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As part of an effort to improve its product lines, Dell EMC periodically releases revisions of its software and hardware. Therefore, some functions described in this document might not be supported by all versions of the software or hardware currently in use. The product release notes provide the most up-to-date information on product features, software updates, software compatibility guides, and information about this product, licensing, and service.

Contact your technical support professional if a product does not function properly or does not function as described in this document.

Note: This document was accurate at publication time. Go to Online Support (https://support.emc.com) to ensure that you are using the latest version of this document.

Purpose

This guide explains how to manage the PowerProtect DD Series Appliance systems with an emphasis on procedures using the DD System Manager, a browser-based graphical user interface (GUI).

Audience

This guide is for system administrators who are familiar with standard backup software packages and general backup administration.

Related documentation


Special notice conventions used in this document

This document uses the following conventions for special notices:

Notices

<table>
<thead>
<tr>
<th>Notice Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notice</td>
<td>A notice identifies content that warns of a potential business or data loss.</td>
</tr>
<tr>
<td>Note</td>
<td>A note identifies information that is incidental, but not essential, to the topic. Notes can provide an explanation, a comment, reinforcement of a point in the text, or just a related point.</td>
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Typographical conventions

This document uses the following typographical conventions in this document:

Table 1 Typography

<table>
<thead>
<tr>
<th>Style</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Bold</td>
<td>Indicates interface element names, such as names of windows, dialog boxes, buttons, fields, tab names, key names, and menu paths (what the user specifically selects or clicks)</td>
</tr>
<tr>
<td>Italic</td>
<td>Highlights publication titles listed in text</td>
</tr>
<tr>
<td>Monospace</td>
<td>Indicates system information, such as:</td>
</tr>
<tr>
<td></td>
<td>- System code</td>
</tr>
<tr>
<td></td>
<td>- System output, such as an error message or script</td>
</tr>
<tr>
<td></td>
<td>- Pathnames, filenames, prompts, and syntax</td>
</tr>
<tr>
<td></td>
<td>- Commands and options</td>
</tr>
</tbody>
</table>
Table 1 Typography (continued)

Monospace italic  Highlights a variable name that must be replaced with a variable value
Monospace bold    Indicates text for user input
[]                 Square brackets enclose optional values
|                  Vertical bar indicates alternate selections—the bar means “or”
{}                Braces enclose content that the user must specify, such as x or y or z
...  Ellipses indicate nonessential information omitted from the example

Where to get help
You can get support, product, and licensing information as follows:

Product information
For documentation, release notes, software updates, or information about this product, go to Online Support at https://support.emc.com.

Technical support
Go to Online Support and click Service Center. You will see several options for contacting Technical Support. Note that to open a service request, you must have a valid support agreement. Contact your sales representative for details about obtaining a valid support agreement or with questions about your account.

Your comments
Your suggestions will help us continue to improve the accuracy, organization, and overall quality of the user publications. Send your opinions of this document to: DPAD.Doc.Feedback@emc.com.
CHAPTER 1
Introducing DD OS

This chapter presents the following topics:

- Revision history .................................................. 18
- System overview .................................................. 18
- DD OS features .................................................... 19
Revision history

The revision history lists the major changes to this document.

Table 2 Document revision history

<table>
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<tr>
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</table>
| 03 (7.1.0) | March 2020 | This revision includes the following corrections and clarifications:  
* Add the CLI steps to register the system with an ESRS gateway.  
* Added additional information about snapshot retention after breaking an MTree replication context.  
* Added additional information about licensing requirements for storage migration. |
| 02 (7.1.0) | February 2020 | This revision includes support for the following DD system models:  
* DD4200  
* DD4500  
* DD7200  
* DD9500 |
| 01 (7.1.0) | January 2020 | This revision includes information about:  
* CAC/PIV card login  
* FIPS 140-2 compliance  
* SHA256 support for SNMPv3 |

System overview

Dell EMC PowerProtect DD Series Appliances and older Data Domain systems are disk-based appliances that run PowerProtect DD OS to provide inline deduplication for data protection and disaster recovery (DR) in the enterprise environment.

Note: In this guide, "DD system," "the protection system," or simply "the system" refers to PowerProtect DD Series Appliances running DD OS 7.0 or later as well as earlier Data Domain systems.

DD system appliances vary in storage capacity and data throughput. Systems are typically configured with expansion enclosures that add storage space.

DD OS provides the following interfaces:

* DD System Manager—Enables you to configure, manage, and monitor your system using a browser-based graphical user interface (GUI). DD System Manager provides real-time graphs and tables that enable you to monitor the status of system hardware components and
configured features. DD System Manager provides a single, consolidated management interface that enables you to manage a single system from any location.

**Note:** If you have a larger environment, PowerProtect DD Management Center (DDMC) enables you to manage multiple systems from a single browser window. Contact your Dell EMC representative for more information.

- Command-line interface (CLI)—Enables you to perform all system operations, including operations that cannot be managed by DD System Manager. Using the CLI commands you can configure system settings and display system hardware status, feature configuration, and operations. Refer to the *PowerProtect DD Series Appliances Operating System Command Reference Guide* for a complete description of commands.

## DD OS features

DD OS features include:

- **Data integrity**—The DD OS Data Invulnerability Architecture protects against data loss from hardware and software failures.
- **Data Deduplication**—The file system deduplicates data by identifying redundant data during each backup and storing unique data just once.
- **Restore operations**—File restore operations create little or no contention with backup or other restore operations.
- **DD Replicator**—DD Replicator sets up and manages the replication of backup data between two protection systems.
- **Multipath and load balancing**—In a Fibre Channel multipath configuration, multiple paths are established between a protection system and a backup server or backup destination array. When multiple paths are present, the system automatically balances the backup load between the available paths.
- **High availability**—The High Availability (HA) feature lets you configure two protection systems as an Active-Standby pair, providing redundancy in the event of a system failure. HA keeps the active and standby systems in sync, so that if the active node were to fail due to hardware or software issues, the standby node can take over services and continue where the failing node left off.
- **Random I/O handling**—The random I/O optimizations included in DD OS provide improved performance for applications and use cases that generate larger amounts of random read and write operations than sequential read and write operations.
- **System Administrator access**—System administrators can access the system for configuration and management using a command line interface (CLI) or a graphical user interface (GUI).
- **Licensed features**—Feature licenses allow you to purchase only those features you intend to use. Some examples of features that require licenses are DD Boost, and capacity on demand (storage capacity increases).
- **Storage environment integration**—DD OS systems integrate easily into existing data centers.
CHAPTER 2

Getting Started

This chapter presents the following topics:

- Logging in and out of DD System Manager ................................................................. 22
- Using the system configuration wizard .......................................................................... 24
- Using the command line interface ................................................................................ 25
- Managing HA systems .................................................................................................... 26
- Managing electronic licenses ........................................................................................ 27
Logging in and out of DD System Manager

Before you begin
DD System Manager uses HTTP port 80 and HTTPS port 443. To reach the system if it is behind a firewall, you might need to enable port 80 for HTTP or port 443 for HTTPS. You can change the port numbers according to your security requirements.

About this task
When you connect to DD System Manager from a web browser, all HTTP connections are automatically redirected to HTTPS.

Use one of the following methods to log in to DD System Manager:

- Log in with a user name and password.
- Log in using a certificate.
- Log in with SSO.

For information about managing user permissions, see the KB article Managing User Permissions on the Data Domain system, available from Online Support.

Logging in with a user name and password
Log in to DD System Manager using a web browser and your assigned user name and password.

Procedure

1. Open a web browser and enter the IP address or hostname to connect to DD System Manager. It must be one of the following:
   - A fully qualified domain name (for example, http://dd01.example.com)
   - A hostname (http://dd01)
   - An IP address (http://10.5.50.5)

2. For HTTPS secure login, click Secure Login.

   Secure login with HTTPS requires a digital certificate to validate the identity of the DD OS system and to support bi-directional encryption between DD System Manager and a browser. DD OS includes a self-signed certificate, and DD OS allows you to import your own certificate.

3. Enter your assigned username and password.
   - For physical systems the default password is the system serial number.
   - For PowerProtect DD Virtual Edition (DD VE) instances the default password is changeme.

4. Click Log In.

   For first-time login, the Home page appears.

   **Note:** If this is the first time you are logging in and the system administrator has configured your username to require a password change, you must change the password before gaining access to DD System Manager.

5. To log out, click the log out button in the DD System Manager banner.
Log in with certificate using CAC/PIV card

Log in to DD System Manager with a certificate issued by a Certificate Authority (CA).

Before you begin

- You must have authorization privileges on the protection system, and the protection system must trust the CA certificate. Your username must be specified in the common-name field in the certificate.
- You must have a user account on the protection system. You can be either a local user or a name service user (NIS/AD). For a name service user, your group-to-role mapping must be configured on the protection system.

Procedure

1. Use the following CLI command to import the public key from the CA that issued the certificate:
   `adminaccess certificate import ca application login-auth`.
2. Load the user certificate in PKCS12 format in your browser from the CAC/PIV card after swiping CAC/PIV card against a card reader which interacts with the browser. Once the CA certificate is trusted by the protection system, a Log in with certificate link is visible on the HTTPS login screen.
3. Click Log in with certificate, and choose the user certificate from the list of certificates that are prompted by the browser.

Results

The system validates the user certificate against the trust store. Based on authorization privileges associated with your account, a System Manager session is created for you.

Logging in using single sign-on (SSO)

Log in to DD System Manager with a username and password from a supported SSO provider.

Before you begin

SSO must be enabled and the protection system must be registered with an SSO provider.

About this task

Configuring SSO authentication on page 100 describes how to enable SSO authentication and register the protection system with the SSO provider.

Procedure

1. At the login screen, click Log in with Data Protection Central.
   - Note: If a brand name is set on Data Protection Central (DPC), the link appears as Log in with <DPC-brand-name>.
2. Log in with the DPC username and password.

Troubleshooting login issues

The GUI Service is temporarily unavailable

DD System Manager is unable to launch from any web browser with this error message. Do one of the following:

- Refresh your browser. If the problem persists, contact support for assistance.
• Use SSH to login to the system and run all commands.

• If you have not upgraded the DD OS and this GUI error occurs, use the following procedure:
  1. Close the web browser session on the system with the reported error.
  2. Run these commands in sequence:
     - adminaccess disable http
     - adminaccess disable https
     - adminaccess enable http
     - adminaccess enable https
  3. Wait 5 minutes to allow the http and https services to start completely.
  4. Open a web browser, and connect to DD System Manager.

• If this GUI issue occurs after a DD OS upgrade, use the following procedure:
  1. Close the web browser session on the system with the reported error.
  2. Run these commands in sequence:
     - adminaccess disable http
     - adminaccess disable https
     - adminaccess certificate generate self-signed-cert
     - adminaccess enable http
     - adminaccess enable https
  3. Wait 5 minutes to allow the http and https services to start completely.
  4. Open a web browser, and connect to DD System Manager.

User locked out

If you enter an incorrect password 4 consecutive times, the system locks out the specified username for 120 seconds. The login count and lockout period are configurable and might be different on your system.

Forgot sysadmin password

If you forget the sysadmin password after changing it, contact Dell EMC Support.

Using the system configuration wizard

The DD System Manager wizard guides you through a simplified configuration to get your system operating quickly. After you complete the basic configuration with a wizard, you can use DD System Manager and the CLI to further configure your system.

Procedure

1. Select Maintenance > System > Configure System.

2. Use the controls at the bottom of the Configuration Wizard dialog box to select which features to configure and to advance through the wizard. To display help for a feature, click the help icon (question mark) in the lower left corner of the dialog box.

Configuration parameters

View the parameters that you can configure using the Configuration wizard.

The Configuration wizard enables you to define the parameters for the following components:
- Licensing
- Network
- File System
- System settings
- Deployment Assessment page for DDVE
- DD Boost protocol
- CIFS protocol
- NFS protocol
- Virtual Tape Library (VTL) protocol

The Online Help provides more details about these options.

Using the command line interface

The command line interface (CLI) is a text-driven interface that you can use instead of or in addition to DD System Manager. Although most management tasks can be performed in DD System Manager, the CLI offers some configuration options and reports that are not yet supported in DD System Manager.

Any command that accepts a list, such as a list of IP addresses, accepts entries separated by commas, by spaces, or both.

The command-line interface is available through a serial console or through an Ethernet connection using SSH, Telnet, or serial over LAN (SOL). Some systems support access using a keyboard and monitor attached directly to the system.

The *DD OS Command Reference Guide* provides information for each of the CLI commands. Online help provides the complete syntax for each command.

Logging into the CLI

You can access the CLI by using a direct connection to the protection system or by using an Ethernet connection through SSH or Telnet. By default, SSH is enabled and Telnet is disabled.

**Before you begin**

To use the CLI, you must establish a local or remote connection to the protection system using one of the following methods.

- If you are connecting through a serial console port on the system, connect a terminal console to the port and use the communication settings: 115200 baud, 8 data bits, no parity, and 1 stop bit.
- If the system supports keyboard and monitor ports, connect a keyboard and monitor to those ports.
- If you are connecting through Ethernet, connect a computer with SSH or Telnet client software to an Ethernet network that can communicate with the system.

