushed on a 0629 sense (only on a hard reset).

Soft Reset
Supports SCSI soft reset on a Symmetrix port when enabled for a Bull/GCOS-7 host.

SCSI 3
Alters the inquiry data (when returned by any volume on the port) to report that the Symmetrix system supports the SCSI-3 protocol. When disabled, the SCSI-2 protocol is supported.
SCSI Support (OS2007)
Provides a stricter compliance with SCSI standards for managing volume identifiers, multi-port targets, unit attention reports, and the absence of a volume at LUN 0.

SPC2 Protocol Version

Open VMS
This flag should be enabled (default) in a Windows 2003 environment running Microsoft HCT test version 12.1. When setting this flag, the port must be offline.

ISID Protected
Enables an Open VMS fiber connection.

iSCSI Targets
The list view of iSCSI targets listing the single attached iSCSI target.

iSCSI Ports
The list view of iSCSI ports listing the single attached iSCSI port.

Mapped Volumes
The list view of volumes that are mapped to iSCSI targets associated with the director.

Viewing iSCSI targets list

Procedure
1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI to open the iSCSI dashboard.
3. Click iSCSI Targets (Attached or Unattached) to open the iSCSI Targets list view and select a specific director to filter the list.

The following properties display, depending on the operating environment:

Name
The IQN of the iSCSI target.

Dir:Virtual Port
The assigned virtual port for the iSCSI target.

Status
The status of the iSCSI target.

Network ID
The network identity of the IP interface that provides isolated IP routes.

IP Interfaces
The total number of IP interfaces attached to the iSCSI target.

iSCSI Ports
The total number of physical IP ports associated with the iSCSI target.

Volumes
The total number of volumes mapped to the iSCSI target.
The following controls are available, depending on the operating environment:

- Viewing iSCSI target details on page 857
- Create—Creating an iSCSI target on page 844
- Enable—Enabling an iSCSI target on page 851
- Disable—Disabling an iSCSI target on page 850
- Set Port Flags—Setting port flags on page 851
- Attach—Attaching an IP interface to an iSCSI target on page 848
- Modify—Modifying an iSCSI target on page 845
- Detach—Detaching an IP interface from an iSCSI target on page 850
- Delete—Deleting an iSCSI target on page 847

Viewing iSCSI target details

Procedure

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI to open the iSCSI dashboard.
3. Click iSCSI Targets (Attached or Unattached) to open the iSCSI Targets list view and select a specific director to filter the list.
4. Select a row from the list and click to open the iSCSI Targets details view.

The following properties display, depending on the operating environment:

**Name**
The IQN of the iSCSI target (editable).

**Dir:Virtual Port**
The assigned virtual port for the iSCSI target.

**Network ID**
The network identity of the IP interface that provides isolated IP routes (editable).

**TCP Port**
The TCP port to be used for all IP addresses attached to it (editable).

**Status**
The status of the iSCSI target.

**IP Interfaces**
The IP Interfaces attached to the iSCSI target.

**iSCSI Ports**
The physical iSCSI ports associated with the iSCSI target.

**Volumes**
The total number of volumes mapped to the iSCSI target.

**iSCSI Ports**
The list view of iSCSI ports that are associated with this iSCSI target.
**IP Interfaces**
The list view of IP interfaces that are associated with the physical ports on this iSCSI target.

**Volumes**
The list view of volumes that are mapped to this iSCSI target.

### Viewing IP routes list

**Procedure**

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI to open the iSCSI dashboard.
3. Click IP Routes to open the IP Routes list view and select a specific director to filter the list.

The following properties display, depending on the operating environment:

- **Destination IP**
  The IPv4 or IPv6 destination IP address of the IP route.

- **Prefix**
  The IPv4 or IPv6 network mask prefix of the IP route.

- **Gateway IP**
  The gateway IP address of the IP route.

- **Network ID**
  The network identity of the IP route.

- **Director**
  The director with which the IP route is associated.

The following controls are available, depending on the operating environment:

- ![Viewing the IP routes details](#) — Viewing the IP routes details on page 858
- **Create** — Adding an IP route on page 847
- **Remove** — Removing an IP route on page 848

### Viewing the IP routes details

**Procedure**

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI to open the iSCSI dashboard.
3. Click IP Routes to open the IP Routes list view and select a specific director to filter the list.
4. Select a row from the list and click ![Properties panel](#) to open the IP Routes details view.

**Properties panel**
The following properties display, depending on the operating environment:
Destination IP
The IPv4 or IPv6 destination IP address of the IP route.

Prefix
The IPv4 or IPv6 network mask prefix of the IP route.

Gateway IP
The gateway IPv4 or IPv6 address of the IP route.

Network ID
The network identity of the IP route.

Director
The director with which the IP route is associated.

The following control is available, depending on the operating environment:

- **Remove**—Removing an IP route on page 848

**Viewing iSCSI ports list**

**Procedure**

1. Select a storage system running or higher.
2. Select System > iSCSI to open the iSCSI dashboard.
3. Click iSCSI Ports to open the iSCSI Ports list view and select a specific director to filter the list.

The following properties display, depending on the operating environment:

- **Director**
  The name of the iSCSI director.

- **Port**
  The iSCSI physical port number associated with the director.

- **Status**
  The current status of the physical port (offline or online).

- **IP Interfaces**
  The total number of IP interfaces associated with the physical port.

- **iSCSI targets**
  The number of iSCSI targets that are attached to the IP interfaces.

- **Volumes**
  The total number of volumes mapped to all iSCSI targets on that port.

The following controls are available, depending on the operating environment:

- **Create IP Interface**—Creating an IP interface on page 846
- **Viewing iSCSI ports details** on page 860
Viewing iSCSI ports details

Procedure

1. Select a storage system running HYPERMAX OS 5977 or higher.
2. Select System > iSCSI to open the iSCSI dashboard.
3. Click iSCSI Ports to open the iSCSI Ports list view and select a specific director to filter the list.
4. Select a row from the list and click to open the iSCSI Ports details view.

Properties panel

The following properties display, depending on the operating environment:

**Director**
The name of the director and the iSCSI port combined.

**Status**
The current status of the iSCSI port (offline or online).

**IP Interfaces**
The total number of IP interfaces attached to this iSCSI port.

**Attached iSCSI Targets**
The list view of iSCSI targets on this director that are attached to IP interfaces.

**Volumes**
The total number of volumes mapped to all iSCSI targets on this port.

**Speed GB/Sec**
The speed of the iSCSI port.

**IP Interfaces**
The list view of IP interfaces that are associated with the physical ports on this director.

**Attached iSCSI Targets**
The list view of iSCSI targets on this director that are attached to IP interfaces.

**Unattached iSCSI Targets**
The list view of iSCSI targets on this director that are unattached.

**Mapped Volumes**
The list view of volumes that are mapped to iSCSI targets associated with the director.

**iSCSI Director**
The list view listing the director that is associated with the selected iSCSI port.