**Procedure**

1. If you are using an SSH or Telnet connection to access the CLI, start the SSH or Telnet client and specify the IP address or host name of the protection system.
   
   For information on initiating the connection, see the documentation for the client software. The system prompts you for a username.

2. When prompted, enter your protection system username or *sysadmin*, the default username.
3. When prompted, enter the password for the specified username.

The following example shows SSH login to a system named *mysystem* using SSH client software.

```
ssh -l sysadmin mysystem.mydomain.com
DD9900-157.dellemc.com
DD OS
Password:
```

### CLI online help guidelines

The CLI displays two types of help: syntax-only help and command-description help, which includes the command syntax. Both types of help offer features that enable you to reduce the time it takes to find the information you need.

The following guidelines describe how to use syntax-only help.

- To list the top-level CLI commands, enter a question mark (\?), or type `help` or `man` at the prompt.
- To list all forms of a top-level command, enter the command with no options at the prompt or enter `command ?`.
- To list all commands that use a specific keyword, enter `help keyword`, `man keyword`, or `? keyword`.
  For example, `? password` displays all system commands that use the password argument.

The following guidelines describe how to use command-description help.

- To list the top-level CLI commands, enter a question mark (\?), or type `help` or `man` at the prompt.
- To list all forms of a top-level command with an introduction, enter `help command`, `man command`, or `? command`.
- The end of each help description is marked `END`. Press Enter to return to the CLI prompt.
- When the complete help description does not fit in the display, the colon prompt (:) appears at the bottom of the display. The following guidelines describe what you can do when this prompt appears.
  - To move through the help display, use the up and down arrow keys.
  - To quit the current help display and return to the CLI prompt, press `q`.
  - To display help for navigating the help display, press `h`.
  - To search for text in the help display, enter a slash character (`/`) followed by a pattern to use as search criteria and press Enter. Matches are highlighted.

### Managing HA systems

The High Availability (HA) feature lets you configure two protection systems as an Active-Standby pair, providing redundancy in the event of a system failure. HA keeps the active and standby systems in sync, so that if the active node were to fail due to hardware or software issues, the standby node can take over services and continue where the failing node left off.

Using DD System Manager, you can view the status of a configured HA system, but you cannot perform an initial HA system set-up. Use the DD OS CLI commands to set up the HA relationship between the two nodes, one active and one standby.

HA is supported on the following systems:
• Data Domain DD6800
• Power Protect DD6900
• Data Domain DD9300
• Power Protect DD9400
• Data Domain DD9500
• Data Domain DD9800
• Power Protect DD9900

Setup
Both nodes of the HA pair must have identical hardware. This requirement is validated during setup and system boot-up. Ensure that the system interconnect and identical hardware are set up on both nodes. Run the initial set-up on either node, one at a time.

When configuring HA for the first time, run the `ha create` command on the node with the license installed. To upgrade an existing system to HA by adding a new or unconfigured system, initiate the HA upgrade from the existing standalone system.

Feature continuity
HA provides failover within 10 minutes for most operations. CIFS, DD VTL, and NDMP must be restarted manually.

Note: Recovery of DD Boost applications may take longer than 10 minutes, because Boost application recovery cannot begin until the DD server failover is complete. In addition, Boost application recovery cannot start until the application invokes the Boost library. Similarly, NFS may require additional time to recover.

The installation guides for the systems that support HA describe how to install a new HA system. The *Single Node to HA Upgrade* describes how to upgrade an existing system to an HA pair.

Maintenance
The HA architecture provides a rolling upgrade, which reduces maintenance downtime for the upgrade.

With a rolling upgrade, the HA nodes are upgraded one at a time. The standby node is restarted and upgraded first. The newly upgraded standby node then takes over the active role through an HA failover. After the failover, the second node is restarted and assumes the role of the standby node after the upgrade.

System upgrade operations that require data conversion cannot start until both systems are upgraded to the same level and HA state is fully restored.

Managing electronic licenses
Add and delete electronic licenses from the system. Refer to the applicable Release Notes for the most up-to-date information on product features, software updates, software compatibility guides, and information about products, licensing, and service. If DD Retention Lock Compliance is enabled on the system, the `elicense` CLI commands are required to update or remove licenses because license control in the DD SM GUI is disabled.
Managing HA system licenses

HA is a licensed feature, and the system licensing key is registered by following the steps to add any other license to the DD system.

A system is configured as Active-Standby, where one node is designated "standby." Only one set of licenses is required for both nodes. During failover, the licenses on one node will failover to the other node.
CHAPTER 3
Configuring System Settings

This chapter presents the following topics:

- Managing the system passphrase ................................................................. 30
- Enabling FIPS mode .................................................................................. 31
- Configuring mail server settings ............................................................... 31
- Managing time and date settings ............................................................. 32
- Managing system properties ................................................................. 33
- Managing SNMP ....................................................................................... 33
- Troubleshooting system management ..................................................... 40
Managing the system passphrase

The system passphrase is a key that allows a protection system to be transported with encryption keys on the system. The encryption keys protect the data and the system passphrase protects the encryption keys.

The system passphrase is a password-like phrase, which generates an AES 256 encryption key. If the system is stolen in transit, an attacker cannot easily recover the data; at most, they can recover the encrypted user data and the encrypted keys.

The passphrase is stored internally on a hidden part of the storage subsystem. This allows the protection system to boot and continue servicing data access without administrator intervention.

Setting the system passphrase

The system passphrase must be set before the system can support data encryption or request digital certificates.

Before you begin

No minimum system passphrase length is configured when DD OS is installed, but the CLI provides a command to set a minimum length. To determine if a minimum length is configured for the passphrase, enter the `system passphrase option show` CLI command.

Procedure

   
   If the system passphrase is not set, the Set Passphrase button appears in the Passphrase area. If a system passphrase is configured, the Change Passphrase button appears, and your only option is to change the passphrase.

2. Click the Set Passphrase button.
   
   The Set Passphrase dialog appears.

3. Enter the system passphrase in the boxes and click Next.
   
   If a minimum length is configured for the system passphrase, the passphrase you enter must contain the minimum number of characters.

Results

The system passphrase is set and the Change Passphrase button replaces the Set Passphrase button.

Changing the system passphrase

The administrator can change the passphrase without having to manipulate the actual encryption keys. Changing the passphrase indirectly changes the encryption of the keys, but does not affect user data or the underlying encryption key.

About this task

⚠️ WARNING Be sure to take care of the passphrase. If the passphrase is lost, you can never unlock the file system and access the data; the data is irrevocably lost.

Changing the passphrase requires two-user authentication to protect against data shredding.
Procedure


2. To change the system passphrase, click Change Passphrase.

   The Change Passphrase dialog appears.

   **Note:** The file system must be disabled to change the passphrase. If the file system is running, you are prompted to disable it.

3. In the text fields, provide:

   - The user name and password of a Security Officer account (an authorized user in the Security User group on that system).
   - The current passphrase when changing the passphrase.
   - The new passphrase, which must contain the minimum number of characters configured with the `system passphrase option set min-length` command.

4. Click the checkbox for **Enable file system now**.

5. Click **OK**.

**Enabling FIPS mode**

The FIPS mode button allows you to enable or disable FIPS 140-2 compliance mode.

**Before you begin**

The *DD OS, PowerProtect DD Virtual Edition, and PowerProtect DD Management Center Security Configuration Guide* provides additional details about FIPS 140-2 compliance on DD OS.

**Procedure**

1. Select Administration > Settings.

2. Click **FIPS Mode** to enable or disable FIPS 140-2 compliance mode.

**Results**

After enabling FIPS 140-2 compliance mode, DD OS:

- Forces a password change for the sysadmin account and one security officer account (if security officer is enabled).
- Reboots, causing an interruption in file system access.
- Allows only applications with FIPS-compatible clients to access the file system after the reboot is complete.

**Configuring mail server settings**

The Mail Server tab allows you to specify the mail server to which DD OS sends email reports.

**About this task**

**Procedure**

1. Select Administration > Settings > Mail Server.

2. Select More Tasks > Set Mail Server.

   The Set Mail Server dialog box appears.
3. Specify the name of the mail server in the Mail Server field.
4. Use the Credentials button to enable or disable the use of credentials for the mail server.
5. If credentials are enabled, specify the mail server username in the User Name field.
6. If credentials are enabled, specify the mail server password in the Password field.
7. Click Set.
8. Optionally use the CLI to verify and troubleshoot the mail server configuration.
   a. Run the config show mailserver command to verify the mail server is configured.
   b. Run the net ping <mailserver-hostname> count 4 command to ping the mail server.
   c. If the mail server is not configured correctly, run the config set mailserver
      <mailserver-hostname> command to set the mail server, and attempt to ping it again.
   d. Run the net show dns command to verify the DNS server is configured.
   e. Run the net ping <DNS-hostname> count 4 command to ping the DNS server.
   f. If the DNS server is not configured correctly, run the config set dns <dns-IP>
      command to set the DNS server, and attempt to ping it again.
   g. Optionally run the net hosts add <IP-address> <hostname> command to add the
      mail server IP address and hostname to the system hosts file for local resolving.
   h. Run the net ping <mailserver-hostname> count 4 command to ping the mail server.

Managing time and date settings

Dell EMC recommends that you configure NTP after you have completed the configuration wizard
to keep the protection system time synchronized with other systems in your environment. The
Time and Date Settings tab enables you to view and configure the system time and date or
configure the Network Time Protocol to set the time and date.

Before you begin

When using active directory mode for CIFS access, the system clock time can differ by no more
than five minutes from that of the domain controller.

About this task

⚠️ WARNING When the system is configured for Active Directory authentication, it uses an
alternate mechanism to sync time with the domain controller. To avoid time sync conflicts, do
not enable NTP when the system is configured for Active Directory authentication.

Procedure

1. To view the current time and date configuration, select Administration > Settings > Time
   and Date Settings.
   The Time and Date Settings page shows the current system date and time, whether NTP is
   enabled, and IP addresses or host names of configured NTP servers.
2. To change the configuration, select More Tasks > Configure Time Settings.
   The Configure Time Settings dialog box appears. Do one of the following:
   - In the Time Zone list, select the time zone where the system resides.
   - To manually set the time and date, select None, type the date in the Date box, and
     select the time in the Time lists.
   - To use NTP to synchronize the time, select NTP and set how the NTP server is
     accessed.
To use DHCP to automatically select a server, select **Obtain NTP Servers using DHCP**.

To configure an NTP server IP address, select **Manually Configure**, add the IP address of the server, and click **OK**.

3. Click **OK**.

4. If you changed the time zone, you must reboot the system:

   Select **Maintenance > System > Reboot System > OK**.

**Managing system properties**

The System Properties tab enables you to view and configure system properties that identify the managed system location, administrator email address, and host name.

**Procedure**

1. To view the current configuration, select **Administration > Settings > System Properties**.

   The System Properties tab displays the system location, the administrator email address, and the administrator hostname.

2. To change the configuration, select **More Tasks > Set System Properties**.

   The Set System Properties dialog box appears.

3. In the **Location** box, enter information about where the protection system is located.

4. In the **Admin Email** box, enter the email address of the system administrator.

5. In the **Admin Host** box, enter the name of the administration server.

6. Click **OK**.

**Managing SNMP**

The Simple Network Management Protocol (SNMP) is a standard protocol for exchanging network management information, and is a part of the Transmission Control Protocol/Internet Protocol (TCP/IP) protocol suite. SNMP provides a tool for network administrators to manage and monitor network-attached devices, such as DD systems, for conditions that warrant administrator attention.

To monitor systems using SNMP, install the DD OS MIB in your SNMP Management system. DD OS also supports the standard MIB-II so you can query MIB-II statistics for general data such as network statistics. For full coverage of available data, use both the DD OS MIB and the standard MIB-II.

The DD OS system SNMP agent accepts queries for system-specific information from management systems using SNMP v1, v2c, and v3. SNMP V3 provides a greater degree of security than v2c and v1 by replacing cleartext community strings (used for authentication) with user-based authentication using either MD5, SHA1, or SHA256. SNMP v3 user authentication packets can be encrypted and their integrity verified with either DES or AES.

DD systems can send SNMP traps (which are alert messages) using SNMP v2c and SNMP v3. Because SNMP v1 traps are not supported, if possible, use SNMP v2c or v3.

The default port that is open when SNMP is enabled is port 161. Traps are sent out through port 162.
The DD OS MIB Quick Reference describes the full set of MIB parameters included in the DD OS MIB branch.

**Viewing SNMP status and configuration**

The SNMP tab displays the current SNMP status and configuration.

**Procedure**

1. Select Administration > Settings > SNMP.

   The SNMP view shows the SNMP status, SNMP properties, SNMP V3 configuration, and SNMP V2C configuration.

**Enabling and disabling SNMP**

Use the SNMP tab to enable or disable SNMP.

**Procedure**

1. Select Administration > Settings > SNMP.
2. In the Status area, click Enable or Disable.

**Downloading the SNMP MIB**

Use the SNMP tab to download the SNMP MIB.

**Procedure**

1. Select Administration > Settings > SNMP.
2. Click Download MIB file.
3. In the Opening <protection system>.mib dialog box, select Open.
4. Click Browse and select a browser to view the MIB in a browser window.

   **Note:** If using the Microsoft Internet Explorer browser, enable Automatic prompting for file download.

5. Save the MIB or exit the browser.

**Configuring SNMP properties**

Use the SNMP tab to configure the text entries for system location and system contact.

**Procedure**

1. Select Administration > Settings > SNMP.
2. In the SNMP Properties area, click Configure.

   The SNMP Configuration dialog box appears.

3. In the text fields, specify the following information: and/or an
   - SNMP System Location: A description of where the protection system is located.
   - SNMP System Contact: The email address of the system administrator.
   - SNMP System Notes: (Optional) Additional SNMP configuration information.
   - SNMP Engine ID: A unique identifier for the SNMP entity. The engine ID must be 5-34 hexadecimal characters (SNMPv3 only).
SNMP V3 user management

Use the SNMP tab to create, modify, and delete SNMPv3 users and trap hosts.

Creating SNMP V3 users

When you create SNMPv3 users, you define a username, specify either read-only or read-write access, and select an authentication protocol.

Procedure

1. Select Administration > Settings > SNMP.
2. In the SNMP Users area, click Create.
   The Create SNMP User dialog box appears.
3. In the Name text field, enter the name of the user for whom you want to grant access to the system agent. The name must be a minimum of eight characters.
4. Select either read-only or read-write access for this user.
5. To authenticate the user, select Authentication.
   a. Select the MD5, SHA1, or SHA256 protocol.
   b. Enter the authentication key in the Key text field.
   c. To provide encryption to the authentication session, select Privacy.
   d. Select either the AES or the DES protocol.
   e. Enter the encryption key in the Key text field.
6. Click OK.
   The newly added user account appears in the SNMP Users table.

Modifying SNMP V3 users

You can modify the access level (read-only or read-write) and authentication protocol for existing SNMPv3 users.

Procedure

1. Select Administration > Settings > SNMP.
2. In the SNMP Users area, select a checkbox for the user and click Modify.
   The Modify SNMP User dialog box appears. Add or change any of the following settings.
3. Select either read-only or read-write access for this user.
4. To authenticate the user, select Authentication.
   a. Select the MD5, SHA1, or SHA256 protocol.
   b. Enter the authentication key in the Key text field.
   c. To provide encryption to the authentication session, select Privacy.
   d. Select either the AES or the DES protocol.
e. Enter the encryption key in the Key text field.

5. Click OK.

The new settings for this user account appear in the SNMP Users table.

Removing SNMP V3 users

Use the SNMP tab to delete existing SNMPv3 users.

Procedure

1. Select Administration > Settings > SNMP.
2. In the SNMP Users area, select a checkbox for the user and click Delete.
   The Delete SNMP User dialog box appears.

   ![Note: If the Delete button is disabled, the selected user is being used by one or more trap hosts. Delete the trap hosts and then delete the user.]

3. Verify the user name to be deleted and click OK.
4. In the Delete SNMP User Status dialog box, click Close.
   The user account is removed from the SNMP Users table.

SNMP V2C community management

Define SNMP v2c communities (which serve as passwords) to control management system access to the protection system. To restrict access to specific hosts that use the specified community, assign the hosts to the community.

![Note: The SNMP V2c Community string is a sent in cleartext and is very easy to intercept. If this occurs, the interceptor can retrieve information from devices on your network, modify their configuration, and possibly shut them down. SNMP V3 provides authentication and encryption features to prevent interception.]

![Note: SNMP community definitions do not enable the transmission of SNMP traps to a management station. You must define trap hosts to enable trap submission to management stations.]

Creating SNMP V2C communities

Create communities to restrict access to the DDR system or for use in sending traps to a trap host. You must create a community and assign it to a host before you can select that community for use with the trap host.

Procedure

1. Select Administration > Settings > SNMP.
2. In the Communities area, click Create.
   The Create SNMP V2C Community dialog box appears.

3. In the Community box, enter the name of a community for whom you want to grant access to the system agent.
4. Select either read-only or read-write access for this community.
5. If you want to associate the community to one or more hosts, add the hosts as follows:
   a. Click + to add a host.
The Host dialog box appears.

b. In the Host text field, enter the IP address or domain name of the host.

c. Click OK.

The Host is added to the host list.

6. Click OK.

The new community entry appears in the Communities table and lists the selected hosts.

Modifying SNMP V2C Communities

Procedure

1. Select Administration > Settings > SNMP.

2. In the Communities area, select the checkbox for the community and click Modify.

The Modify SNMP V2C Community dialog box appears.

3. To change the access mode for this community, select either read-only or read-write access.

   Note: The Access buttons for the selected community are disabled when a trap host on the same system is configured as part of that community. To modify the access setting, delete the trap host and add it back after the community is modified.

4. To add one or more hosts to this community, do the following:

   a. Click + to add a host.

      The Host dialog box appears.

   b. In the Host text field, enter the IP address or domain name of the host.

   c. Click OK.

      The Host is added to the host list.

5. To delete one or more hosts from the host list, do the following:

   Note: DD System Manager does not allow you to delete a host when a trap host on the same system is configured as part of that community. To delete a trap host from a community, delete the trap host and add it back after the community is modified.

   Note: The Access buttons for the selected community are not disabled when the trap host uses an IPv6 address and the system is managed by an earlier DD OS version that does not support IPv6. If possible, always select a management system that uses the same or a newer DD OS version than the systems it manages.

   a. Select the checkbox for each host or click the Host check box in the table head to select all listed hosts.

   b. Click the delete button (X).

6. To edit a host name, do the following:

   a. Select the checkbox for the host.

   b. Click the edit button (pencil icon).

   c. Edit the host name.

   d. Click OK.
7. Click OK. The modified community entry appears in the Communities table.

Deleting SNMP V2C communities
Use the SNMP tab to delete existing SNMPv2 communities.

Procedure
1. Select Administration > Settings > SNMP.
2. In the Communities area, select a checkbox for the community and click Delete. The Delete SNMP V2C Communities dialog box appears.
   
   ![Note: If the Delete button is disabled, the selected community is being used by one or more trap hosts. Delete the trap hosts and then delete the community.]

3. Verify the community name to be deleted and click OK.
4. In the Delete SNMP V2C Communities Status dialog box, click Close. The community entry is removed from the Communities table.

SNMP trap host management
Trap host definitions enable protection systems to send alert messages in SNMP trap messages to an SNMP management station.

Creating SNMP V3 and V2C trap hosts
Trap host definitions identify remote hosts that receive SNMP trap messages from the system.

Before you begin
If you plan to assign an existing SNMP v2c community to a trap host, you must first use the Communities area to assign the trap host to the community.

Procedure
1. Select Administration > Settings > SNMP.
2. In the SNMP V3 Trap Hosts or SNMP V2C Trap Hosts area, click Create. The Create SNMP [V3 or V2C] Trap Hosts dialog appears.
3. In the Host box, enter the IP address or domain name of the SNMP Host to receive traps.
4. In the Port box, enter the port number for sending traps (port 162 is a common port).
5. Select the user (SNMP V3) or the community (SNMP V2C) from the drop-down menu.
   
   ![Note: The Community list displays only those communities to which the trap host is already assigned.]

6. To create a new community, do the following:
   a. Select Create New Community in the Community drop-down menu.
   b. Enter the name for the new community in the Community box.
   c. Select the Access type.
   d. Click the add (+) button.
Modifying SNMP V3 and V2C trap hosts
You can modify the port number and community selection for existing trap host configurations.

Procedure
1. Select Administration > Settings > SNMP.
2. In the SNMP V3 Trap Hosts or SNMP V2C Trap Hosts area, select a Trap Host entry, and click Modify.

   The Modify SNMP [V3 or V2C] Trap Hosts dialog box appears.

3. To modify the port number, enter a new port number in the Port box (port 162 is a common port).
4. Select the user (SNMP V3) or the community (SNMP V2C) from the drop-down menu.
   
   Note: The Community list displays only those communities to which the trap host is already assigned.

5. To create a new community, do the following:
   a. Select Create New Community in the Community drop-down menu.
   b. Enter the name for the new community in the Community box.
   c. Select the Access type.
   d. Click the add (+) button.
   e. Enter the trap host name.
   f. Click OK.
   g. Click OK.
6. Click OK.

Removing SNMP V3 and V2C trap hosts
Use the SNMP tab to delete existing trap host configurations.

Procedure
1. Select Administration > Settings > SNMP.
2. In the Trap Hosts area (either for V3 or V2C, select a checkbox for the trap host and click Delete.

   The Delete SNMP [V3 or V2C] Trap Hosts dialog box appears.

3. Verify the host name to be deleted and click OK.
4. In the Delete SNMP [V3 or V2C] Trap Hosts Status dialog box, click Close.
   
   The trap host entry is removed from the Trap Hosts table.
Troubleshooting system management

Slow response time

When processing a heavy load, a system might be less responsive than normal. In this case, management commands issued from either DD System Manager or the CLI might take longer to complete. When the duration exceeds allowed limits, a timeout error is returned, even if the operation completed.

The following table lists the recommendations for the maximum number of user sessions supported by DD System Manager:

<table>
<thead>
<tr>
<th>System Model</th>
<th>Maximum Active Users</th>
<th>Maximum Logged In Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 GB and greater models(^a)</td>
<td>10</td>
<td>20</td>
</tr>
</tbody>
</table>

\(^a\) DD4200, DD4500, DD6300, DD6800, DD6900, DD7200, DD9300, DD9400, DD9500, DD9800, and DD9900
CHAPTER 4

Monitoring DD Systems

This chapter presents the following topics:

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- Viewing hardware component status.........................................................42
- Viewing system statistics............................................................................43
- Capacity statistics charts..........................................................................43
- Viewing the Task Log..............................................................................44
- Viewing the system High Availability status..............................................44
Monitoring system information

The Dashboard displays summary information and status for alerts, the file system, licensed services, and hardware enclosures. The Maintenance area displays additional system information, including the system uptime and system and chassis serial numbers.

Procedure

• To view system dashboard, select Home > Dashboard.

From the Dashboard you can view the following information:

- Alerts—Shows the most recent alerts for each subsystem (hardware, replication, file system, and others). Click anywhere in the alerts area to display more information on current alerts.
- File System—Shows statistics for the entire file system. Click anywhere in the File System area to display more information.
- Dashboard services—Shows the status of replication, DD VTL, CIFS, NFS, DD Boost, and vDisk services. Click on a service to display detailed information about that service.
- HA Readiness—Indicates whether the system can fail over from the active node to the standby node if necessary.
- Hardware—Shows the status of the system enclosures and drives. Click anywhere in the Hardware area to display more information on these components.
- Maintenance—Shows the system model number, DD OS version, system uptime, and system and chassis serial numbers.

• To view the system uptime and identity information, select Maintenance > System.

Viewing hardware component status

The Hardware Chassis panel displays a block drawing of each enclosure in a system, including the chassis serial number and the enclosure status. Within each block drawing are the enclosure components, such as disks, fans, power supplies, NVRAM, CPUs, and memory. The components that appear depend upon the system model.

About this task

DD SM also displays the system serial number. The system serial number is independent of the chassis serial number and remains the same during many types of maintenance events, including chassis replacements.

Procedure

1. Select Hardware > Chassis.

The Chassis view shows the system enclosures. Enclosure 1 is the system controller, and the rest of the enclosures appear below Enclosure 1.

Components with problems show yellow (warning) or red (error); otherwise, the component displays OK.

2. Click a component to see detailed status.
Viewing system statistics

The Realtime Charts panel displays up to seven charts that show real-time subsystem performance statistics, such as CPU usage and disk traffic.

**Procedure**

1. Select **Home > Realtime Charts**.
   
   The Performance Charts area displays the currently selected charts.

2. To view specific data-point information, hover over a chart point.

3. When a chart contains multiple data, you can use the checkboxes in the upper-right corner of the chart to select what to display. For example, if Read is not selected in the upper right of the disk activity chart, only write data is charted.

**Results**

Each chart shows usage over the last 5 to 10 minutes.

Capacity statistics charts

DD System Manager enables you to view statistics for the amount of data backup to the DD system, and the amount of deduplication performed on the system in chart form.

Navigate to **Data Management > File System > Charts** to view the charts. There are three different charts available:

- Space Usage
- Consumption
- Daily Written

Use the **Chart** and **Scope** list boxes to select the parameters for the chart to display.

**Note:** For systems without Cloud Tier, **File System** is the only available scope. For systems with Cloud Tier, the scope can be **File System, Active Tier**, or **Cloud Tier**.

Use the **Date Range** options to select a date range to display on the chart. Choose from one of the preconfigured time periods, or specify specific dates to view.

Customize any chart by selecting or deselecting the available labels.

**Space Usage chart**

This chart displays a cumulative representation of how much data is backed up to the system, the amount of deduplication performed on that data, and the amount of space consumed on the system.

The space usage chart uses the following labels:

- Pre-Comp Used: The amount of storage consumed before compression.
- Post-Comp Used: The amount of storage consumed after compression.
- Comp Factor: The compression ratio.

**Consumption chart**

This chart displays a cumulative representation of the amount of space consumed on the system, and the amount of deduplication performed against the total capacity of the system.

Administrators may also view the time lines and durations for system cleaning and data movement operations.

The space usage chart uses the following labels:
- Capacity: The total capacity of the system.
- Post-Comp Used: The amount of storage consumed after compression.
- Comp Factor: The compression ratio.
- Cleaning: The time lines and duration of system cleaning operations.
- Data Movement: The time lines and duration of data movement operations.

**Daily Written chart**

This chart displays the amount of data written to the system and the amount of deduplication performed on the system on a daily basis.

The space usage chart uses the following labels:

- Pre-Comp Written: The amount of data written to the system before compression.
- Post-Comp Written: The amount of data written to the system after compression.
- Total Comp Factor: The total compression ratio.

**Viewing the Task Log**

The Task Log displays a list of currently running jobs, such as, replication or system upgrades. DD System Manager can manage multiple systems and can initiate tasks on those systems. If a task is initiated on a remote system, the progress of that task is tracked in the management station task log, not in the remote system task log.

**Procedure**

1. Select **Health > Jobs**.
   - The Tasks view appears.
2. Select a filter by which to display the Task Log from the Filter By list box. You can select **All**, **In Progress**, **Failed**, or **Completed**.
   - The Tasks view displays the status of all tasks based on the filter you select and refreshes every 60 seconds.
3. To manually refresh the Tasks list, do either of the following.
   - Click **Update** to update the task log.
   - Click **Reset** to display all tasks and remove any filters that were set.
4. To display detailed information about a task, select the task in the task list.

**Viewing the system High Availability status**

You can use the **High Availability** panel to see detailed information about the HA status of the system and whether the system can perform failover if necessary.

**Procedure**

1. Select **Health > High Availability** on the DD System Manager.
   - The **Health High Availability** screen appears.
   - A green check mark indicates the system is operating normally and ready for failover.
   - The screen shows the active node, which is typically Node 0.
2. Hover the cursor over a node to see its status.
   - The node is highlighted in blue if it is active.
3. Click the drop-down menu in the banner if you want to change the view from the active node to the standby node, which is typically Node 1.

**High Availability status**

The **Health High Availability** (HA) view informs you about the system status using a diagram of the nodes and their connected storage. You can also see any current alerts as well as detailed information about the system.

You can determine if the active node and the storage are operational by hovering the cursor over them. Blue highlighting indicates normal operation. The standby node should appear gray.

You can filter the alerts table by selecting a component. Only alerts related to the selected components are displayed.

**Figure 1 Health/High Availability indicators**
CHAPTER 5
Managing System Power

This chapter presents the following topics:

- Restarting a DD OS system ................................................................. 48
- Powering the DD OS system off ......................................................... 48
- Powering the DD OS system on ......................................................... 49
- Remote system power management with IPMI ..................................... 49
Restarting a DD OS system

After modifying the system configuration, you might need to restart the system for the change to take effect. For example, changing the time zone requires that you restart the system before the new time zone is applied.

Procedure

1. Select **Maintenance > System > Reboot System**.
2. Click **OK** to confirm.

Powering the DD OS system off

When powering a protection system off, follow the proper procedure to preserve the file system and configuration integrity.

About this task

⚠️ **CAUTION** Do not use the chassis power switch or the IMPI Remote System Power Down feature to power off the protection system unless the `system poweroff` command is unsuccessful. Using the chassis power switch to power down the system prevents remote power control using IPMI. Using the IMPI Remote System Power Down feature to power off the protection system does not perform an orderly shutdown.

For HA systems, a management connection to both nodes is required.

Procedure

1. Run the following commands to verify that I/O on the system is stopped:
   - cifs show active
   - nfs show active
   - system show stats view sysstat interval 2
   - system show perf

2. For HA systems, run the `ha status` command to verify the health of the HA configuration.
   The following example is from a healthy system. If the system has a failed component, the HA System Status is degraded, and one or both nodes show offline for the HA State.
   
<table>
<thead>
<tr>
<th>HA System Name: dd9900-ha3a.example.com</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA System Status: highly available</td>
</tr>
<tr>
<td>Node Name</td>
</tr>
<tr>
<td>dd9900-ha3a-p0.example.com 0 active online</td>
</tr>
<tr>
<td>dd9900-ha3a-p1.example.com 1 standby online</td>
</tr>
<tr>
<td>----------------------------------------</td>
</tr>
</tbody>
</table>

3. Run the `alerts show current` command. For HA pairs, run the command on the active node first, and then the standby node.

4. For HA systems, run the `ha offline` command if the system is in a highly available state with both nodes online. Skip this step if the HA status is degraded.

5. Run the `system poweroff` command. For HA pairs, run the command on the active node first, and then the standby node.
6. Remove the power cords from the power supplies on the controller or controllers.

7. Verify that the blue power LED on the controllers is off to confirm that the system is powered down.

8. When the controller has powered off, switch off any external expansion shelves.

Powering the DD OS system on

When powering a system on, follow the proper procedure to preserve the file system and configuration integrity.

About this task

Restore power to the protection system when the system downtime is complete.

Procedure

1. Power on expansion shelves before powering on the controller. Wait approximately three minutes after all expansion shelves are turned on.
   
   Note: A controller includes the chassis and any internal storage. A DD OS system includes the controller and any external storage.

2. Plug in the power cord for the controller, and if there is a power button on the controller, press the power button, as shown in the *Installation Guide* for your system. For HA systems, power on the active node first, and then the standby node.
   
   Note: Some DD OS appliances do not have a traditional power button, and are designed to be "always on." These devices will power up as soon as AC power is applied.

3. For HA systems, verify the health of the HA configuration.
   
   Run the command,
   
   ```
   ha status
   ```

4. For HA systems, if one of the nodes displays as offline, run the `ha online` command on that node to restore the HA configuration.

5. Use a serial connection or an SSH session to verify that the system is fully booted and the operating system is running. The system is up when you can log into the system.

6. Run the `alerts show current` command. For HA pairs, run the command on the active node first, and then on the standby node.

Remote system power management with IPMI

Select DD systems support remote power management using the Intelligent Platform Management Interface (IPMI), and they support remote monitoring of the boot sequence using Serial over LAN (SOL).

IPMI power management takes place between an IPMI initiator and an IPMI remote host. The IPMI initiator is the host that controls power on the remote host. To support remote power management from an initiator, the remote host must be configured with an IPMI username and password. The initiator must provide this username and password when attempting to manage power on a remote host.

IPMI runs independently of DD OS and allows an IPMI user to manage system power as long as the remote system is connected to a power source and a network. An IP network connection is required between an initiator and a remote system. When properly configured and connected, IPMI
management eliminates the need to be physically present to power on or power off a remote system.

You can use both DD System Manager and the CLI to configure IPMI users on a remote system. After you configure IPMI on a remote system, you can use IPMI initiator features on another system to log in and manage power.

**Note:** If a system cannot support IPMI due to hardware or software limitations, DD System Manager displays a notification message when attempting to navigate to a configuration page.

SOL is used to view the boot sequence after a power cycle on a remote system. SOL enables text console data that is normally sent to a serial port or to a directly attached console to be sent over a LAN and displayed by a management host.

The DD OS CLI allows you to configure a remote system for SOL and view the remote console output. This feature is supported only in the CLI.

**NOTICE** IPMI power removal is provided for emergency situations during which attempts to shut down power using DD OS commands fail. IPMI power removal simply removes power to the system, it does not perform an orderly shutdown of the DD OS file system. The proper way to remove and reapply power is to use the DD OS `system reboot` command. The proper way to remove system power is to use the DD OS `system poweroff` command and wait for the command to properly shut down the file system.

### IPMI and SOL limitations

IPMI and SOL is supported on all systems supported by this release.

IPMI user support is as follows:

- Maximum user IDs = 10.
- Two default users (NULL, root).
- Maximum user IDs available = 8.

### Adding and deleting IPMI users with DD System Manager

Each system contains its own list of configured IPMI users, which is used to control access to local power management features. Another system operating as an IPMI initiator can manage remote system power only after providing a valid username and password.

**About this task**

This functionality is not supported on DD6900, DD9400, and DD9900 systems with DD OS 7.0 and later.

To give an IPMI user the authority to manage power on multiple remote systems, you must add that user to each of the remote systems.

**Note:** The IPMI user list for each remote system is separate from the DD System Manager lists for administrator access and local users. Administrators and local users do not inherit any authorization for IPMI power management.

**Procedure**

1. Select **Maintenance > IPMI**.
2. To add a user, complete the following steps.
   a. Above the IPMI Users table, click **Add**.
   b. In the Add User dialog box, type the user name (16 or less characters) and password in the appropriate boxes (reenter the password in the **Verify Password** box).
c. Click Create.

The user entry appears in the IPMI Users table.

3. To delete a user, complete the following steps.
   a. In the IPMI Users list, select a user and click Delete.
   b. In the Delete User dialog box, click OK to verify user deletion.

Changing an IPMI user password

Change the IPMI user password to prevent use of the old password for power management.

About this task

This functionality is not supported on DD6900, DD9400, and DD9900 systems with DD OS 7.0 and later.

Procedure

1. Select Maintenance > IPMI.
2. In the IPMI Users table, select a user, and click Change Password.
3. In the Change Password dialog box, type the password in the appropriate text box and reenter the password in the Verify Password box.
4. Click Update.

Configuring an IPMI port

When you configure an IPMI port for a system, you select the port from a network ports list and specify the IP configuration parameters for that port. The selection of IPMI ports displayed is determined by the protection system model.

About this task

Some systems support one or more dedicated ports, which can be used only for IPMI traffic. Other systems support ports that can be used for both IPMI traffic and all IP traffic supported by the physical interfaces in the Hardware > Ethernet > Interfaces view. Shared ports are not provided on systems that provide dedicated IPMI ports.

The port names in the IPMI Network Ports list use the prefix bmc, which represents baseboard management controller. To determine if a port is a dedicated port or shared port, compare the rest of the port name with the ports in the network interface list. If the rest of the IPMI port name matches an interface in the network interface list, the port is a shared port. If the rest of the IPMI port name is different from the names in the network interface list, the port is a dedicated IPMI port.

Note: DD4200, DD4500, and DD7200 systems are an exception to the naming rules described earlier. On these systems, IPMI port, bmc0a, corresponds to shared port ethMa in the network interface list. If possible, reserve the shared port ethMa for IPMI traffic and system management traffic (using protocols such as HTTP, Telnet, and SSH). Backup data traffic should be directed to other ports.

When IPMI and nonIPMI IP traffic share an Ethernet port, if possible, do not use the link aggregation feature on the shared interface because link state changes can interfere with IPMI connectivity.

Procedure

1. Select Maintenance > IPMI.
The IPMI Configuration area shows the IPMI configuration for the managed system. The Network Ports table lists the ports on which IPMI can be enabled and configured. The IPMI Users table lists the IPMI users who can access the managed system.

2. In the **Network Ports** table, select a port to configure.
   
   **Note:** If the IPMI port also supports IP traffic (for administrator access or backup traffic), the interface port must be enabled before you configure IPMI.

3. Above the **Network Ports** table, click **Configure**.
   
   The Configure Port dialog box appears.

4. Choose how network address information is assigned.
   
   - To collect the IP address, netmask, and gateway configuration from a DHCP server, select **Dynamic (DHCP)**.
   
   - To manually define the network configuration, select **Static (Manual)** and enter the IP address, netmask, and gateway address.

5. Enable a disabled IPMI network port by selecting the network port in the **Network Ports** table, and clicking **Enable**.

6. Disable a disabled IPMI network port by selecting the network port in the **Network Ports** table, and clicking **Disable**.

7. Click **Apply**.

---

**Preparing for remote power management and console monitoring with the CLI**

Remote console monitoring uses the Serial Over Lan (SOL) feature to enable viewing of text-based console output without a serial server. You must use the CLI to set up a system for remote power management and console monitoring.

**About this task**

Remote console monitoring is typically used in combination with the `ipmi remote power cycle` command to view the remote system’s boot sequence. This procedure should be used on every system for which you might want to remotely view the console during the boot sequence.

**Procedure**

1. Connect the console to the system directly or remotely.
   
   - Use the following connectors for a direct connection.
     
     - DIN-type connectors for a PS/2 keyboard
     
     - USB-A receptacle port for a USB keyboard
     
     - DB15 female connector for a VGA monitor
   
   **Note:** Systems DD4200, DD4500, and DD7200 do not support direct connection, including KVM.

   - For a serial connection, use a standard DB9 male or micro-DB9 female connector. Systems DD4200, DD4500, and DD7200 provide a female micro-DB9 connector. A null modem cable with male micro-DB9 and standard female DB9 connectors is included for a typical laptop connection.

   - For a remote IPMI/SOL connection, use the appropriate RJ45 receptacle as follows.
- For other systems, use the maintenance or service port. For port locations, refer to the system documentation, such as a hardware overview or installation and setup guide.

2. To support remote console monitoring, use the default BIOS settings.
3. To display the IPMI port name, enter `ipmi show config`.
4. To enable IPMI, enter `ipmi enable {port | all}`.
5. To configure the IPMI port, enter `ipmi config port { dhcp | ipaddress ipaddr netmask mask gateway ipaddr }`.

   **Note:** If the IPMI port also supports IP traffic (for administrator access or backup traffic), the interface port must be enabled with the `net enable` command before you configure IPMI.

6. If this is the first time using IPMI, run `ipmi user reset` to clear IPMI users that may be out of synch between two ports, and to disable default users.
7. To add a new IPMI user, enter `ipmi user add user`.
8. To set up SOL, do the following:
   a. Enter `system option set console lan`.
   b. When prompted, enter `y` to reboot the system.

**Managing power with DD System Manager**

After IPMI is properly set up on a remote system, you can use DD System Manager as an IPMI initiator to log into the remote system, view the power status, and change the power status.

**Procedure**

1. Select Maintenance > IPMI.
2. Click Login to Remote System.
   The IPMI Power Management dialog box appears.
3. Enter the remote system IPMI IP address or hostname and the IPMI username and password, then click Connect.
4. View the IPMI status.
   The IPMI Power Management dialog box appears and shows the target system identification and the current power status. The Status area always shows the current status.

   **Note:** The Refresh icon (the blue arrows) next to the status can be used to refresh the configuration status (for example, if the IPMI IP address or user configuration were changed within the last 15 minutes using the CLI commands).

5. To change the IPMI power status, click the appropriate button.
   - **Power Up**—Appears when the remote system is powered off. Click this button to power up the remote system.
   - **Power Down**—Appears when the remote system is powered on. Click this button to power down the remote system.
   - **Power Cycle**—Appears when the remote system is powered on. Click this button to power cycle the remote system.
   - **Manage Another System**—Click this button to log into another remote system for IPMI power management.
Managing System Power

- **Done**—Click to close the IPMI Power Management dialog box.

**NOTICE** The IPMI Power Down feature does not perform an orderly shutdown of the DD OS. This option can be used if the DD OS hangs and cannot be used to gracefully shutdown a system.

### Managing power with the CLI

You can manage power on a remote system and start remote console monitoring using the CLI.

**About this task**

**Note:** The remote system must be properly set up before you can manage power or monitor the system.

**Procedure**

1. Establish a CLI session on the system from which you want to monitor a remote system.
2. To manage power on the remote system, enter `ipmi remote power {on | off | cycle | status} ipmi-target <ipaddr | hostname> user user.`
3. To begin remote console monitoring, enter `ipmi remote console ipmi-target <ipaddr | hostname> user user.`
   
   **Note:** The user name is an IPMI user name defined for IPMI on the remote system. DD OS user names are not automatically supported by IPMI.

4. To disconnect from a remote console monitoring session and return to the command line, enter the at symbol (`@`).
5. To terminate remote console monitoring, enter the tilde symbol (`~`).
CHAPTER 6
Managing Alerts

This chapter presents the following topics:

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- Viewing and clearing current alerts....................................................................................... 56
- Viewing the alerts history...................................................................................................... 56
- Managing alert notifications.................................................................................................. 57
Health Alerts panel

Alerts are messages from system services and subsystems that report system events. The Health > Alerts panel displays tabs that allow you to view current and non-current alerts, the configured alert notification groups, and the configuration for those who want to receive daily alert summary reports.

Alerts are also sent as SNMP traps. See the MIB Quick Reference Guide or the SNMP MIB for the full list of traps.

Viewing and clearing current alerts

The Current Alerts tab displays a list of all the current alerts and can display detailed information for a selected alert. An alert is automatically removed from the Current Alerts list when the underlying situation is corrected or when manually cleared.

Procedure

1. To view all of the current alerts, select Health > Alerts > Current Alerts.
2. To limit the number of entries in the current alert list, do the following.
   a. In the Filter By area, select a Severity and Class to expose only alerts that pertain to those choices.
   b. Click Update.
      All alerts not matching the Severity and Class are removed from the list.
3. To display additional information for a specific alert in the Details area, click the alert in the list.
4. To clear an alert, select the alert checkbox in the list and click Clear.
   A cleared alert no longer appears in the current alerts list, but it can be found in the alerts history list.
5. To remove filtering and return to the full listing of current alerts, click Reset.

Viewing the alerts history

The Alerts History tab displays a list of all the cleared alerts and can display detailed information for a selected alert.

Procedure

1. To view all of the alerts history, select Health > Alerts > Alerts History.
2. To limit the number of entries in the current alert list, do the following.
   a. In the Filter By area, select a Severity and Class to expose only alerts that pertain to those choices.
   b. Click Update.
      All alerts not matching the Severity and Class are removed from the list.
3. To display additional information for a specific alert in the Details area, click the alert in the list.
4. To remove filtering and return to the full listing of cleared alerts, click Reset.
Managing alert notifications

The alert feature generates event and summary reports that can be distributed to configurable email lists and to Dell EMC.

Event reports are sent immediately and provide detailed information on a system event. The distribution lists for event alerts are called notification groups. You can configure a notification group to include one or more email addresses, and you can configure the types and severity level of the event reports sent to those addresses. For example, you might configure one notification group for individuals who need to know about critical events and another group for those who monitor less critical events. Another option is to configure groups for different technologies. For example, you might configure one notification group to receive email messages about all network events and another group to receive messages about storage issues.

Summary reports are sent daily and provide a summary of the events that occurred during the last 24 hours. Summary reports do not include all the information that is provided in event reports. The default generation time for the daily report is 08.00 a.m, and it can be changed. Summary reports are sent using a dedicated email list that is separate from the event notification groups.

You can enable or disable alert distribution to Dell EMC. When sending reports to Dell EMC, you have the option to select the legacy unsecure method or Secure Remote Services for secure transmissions.

HA system alert notification management

The alert feature on an HA system generates event and summary reports like a non-HA system but how the HA system manages these alerts is different due to the two node system set-up.

Initial alert configuration is completed on the active node and mirrored to the stand-by (i.e., same configuration on both nodes). Local and AM-Alerts are emailed according to the notification settings and include information indicating they are from an HA system and from which node, the active or standby, that generated the alerts.

If there are active alerts on the file system, replication, or protocols when a failover occurs, these active alerts continue to show on the new active node after failover if the alert conditions have not cleared up.

Historical alerts on the filesystem, replication, and protocols stay with the node where they originated rather than failing over together with the filesystem on a failover. This means the CLIs on the active node will not present a complete/continuous view of historical alerts for filesystem, replication, and protocols.

During a failover, local historical alerts stay with the node from which they were generated; however, the historical alerts for the filesystem, replication, and protocols (generally called "logical alerts") fail over together with the filesystem.

Note: The Health > High Availability panel displays only alerts that are HA-related. Those alerts can be filtered by major HA component, such as HA Manager, Node, Interconnect, Storage, and SAS connection.

Viewing the notification group list

A notification group defines a set of alert types (classes) and a group of email addresses (for subscribers). Whenever the system generates an alert type selected in a notification list, that alert is sent to the list subscribers.

Procedure

1. Select Health > Alerts > Notification.
Managing Alerts

```bash
# alerts notify-list show
```

2. To limit (filter) the entries in the Group Name list, type a group name in the Group Name box or a subscriber email in the Alert Email box, and click **Update**.

   | **Note:** Click **Reset** to display all configured groups.

3. To display detailed information for a group, select the group in the Group Name list.

Creating a notification group

Use the Notification tab to add notification groups and select the severity level for each group.

**Procedure**

1. Select **Health > Alerts > Notification**.
2. Click **Add**.

   The Add Group dialog box appears.

3. Type the group name in the **Group Name** box.
4. Select the checkbox of one or more alert classes of which to be notified.
5. To change the default severity level (Warning) for a class, select another level in the associated list box.

   The severity levels are listed in ascending severity level. **Emergency** is the highest severity level.
6. Click **OK**.

   **CLI equivalent**

   ```bash
   # alerts notify-list create eng_grp class hardwareFailure
   ```

Managing the subscriber list for a group

Use the Notification tab to add, modify, or delete email addresses from a notification group subscriber list.

**Procedure**

1. Select **Health > Alerts > Notification**.
2. Select the checkbox of a group in the Notifications group list, and do one of the following.
   - Click **Modify** and select **Subscribers**.
   - Click **Configure** in the Subscribers list.
3. To add a subscriber to the group, do the following.
   a. Click the + icon.

      The Email Address dialog box appears.

   b. Enter the email address of a subscriber.
   c. Click **OK**.

   **CLI equivalent**

   ```bash
   ```
4. To modify an email address, do the following.
   a. Click the checkbox of the email address in the Subscriber Email list.
   b. Click the pencil icon.
   c. Edit the email address in the Email Address dialog box.
   d. Click OK.

5. To delete an email address, click the checkbox of the email address in the Subscriber Email list and click the X icon.

   CLI equivalent
   # alerts notify-list del eng_lab emails bob@urcompany.com

6. Click Finish or OK.

Modifying a notification group

Use the Notification table to modify the attribute classes in an existing group.

Procedure

1. Select Health > Alerts > Notification.
2. Select the checkbox of the group to modify in the group list.
3. To modify the class attributes for a group, do the following.
   a. Click Configure in the Class Attributes area.
      
      The Edit Group dialog box appears.
   b. Select (or clear) the checkbox of one or more class attributes.
   c. To change the severity level for a class attribute, select a level from the corresponding list box.
   d. Click OK.

   CLI equivalent
   # alerts notify-list add eng_lab class cloud severity warning
   # alerts notify-list del eng_lab class cloud severity notice

4. To modify the subscriber list for a group, do the following.
   a. Click Configure in the Subscribers area.
      
      The Edit Subscribers dialog box appears.
   b. To delete subscribers from the group list, select the checkboxes of subscribers to delete and click the Delete icon (X).
   c. To add a subscriber, click the Add icon (+), type a subscriber email address, and click OK.
   d. Click OK.

   CLI equivalent
   # alerts notify-list add eng_lab emails
5. Click OK.

Deleting a notification group

Use the Notification tab to delete one or more existing notification groups.

Procedure

1. Select Health > Alerts > Notification.
2. Select one or more checkboxes of groups in the Notifications group list, and click Delete.
   The Delete Group dialog box appears.
3. Verify the deletion and click OK.

   CLI equivalent

   # alerts notify-list destroy eng_grp

Resetting the notification group configuration

Use the Notification tab to remove all notification groups added and to remove any changes made to the Default group.

Procedure

1. Select Health > Alerts > Notification.
2. Select More Tasks > Reset Notification Groups.
3. In the Reset Notification Groups dialog box, click Yes in the verification dialog.

   CLI equivalent

   # alerts notify-list reset

Configuring the daily summary schedule and distribution list

Every day, each managed system sends a Daily Alert Summary email to the subscribers configured for the alertssummary.list email group. The Daily Alert Summary email contains current and historical alerts showing messages about non-critical hardware situations and disk space usage numbers that you might want to address soon.

About this task

A fan failure is an example of a noncritical issue that you might want to address as soon as is reasonably possible. When Support receives the failure notification, they contact you to arrange for component replacement.

Procedure

1. Select Health > Alerts > Daily Alert Summary.
2. If the default deliver time of 8 AM is not acceptable, do the following.
   a. Click Schedule.
      The Schedule Alert Summary dialog box appears.
b. Use the list boxes to select the hour, minute, and either AM or PM for the summary report.

c. Click OK.

   CLI equivalent

   # autosupport set schedule alert-summary daily 1400

3. To configure the daily alert subscriber list, do the following.

   a. Click Configure.

      The Daily Alert Summary Mailing List dialog box appears.

   b. Modify the daily alert subscriber list as follows.

      • To add a subscriber, click the + icon, type the email address, and click OK.

         CLI equivalent

         # autosupport add alert-summary emails djones@company.com

      • To modify an email address, select the checkbox for the subscriber, click the pencil icon, edit the email address, and click OK.

      • To delete an email address, select the checkbox for the subscriber and click X.

         CLI equivalent

         # autosupport del alert-summary emails djones@company.com

c. Click Finish.

Enabling and disabling alert notification to Dell EMC

You can enable or disable alert notification to Dell EMC without affecting whether or not autosupport reports are sent to Dell EMC.

Procedure

1. To view the alert reporting status, select Maintenance > Support > Autosupport.

   The alert notification status is highlighted in green next to the Real-time alert label in the Support area. Depending on the current configuration, either an Enable or a Disable button appears in the Real-time alert row.

2. To enable alert reporting, click Enable in the Real-time alert row.

3. To disable alert reporting, click Disable in the Real-time alert row.

Testing the alerts email feature

Use the Notification tab to send a test email to select notification groups or email addresses. This feature allows you to determine if the system is configured correctly to send alert messages.

Procedure

1. To control whether or not a test alert is sent to Dell EMC, do the following.

   a. Select Maintenance > Support > Autosupport.

   b. In the Alert Support area, click Enable or Disable to control whether or not the test email is sent.

      You cannot change the email address.
2. Select **Health > Alerts > Notification**.
3. Select **More Tasks > Send Test Alert**.
   The Send Test Alert dialog box appears.
4. In the **Notification Groups** list, select groups to receive the test email and click **Next**.
5. Optionally, add additional email addresses to receive the email.
6. Click **Send Now** and **OK**.
   
   **CLI equivalent**
   ```
   # alerts notify-list test jsmith@yourcompany.com
   ```
7. If you disabled sending of the test alert to Dell EMC and you want to enable this feature now, do the following.
   a. Select **Maintenance > Support > Autosupport**.
   b. In the **Alert Support** area, click **Enable**.

**Results**

To test newly added alerts emails for mailer problems, enter: `autosupport test email email-addr`

For example, after adding the email address djones@yourcompany.com to the list, check the address with the command: `autosupport test email djones@yourcompany.com`
CHAPTER 7
Setting up Support

This chapter presents the following topics:

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- Managing support bundles ........................................................................ 67
- Managing support delivery ......................................................................... 68
- Managing log files .................................................................................... 70
- Managing a core dump ............................................................................. 74
Managing Autosupport reports

The Autosupport feature generates a report that is called an Auto Support log (ASUP). The ASUP shows system identification information, consolidated output from several system commands, and entries from various log files. Extensive and detailed internal statistics appear at the end of the report. This report is designed to aid Support in debugging system problems.

An ASUP is generated as scheduled, which is usually once per day. Additionally, every time the file system starts, the system generates a new ASUP.

Other reports are triggered by system events such as alerts, and are more limited in scope. They contain basic system information, and information about the event that triggered the report.

You can configure email addresses to receive the daily ASUP reports, and you can enable or disable sending of these reports to Dell EMC. The default time for sending the daily ASUP is 06.00 a.m, and it is configurable. When sending ASUPs to Dell EMC you have the option to select the legacy unsecure method or the ConnectEMC method, which encrypts the information before transmission.

Configuring ASUP

Configure the system to send ASUPs to Dell EMC Support.

**Before you begin**

**About this task**

Use the GUI to perform this procedure.

**Procedure**

1. Configure mail server settings:
   a. Select **System Settings > General Configuration > Mail Server tabs**.
   b. From the **More Tasks** menu, select **Set Mail Server**.
      The **Set Mail Server** dialog box opens.
   c. In the **Mail Server** text box, enter the name of the mail server, and then click **OK**.

2. Configure the Autosupport Mailing List:

   **Note:** For Autosupport to send notifications to Dell EMC, you must add the following account: autosupport@autosupport.datadomain.com.

   a. Select **Maintenance > Support**.
   b. Click **Add** or **Modify** next to the **Detailed Autosupport Mailing List**.
      The **Add or Modify Detailed Autosupport Mailing Lists** dialog box opens.
   c. In the **Email** area, click the + (plus) icon.
   d. In the **Email** dialog box, enter the recipients email address in the **Autosupport Email** text box, and then click **OK**.
      The new autosupport email addresses open in the **Detailed Autosupport Mailing Lists** area.

3. Test the Alerts Email List:
   a. Select **Status > Alerts > Notification**.
b. Select More Tasks > Send Test Alert.
   The Send Test Alert dialog box opens.

c. In the Notification Groups area, select the groups who should receive test emails and click Next.

d. Optionally, add or create other email addresses.

e. Click Send Now and click OK.

Managing HA system autosupport and support bundles

The standby node mirrors the configuration on the active node, but the ASUP and support bundle for each node is different.

Contents of the Autosupport and support bundles for each node are:

- Active node—Local node, file system, replication, protocol, and full HA information
- Standby node—Local node information and some HA configuration and status information

Autosupport and support bundles from both the nodes are needed to debug issues related to HA system status (filesystem, replication, protocols, and HA configuration).

Enabling and disabling autosupport reporting to Dell EMC

You can enable or disable autosupport reporting to Dell EMC. This setting does not affect whether or not alerts are sent to Dell EMC.

Procedure

1. To view the autosupport reporting status, select Maintenance > Support > Autosupport.
   The autosupport reporting status is highlighted next to the Scheduled autosupport label in the Support area. Depending on the current configuration, either an Enable or a Disable button appears in the Scheduled autosupport row.

2. To enable autosupport reporting, click Enable in the Scheduled autosupport row.

3. To disable autosupport reporting, click Disable in the Scheduled autosupport row.

Reviewing generated autosupport reports

Review autosupport reports to view system statistics and configuration information captured in the past. The system stores a maximum of 14 autosupport reports.

Procedure

1. Select Maintenance > Support > Autosupport.
   The Autosupport Reports page shows the autosupport report file name and file size, and the date the report was generated. Reports are automatically named. The most current report is autosupport, the previous day is autosupport.1, and the number increments as the reports move back in time.

2. Click the file name link to view the report using a text editor. If doing so is required by your browser, download the file first.
Configuring the autosupport mailing list

Autosupport mailing list subscribers receive autosupport messages through email. Use the Autosupport tab to add, modify, and delete subscribers.

About this task

Autosupport emails are sent through the configured mail server to all subscribers in the autosupport email list. After you configure the mail server and autosupport email list, it is a good practice to test the setup to ensure that autosupport messages reach the intended destinations.

Procedure

1. Select Maintenance > Support > Autosupport.
2. Click Configure.
   The Configure Autosupport Subscribers dialog box appears.
3. To add a subscriber, do the following.
   a. Click Add (+).
      The Email dialog box appears.
   b. Enter the recipients email address in the Email box.
   c. Click OK.
   CLI equivalent
      # autosupport add asup-detailed emails djones@company.com
      # autosupport add alert-summary emails djones@company.com
4. To delete a subscriber, do the following.
   a. In the Configure Autosupport Subscribers dialog box, select the subscriber to delete.
   b. Click Delete (X).
   CLI equivalent
      # autosupport del asup-detailed emails djones@company.com
      # autosupport del alert-summary emails djones@company.com
5. To modify a subscriber email address, do the following.
   a. In the Configure Autosupport Subscribers dialog box, select the subscriber name to edit.
   b. Click Modify (pencil icon).
      The Email dialog box appears.
   c. Modify the email address as needed.
   d. Click OK.
6. Click OK to close the Configure Autosupport Subscribers dialog box.
   The revised autosupport email list appears in the Autosupport Mailing List area.
Verifying ASUP and alert emails

Confirm that external email recipients can receive the autosupport (ASUP) and alert emails you send from your protection system.

About this task

Verify autosupport (ASUP) is getting relayed by the exchange server.

Procedure

1. Check if ASUPs can be sent to a local email address, an email address on the same Mail Server.
   
   ```
   # autosupport send [internal-email-addr]
   ```

2. Check if ASUPs can be sent to an email address outside the local mail server.
   
   ```
   # autosupport send [external email-addr]
   ```

3. If the email does not get to the external email address on the mail server, you may receive an error such as:

   ```
   **** Unable to send message: (errno 51: Unrecoverable errors from server-- giving up)
   ```

   In this case, it is likely that forwarding will need to be enabled for the system on the local mail server by using the steps outlined in the KB article Configure Email Relay on MS Exchange, available at https://support.emc.com/kb/181900.

4. If the ASUP can be sent to an external email address, but is not getting to Dell EMC, there may be an issue with the firewall configuration or spam filters.

Managing support bundles

A support bundle is a file that contains system configuration and operation information. It is a good practice to generate a support bundle before a software upgrade or a system topology change (such as a controller upgrade).

Dell EMC Support often requests a support bundle when providing assistance.

The KB articles How to collect/upload a support bundle (SUB) from a Data Domain Restorer (DDR), available at https://support.emc.com/kb/180563 and Gathering Autosupports, provide additional information about gathering and working with support bundles.

Generating a support bundle

When troubleshooting problems, Dell EMC Support may ask for a support bundle, which is a tar-g-zipped selection of log files with a README file that includes identifying autosupport headers.

Procedure


2. Click Generate Support Bundle.

   ![Note: The system supports a maximum of five support bundles. If you attempt to generate an sixth support bundle, the system automatically deletes the oldest support bundle. You can also delete support bundles using the CLI command `support bundle delete`.](image)
Also, if you generate a support bundle on a upgraded system that contains a support bundle named using the old format, support-bundle.tar.gz, that file is renamed to use the newer name format.

3. Email the file to customer support at support@emc.com.

   Note: If the bundle is too large to be emailed, use the online support site to upload the bundle. (Go to https://support.emc.com.)

**Generating a mini support bundle**

If the support bundle is too large, DD OS provides the ability to create a mini bundle that is smaller in size.

**About this task**

For automatically generated mini support bundles, the maximum number allowed is two created within the last 24 hours, and four total. New mini bundles will not be generated if there are already two that were created in the last 24 hours. If the maximum of four is reached, the system will automatically delete the oldest one.

**Procedure**

1. Select **Maintenance > Support > Support Bundles**.
2. Click **Generate Mini Support Bundle**.
   
   Note: The system supports a maximum of five support bundles (standard and mini). If you attempt to generate an sixth support bundle, the system automatically deletes the oldest support bundle. You can also delete support bundles using the CLI command `support bundle delete`.
3. Email the file to customer support at support@emc.com.

   Note: If the bundle is too large to be emailed, use the online support site to upload the bundle. (Go to https://support.emc.com.)

**Viewing the support bundles list**

Use the Support Bundles tab to view the support bundle files on the system.

**Procedure**

1. Select **Maintenance > Support > Support Bundles**.

   The Support Bundles list appears.

   Listed are the support bundle file name, file size, and date the bundle was generated.

   Bundles are automatically named `hostname-support-bundle-datestamp.tar.gz`. An example filename is `localhost-support-bundle-1127103633.tar.gz`, which indicates that the support bundle was created on the localhost system on November 27th at 10:36:33.

2. Click the file name link and select a gz/tar decompression tool to view the ASCII contents of the bundle.

**Managing support delivery**

Delivery management defines how alerts and autosupport reports are sent to Dell EMC. By default, alerts and autosupport reports are sent to Dell EMC Support using the standard (unsecure) email.
The ConnectEMC method sends messages in a secure format through the Secure Remote Services Virtual Edition (VE) gateway.

When the ConnectEMC method is used with a Secure Remote Services gateway, one benefit is that one gateway can forward messages from multiple systems, and this allows you to configure network security for only the Secure Remote Services gateway instead of for multiple systems. Also, a usage intelligence report is generated and sent if electronic licenses are adopted.

When configuring a Secure Remote Services gateway, the protection system supports registering multiple gateways to provide redundancy.

Selecting standard email delivery to Dell EMC

When you select the standard (non-secure) email delivery method, this method applies to both alert and autosupport reporting.

Procedure

1. Select Maintenance > Support > Autosupport.
2. Click Configure in the Channel row in the Support area.
   
   The Configure EMC Support Delivery dialog appears. The delivery method is displayed after the Channel label in the Support area.
3. In the Channel list box, select Email to datadomain.com.
4. Click OK.

   CLI equivalent
   
   ```
   # support notification method set email
   ```

Selecting and configuring Secure Remote Services delivery

Secure Remote Services Virtual Edition (VE) Gateway provides automated connect home and remote support activities through an IP-based solution that is enhanced by a comprehensive security system.

About this task

An on-premise Secure Remote Services version 3 gateway provides the ability to monitor both on-premise protection systems and DDVE instances, and cloud-based DDVE instances.

Procedure

1. Select Maintenance > Support > Autosupport.
2. Click Configure in the Channel row in the Support area.
   
   The Configure Dell EMC Support Delivery dialog box appears. The delivery method is displayed after the Channel label in the Support area.
3. In the Channel list box, select Secure Remote Services.
4. Type the gateway hostname and select the local IP address for the system.
5. Click OK.
6. Type the service link username and password.
7. Click Register.
   
   Secure Remote Services details are displayed in the Autosupport panel.
CLI equivalent

Procedure

1. To set up the administrator email, enter:
   
   ```
   # config set admin-email dd_admin1@emc.com
   The Admin Email is: dd_admin1@emc.com
   ```

2. To register the system to the ESRS-gateway (Secure Remote Services), enter:
   
   ```
   # support connectemc device register ipaddr esrs-gateway [host-list] [ha-peer ipaddr]
   ```

   **CAUTION** When configuring Secure Remote Services delivery on an HA pair:
   
   - The `ha-peer` parameter is required when configuring Secure Remote Services on HA pairs to register both nodes.
   - The customer must provide Service Link credentials to run the `support connectemc device register` command on an HA pair, because attempting to register the HA pair as a user will fail and cause the RSA key token to become out of synch.

3. To enable the sending of autosupports, enter:
   
   ```
   # support notification enable all
   Enabled sending autosupport and alerts to EMC.
   ```

4. To set the notification method to ConnectEMC, enter:
   
   ```
   # support notification method set connectemc
   Support notification method set to "connectemc".
   ```

5. To show the notification setup, enter:
   
   ```
   # support notification show all
<table>
<thead>
<tr>
<th>Notification</th>
<th>Status</th>
<th>Destination</th>
</tr>
</thead>
<tbody>
<tr>
<td>alerts</td>
<td>enabled</td>
<td>ftp://111.111.111.11:11</td>
</tr>
<tr>
<td>autosupport</td>
<td>enabled</td>
<td>ftp://111.111.111.11:11</td>
</tr>
</tbody>
</table>
   ```

6. To show the notification setup, enter:
   
   ```
   # support connectemc config show
   ConnectEMC configuration:
   ESRS gateway IP/hostname: esrs-gateway.datadomain.com
   Registered device IP(s) 10.25.246.70
   ```

Testing ConnectEMC operation

A CLI command allows you to test ConnectEMC operation by sending a test message to Support through the Secure Remote Services gateway.

Procedure

1. To test ConnectEMC operation, use the CLI.
   
   ```
   #support connectemc test
   Sending test message through ConnectEMC...
   Test message successfully sent through ConnectEMC.
   ```

Managing log files

The DD system maintains a set of log files, which can be bundled and sent to Support to assist in troubleshooting any system issues that may arise. Log files cannot be modified or deleted by any
user with DD System Manager, but they can be copied from the log directory and managed off of the system.

**Note:** Log messages on an HA system are preserved on the node where the log file originated.

Log files are rotated weekly. Every Sunday at 0:45 a.m., the system automatically opens new log files for the existing logs and renames the previous files with appended numbers. For example, after the first week of operation, the previous week messages file is renamed messages.1, and new messages are stored in a new messages file. Each numbered file is rolled to the next number each week. For example, after the second week, the file messages.1 is rolled to messages.2. If a messages.2 file already existed, it rolls to messages.3. At the end of the retention period (shown in the table below, the expired log is deleted. For example, an existing messages.9 file is deleted when messages.8 rolls to messages.9.

The audit.log does not rotate on a weekly basis. Instead, it rotates when the file reaches 70 MB in size.

Except as noted in this topic, the log files are stored in /ddvar/log.

**Note:** Files in the /ddvar directory can be deleted using Linux commands if the Linux user is assigned write permission for that directory.

The set of log files on each system is determined by the features configured on the system and the events that occur.

### Viewing log files in DD System Manager

Use the Logs tab to view and open the system log files in DD System Manager.

**Procedure**

1. Select **Maintenance > Logs**.
   
   The Logs list displays log file names and the size and generation date for each log file.

2. Click a log file name to view its contents. You may be prompted to select an application, such as Notepad.exe, to open the file.

### Displaying a log file in the CLI

Use the `log view` command to view a log file in the CLI.

**Procedure**

1. To view a log file in the CLI, use the `log view` command.
   
   With no argument, the command displays the current messages file.

2. When viewing the log, use the up and down arrows to scroll through the file; use the q key to quit; and enter a slash character (/) and a pattern to search through the file.

The display of the messages file is similar to the following. The last message in the example is an hourly system status message that the protection system generates automatically. The message reports system uptime, the amount of data stored, NFS operations, and the amount of disk space used for data storage (%). The hourly messages go to the system log and to the serial console if one is attached.

```
# log view
Jun 27 12:11:33 localhost rpc.mountd: authenticated unmount request from perfsun-g.emc.com:668 for /ddr/coll/segfs (/ddr/coll/segfs)
```
Learning more about log messages

Look up error messages in the Error Message Catalog for your DD OS version.

About this task
In the log file is text similar to the following.

```
```

The components of the message are as follows.

<table>
<thead>
<tr>
<th>DateTime</th>
<th>Host</th>
<th>Process</th>
<th>[PID]:</th>
<th>Severity:</th>
<th>MSG-Module-MessageID:</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MSG-SMTOOL-00006</td>
<td></td>
</tr>
</tbody>
</table>

Severity levels, in descending order, are: Emergency, Alert, Critical, Error, Warning, Notice, Info, Debug.

Procedure

1. Go to the Online Support website at https://support.emc.com, enter Error Message Catalog in the search box, and click the search button.
2. In the results list, locate the catalog for your system and click on the link.
3. Use your browser search tool to search for a unique text string in the message.

The error message description looks similar to the following display.

```
ID: MSG-SMTOOL-00006 - Severity: NOTICE - Audience: customer
Message: No replication throttle schedules found: setting throttle to unlimited.
Description: The restorer cannot find a replication throttle schedule. Replication is running with throttle set to unlimited.
Action: To set a replication throttle schedule, run the replication throttle add command.
```

4. To resolve an issue, do the recommended action.

Based on the example message description, one could run the replication throttle add command to set the throttle.

Saving a copy of log files

Save log file copies to another device when you want to archive those files.

About this task
Use NFS, CIFS mount, or FTP to copy the files to another machine. If using CIFS or NFS, mount /ddvar to your desktop and copy the files from the mount point. The following procedure describes how to use FTP to move files to another machine.
Procedure

1. On the protection system, use the `adminaccess show ftp` command to see whether FTP service is enabled. If the service is disabled, use the command `adminaccess enable ftp`.

2. Use the `adminaccess show ftp` command to see that the FTP access list includes the IP address of your remote machine. If the address is not in the list, use the command `adminaccess add ftp ipaddr`.

3. On the remote machine, open a web browser.

4. In the Address box at the top of the web browser, use FTP to access the protection system as shown in the following example.

   \[ftp://Data Domain system_name.yourcompany.com/\]

   **Note:** Some web browsers do not automatically ask for a login if a machine does not accept anonymous logins. In that case, add a user name and password to the FTP line. For example: `ftp://sysadmin:your-pw@Data Domain

   system_name.yourcompany.com/`

5. At the login pop-up, log into the protection system as user `sysadmin`.

6. On the protection system, you are in the directory just above the log directory. Open the log directory to list the messages files.

7. Copy the file that you want to save. Right-click the file icon and select **Copy To Folder** from the menu. Choose a location for the file copy.

8. If you want the FTP service disabled on the protection system, after completing the file copy, use SSH to log into the protection system as sysadmin and invoke the command `adminaccess disable ftp`.

Log message transmission to remote systems

Some log messages can be sent from the protection system to other systems. DD OS uses syslog to publish log messages to remote systems.

A protection system exports the following facility.priority selectors for log files. For information on managing the selectors and receiving messages on a third-party system, see your vendor-supplied documentation for the receiving system.

- ***.notice**—Sends all messages at the notice priority and higher.
- ***.alert**—Sends all messages at the alert priority and higher (alerts are included in *.notice).
- **kern.***—Sends all kernel messages (kern.info log files).

The `log host` commands manage the process of sending log messages to another system.

Viewing the log file transmission configuration

Use the `log host show` CLI command to view whether log file transmission is enabled and which hosts receive log files.

Procedure

1. To display the configuration, enter the `log host show` command.

   ```
   # log host show
   Remote logging is enabled.
   ```
Enabling and disabling log message transmission

You must use CLI commands to enable or disable log message transmission.

**Procedure**

1. To enable sending log messages to other systems, use the `log host enable` command.
2. To disable sending log messages to other systems, use the `log host disable` command.

Adding or removing a receiver host

You must use CLI commands to add or remove a receiver host.

**Procedure**

1. To add a system to the list that receives protection system log messages, use the `log host add` command.
2. To remove a system from the list that receives system log messages, use the command: `log host del`.

The following command adds the system named `log-server` to the hosts that receive log messages.

```
log host add log-server
```

The following command removes the system named `log-server` from the hosts that receive log messages.

```
log host del log-server
```

The following command disables the sending of logs and clears the list of destination hostnames.

```
log host reset
```

Managing a core dump

A core is a file that contains details about the specific problem encountered when the protection system suffers a crash due to a core dump. DD OS keeps a record of these files to assist with troubleshooting.

Navigate to **Maintenance > Support > Cores**.

If a core file is too big, DD OS provides the ability to split it into smaller chunks. Split files are automatically deleted after 48 hours.

Splitting a coredump file

When DD OS crashes due to a coredump, a core file describing the problem is created in the `/ddvar/core` directory. This file may be large, and difficult to copy off the protection system. If
the core file cannot be copied off the system because it is too large, DD OS provides the ability to split the core file into smaller chunks.

Procedure

1. Select Maintenance > Support > Cores.
2. Select a core file from the table.
3. Click Split.
4. In the Size field, specify the size of the chunks to create and select MiB or GiB from the list box.

1 Note: A single core file can be broken down into a maximum of 20 chunks. The command will fail with an error if the specified size would result in more than 20 chunks.

5. Click OK.

Results

DD OS splits the selected coredump file into chunks of the specified size, and places them in the /ddvar/core directory. Split files are automatically deleted after 48 hours.

CLI equivalent

Procedure

1. Run the support coredump split <filename> <n> {MiB|GiB} command, where:
   - <filename> is the name of the core file in the /ddvar/core directory
   - <n> is the size of the smaller chunks to create

1 Note: A single core file can be broken down into a maximum of 20 chunks. The command will fail with an error if the specified size would result in more than 20 chunks.

For example, splitting a 42.1 MB core file named cpmdb.core.19297.1517443767 into 10 MB chunks would result in five chunks.

```
# support coredump split cpmdb.core.19297.1517443767 10 MiB

File                  Size       Time Created
cpmdb.core.19297.1517443767_5_01   10.0 MiB   Mon Feb  5 11:50:57 2018
cpmdb.core.19297.1517443767_5_02   10.0 MiB   Mon Feb  5 11:50:57 2018
cpmdb.core.19297.1517443767_5_03   10.0 MiB   Mon Feb  5 11:50:57 2018
cpmdb.core.19297.1517443767_5_04   10.0 MiB   Mon Feb  5 11:50:57 2018
cpmdb.core.19297.1517443767_5_05   2.1 MiB    Mon Feb  5 11:50:57 2018

Download the files as soon as possible. Otherwise they will be automatically deleted in 48 hours.
```

2. Run the support coredump save <file-list> command to save specified coredump files to a USB drive. Split files are automatically deleted after 48 hours.
CHAPTER 8

Managing System Access

This chapter presents the following topics:

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- Viewing active users .............................................................................. 104
System access management

System access management features allow you to control system access to users in a local database or in a network directory. Additional controls define different access levels and control which protocols can access the system.

Role-based access control

Role-based access control (RBAC) is an authentication policy that controls which DD System Manager controls and CLI commands a user can access on a system.

For example, users who are assigned the admin role can configure and monitor an entire system, while users who are assigned the user role are limited to monitoring a system. When logged into DD System Manager, users see only the program features that they are permitted to use based on the role assigned to the user. The following roles are available for administering and managing the DD OS.

admin

An admin role user can configure and monitor the entire system. Most configuration features and commands are available only to admin role users. However, some features and commands require the approval of a security role user before a task is completed.

limited-admin

The limited-admin role can configure and monitor the system with some limitations. Users who are assigned this role cannot perform data deletion operations, edit the registry, or enter bash or SE mode.

user

The user role enables users to monitor systems and change their own password. Users who are assigned the user management role can view system status, but they cannot change the system configuration.

security (security officer)

A security role user, who may be referred to as a security officer, can manage other security officers, authorize procedures that require security officer approval, and perform all tasks supported for user-role users.

The security role is provided to comply with the Write Once Read-Many (WORM) regulation. This regulation requires electronically stored corporate data be kept in an unaltered, original state for purposes such as eDiscovery, auditing, and logging. As a result of compliance regulations, most command options for administering sensitive operations, such as DD Encryption, DD Retention Lock Compliance, and archiving now require security officer approval.

In a typical scenario, an admin role user issues a command and, if security officer approval is required, the system displays a prompt for approval. To proceed with the original task, the security officer must enter his or her username and password on the same console at which the command was run. If the system recognizes the security officer credentials, the procedure is authorized. If not, a security alert is generated.

The following are some guidelines that apply to security-role users:

- Only the sysadmin user (the default user created during the DD OS installation) can create the first security officer, after which the privilege to create security officers is removed from the sysadmin user.
- After the first security officer is created, only security officers can create other security officers.
- Creating a security officer does not enable the authorization policy. To enable the authorization policy, a security officer must log in and enable the authorization policy.
- Separation of privilege and duty apply. admin role users cannot perform security officer tasks, and security officers cannot perform system configuration tasks.
- During an upgrade, if the system configuration contains security officers, a sec-off-defaults permission is created that includes a list of all current security officers.

backup-operator

A backup-operator role user can perform all tasks permitted for user role users, create snapshots for MTrees, import, export, and move tapes between elements in a virtual tape library, and copy tapes across pools.

A backup-operator role user can also add and delete SSH public keys for non-password-required log ins. (This function is used mostly for automated scripting.) He or she can add, delete, reset and view CLI command aliases, synchronize modified files, and wait for replication to complete on the destination system.

none

The none role is for DD Boost authentication and tenant-unit users only. A none role user can log in to a protection system and can change his or her password, but cannot monitor, manage, or configure the primary system. When the primary system is partitioned into tenant units, either the tenant-admin or the tenant-user role is used to define a user's role with respect to a specific tenant unit. The tenant user is first assigned the none role to minimize access to the primary system, and then either the tenant-admin or the tenant-user role is appended to that user.

tenant-admin

A tenant-admin role can be appended to the other (non-tenant) roles when the Secure Multi-Tenancy (SMT) feature is enabled. A tenant-admin user can configure and monitor a specific tenant unit.

tenant-user

A tenant-user role can be appended to the other (non-tenant) roles when the SMT feature is enabled. The tenant-user role enables a user to monitor a specific tenant unit and change the user password. Users who are assigned the tenant-user management role can view tenant unit status, but they cannot change the tenant unit configuration.

Access management for IP protocols

This feature manages system access for the FTP, FTPS, HTTP, HTTPS, SSH, SCP, and Telnet protocols.

Viewing the IP services configuration

The Administrator Access tab displays the configuration status for the IP protocols that can be used to access the system. FTP and FTPS are the only protocols that are restricted to administrators.

Procedure

Managing System Access

Results
The Access Management page displays the Administrator Access, Local Users, Authentication, and Active Users tabs.

Managing FTP access
The File Transfer Protocol (FTP) allows administrators to access files on the protection system.

About this task
You can enable either FTP or FTPS access to users who are assigned the admin management role. FTP access allows admin user names and passwords to cross the network in clear text, making FTP an insecure access method. FTPS is recommended as a secure access method. When you enable either FTP or FTPS access, the other access method is disabled.

Note: Only users who are assigned the admin management role are permitted to access the system using FTP

Note: LFTP clients that connect to a protection system via FTPS or FTP are disconnected after reaching a set timeout limit. However the LFTP client uses its cached username and password to reconnect after the timeout while you are running any command.

Procedure
2. Select FTP and click Configure.
3. To manage FTP access and which hosts can connect, select the General tab and do the following:
   a. To enable FTP access, select Allow FTP Access.
   b. To enable all hosts to connect, select Allow all hosts to connect.
   c. To restrict access to select hosts, select Limit Access to the following systems, and modify the Allowed Hosts list.
      Note: You can identify a host using a fully qualified hostname, an IPv4 address, or an IPv6 address.
      • To add a host, click Add (+). Enter the host identification and click OK.
      • To modify a host ID, select the host in the Hosts list and click Edit (pencil). Change the host ID and click OK.
      • To remove a host ID, select the host in the Hosts list and click Delete (X).
4. To set a session timeout, select the Advanced tab, and enter the timeout value in seconds.
   Note: The session timeout default is Infinite, that is, the connection does not close.
5. Click OK.
   If FTPS is enabled, a warning message appears with a prompt to click OK to proceed.

Managing FTPS access
The FTP Secure (FTPS) protocol allows administrators to access files on the protection system.

About this task
FTPS provides additional security over using FTP, such as support for the Transport Layer Security (TLS) and for the Secure Sockets Layer (SSL) cryptographic protocols. Consider the following guidelines when using FTPS.
Managing System Access

- Only users who are assigned the admin management role are permitted to access the system using FTPS.
- When you enable FTPS access, FTP access is disabled.
- FTPS does not show up as a service for DD systems that run DD OS 5.2, managed from a DD system running DD OS 5.3 or later.
- When you issue the `get` command, the fatal error message `SSL_read: wrong version number lftp` appears if matching versions of SSL are not installed on the protection system and compiled on the LFTP client. As a workaround, attempt to re-issue the `get` command on the same file.

**Procedure**

1. Select **Administration > Access > Administrator Access**.
2. Select **FTPS** and click **Configure**.
3. To manage FTPS access and which hosts can connect, select the General tab and do the following:
   a. To enable FTPS access, select **Allow FTPS Access**.
   b. To enable all hosts to connect, select **Allow all hosts to connect**.
   c. To restrict access to select hosts, select **Limit Access to the following systems**, and modify the hosts list.
      
      **Note:** You can identify a host using a fully qualified hostname, an IPv4 address, or an IPv6 address.
      
      - To add a host, click Add (+). Enter the host identification and click **OK**.
      - To modify a host ID, select the host in the **Hosts** list and click **Edit** (pencil). Change the host ID and click **OK**.
      - To remove a host ID, select the host in the **Hosts** list and click **Delete** (X).
4. To set a session timeout, select the **Advanced** tab and enter the timeout value in seconds.
   
   **Note:** The session timeout default is Infinite, that is, the connection does not close.
5. Click **OK**. If FTP is enabled, a warning message appears and prompts you to click **OK** to proceed.

**Managing HTTP and HTTPS access**

HTTP or HTTPS access is required to support browser access to DD System Manager.

**Procedure**

1. Select **Administration > Access > Administrator Access**.
2. Select **HTTP** or **HTTPS** and click **Configure**.
   
   The Configure HTTP/HTTPS Access dialog appears and displays tabs for general configuration, advanced configuration, and certificate management.
3. To manage the access method and which hosts can connect, select the General tab and do the following:
   a. Select the checkboxes for the access methods you want to allow.
   b. To enable all hosts to connect, select **Allow all hosts to connect**.
   c. To restrict access to select hosts, select **Limit Access to the following systems**, and modify the host list.
To add a host, click Add (+). Enter the host identification and click OK.

To modify a host ID, select the host in the Hosts list and click Edit (pencil). Change the host ID and click OK.

To remove a host ID, select the host in the Hosts list and click Delete (X).

4. To configure system ports and session timeout values, select the Advanced tab, and complete the form.

   - In the HTTP Port box, enter the port number. Port 80 is assigned by default.
   - In the HTTPS Port box, enter the number. Port 443 is assigned by default.
   - In the Session Timeout box, enter the interval in seconds that must elapse before a connection closes. The minimum is 60 seconds and the maximum is 31536000 seconds (one year).

   Note: The session timeout default is 10,800 seconds.

5. Click OK.

Managing host certificates for HTTP and HTTPS

A host certificate allows browsers to verify the identity of the system when establishing management sessions.

Requesting a host certificate for HTTP and HTTPS

You can use DD System Manager to generate a host certificate request, which you can then forward to a Certificate Authority (CA).

About this task

Note: You must configure a system passphrase (system passphrase set) before you can generate a CSR.

Procedure

2. In the Services area, select HTTP or HTTPS and click Configure.
3. Select the Certificate tab.
4. Click Add.

   A dialog appears for the protocol you selected earlier in this procedure.

5. Click Generate the CSR for this Data Domain system.

   The dialog expands to display a CSR form.

   Note: DD OS supports one active CSR at a time. After a CSR is generated, the Generate the CSR for this Data Domain system link is replaced with the Download the CSR for this Data Domain system link. To delete a CSR, use the adminaccess certificate cert-signing-request delete CLI command.

6. Complete the CSR form and click Generate and download a CSR.
The CSR file is saved at the following path: /ddvar/certificates/CertificateSigningRequest.csr. Use SCP, FTP or FTPS to transfer the CSR file from the system to a computer from which you can send the CSR to a CA.

Adding a host certificate for HTTP and HTTPS

You can use DD System Manager to add a host certificate to the system.

**Procedure**

1. If you did not requested a host certificate, request a host certificate from a certificate authority.
2. When you receive a host certificate, copy or move it to the computer from which you run DD Service Manager.
3. Select **Administration > Access > Administrator Access**.
4. In the Services area, select HTTP or HTTPS and click **Configure**.
5. Select the **Certificate** tab.
6. Click **Add**.
   
   A dialog appears for the protocol you selected earlier in this procedure.

7. To add a host certificate enclosed in a .p12 file, do the following:
   a. Select *I want to upload the certificate as a .p12 file*.
   b. Type the password in the **Password** box.
   c. Click **Browse** and select the host certificate file to upload to the system.
   d. Click **Add**.

8. To add a host certificate enclosed in a .pem file, do the following:
   a. Select *I want to upload the public key as a .pem file and use a generated private key*.
   b. Click **Browse** and select the host certificate file to upload to the system.
   c. Click **Add**.

Deleting a host certificate for HTTP and HTTPS

DD OS supports one host certificate for HTTP and HTTPS. If the system is currently using a host certificate and you want to use a different host certificate, you must delete the current certificate before adding the new certificate.

**Procedure**

1. Select **Administration > Access > Administrator Access**.
2. In the Services area, select HTTP or HTTPS and click **Configure**.
3. Select the **Certificate** tab.
4. Select the certificate you want to delete.
5. Click **Delete**, and click **OK**.
Managing SSH and SCP access

SSH is a secure protocol that enables network access to the system CLI, with or without SCP (secure copy). You can use DD System Manager to enable system access using the SSH protocol. SCP requires SSH, so when SSH is disabled, SCP is automatically disabled.

Procedure
2. Select SSH or SCP and click Configure.
3. To manage the access method and which hosts can connect, select the General tab.
   a. Select the checkboxes for the access methods you want to allow.
   b. To enable all hosts to connect, select Allow all hosts to connect.
   c. To restrict access to select hosts, select Limit Access to the following systems, and modify the host list.
      - To add a host, click Add (+). Enter the host identification and click OK.
      - To modify a host ID, select the host in the Hosts list and click Edit (pencil). Change the host ID and click OK.
      - To remove a host ID, select the host in the Hosts list and click Delete (X).
4. To configure system ports and session timeout values, click the Advanced tab.
   - In the SSH/SCP Port text entry box, enter the port number. Port 22 is assigned by default.
   - In the Session Timeout box, enter the interval in seconds that must elapse before connection closes.
      - Note: The session timeout default is Infinite, that is, the connection does not close.
      - Note: Click Default to revert to the default value.
5. Click OK.

Managing Telnet access

Telnet is an insecure protocol that enables network access to the system CLI.

About this task

- Note: Telnet access allows user names and passwords to cross the network in clear text, making Telnet an insecure access method.

Procedure
2. Select Telnet and click Configure.
3. To manage Telnet access and which hosts can connect, select the General tab.
   a. To enable Telnet access, select Allow Telnet Access.
   b. To enable all hosts to connect, select Allow all hosts to connect.
c. To restrict access to select hosts, select Limit Access to the following systems, and modify the host list.

Note: You can identify a host using a fully qualified hostname, an IPv4 address, or an IPv6 address.

- To add a host, click Add (+). Enter the host identification and click OK.
- To modify a host ID, select the host in the Hosts list and click Edit (pencil). Change the host ID and click OK.
- To remove a host ID, select the host in the Hosts list and click Delete (X).

4. To set a session timeout, select the Advanced tab and enter the timeout value in seconds.

Note: The session timeout default is Infinite, that is, the connection does not close.

5. Click OK.

Local user account management

A local user is a user account (user name and password) that is configured on the protection system instead of being defined in a Windows Active Directory, Windows Workgroup, or NIS directory.

After a trusted domain is configured, users who belong to that domain will be able to log into the protection system even if that trusted domain is offline.

UID conflicts: local user and NIS user accounts

When you set up a protection system in an NIS environment, be aware of potential UID conflicts between local and NIS user accounts.

Local user accounts on a protection system start with a UID of 500. To avoid conflicts, consider the size of potential local accounts when you define allowable UID ranges for NIS users.

Viewing local user information

Local users are user accounts that are defined on the system, rather than in Active Directory, a Workgroup, or UNIX. You can display the local user’s username, management role, login status, and target disable date. You can also display the user's password controls and the tenant units the user can access.

About this task

Note: The user-authentication module uses Greenwich Mean Time (GMT). To ensure that user accounts and passwords expire correctly, configure settings to use the GMT that corresponds to the target local time.

Procedure

1. Select Administration > Access > Local Users.

   The Local Users view appears and shows the Local Users table and the Detailed Information area.

   Note: User accounts configured with the admin or security officer roles can view all users. Users with other roles can view only their own user accounts.

2. Select the user you want to view from the list of users.

   Information about the selected user displays in the Detailed Information area.
Creating local users

Create local users when you want to manage access on the local system instead of through an external directory. Protection systems support a maximum of 500 local user accounts.

Procedure
1. Select Administration > Access > Local Users.
   The Local Users view appears.
2. Click Create to create a new user.
   The Create User dialog appears.
3. Enter user information in the General Tab.
   The default value for the minimum length of a password is 6 characters. The default value for the minimum number of character classes required for a user password is 1. Allowable character classes include:
   - Lowercase letters (a-z)
   - Uppercase letters (A-Z)
   - Numbers (0-9)
   - Special Characters ($, %, #, +, and so on)
   Note: Sysadmin is the default admin-role user and cannot be deleted or modified.
4. To manage password and account expiration, select the Advanced tab and set the controls as required.
5. Click OK.

   Note: The default password policy can change if an admin-role user changes them ((More Tasks > Change Login Options)). The default values are the initial default password policy values.

Modifying a local user profile

After you create a user, you can use DD System Manager to modify the user configuration.

Procedure
1. Select Administration > Access > Local Users.
   The Local Users view appears.
2. Click a user name from the list.
3. Click Modify to make changes to a user account.
   The Modify User dialog box appears.
4. Update the information on the General tab.

   Note: If SMT is enabled and a role change is requested from none to any other role, the change is accepted only if the user is not assigned to a tenant-unit as a management-
user, is not a DD Boost user with its default-tenant-unit set, and is not the owner of a storage-unit that is assigned to a tenant-unit.

Note: To change the role for a DD Boost user that does not own any storage units, unassign it as a DD Boost user, change the user role, and re-assign it as a DD Boost user again.

5. Update the information on the Advanced tab.
6. Click OK.

Deleting a local user
You can delete certain users based on your user role. If one of the selected users cannot be deleted, the Delete button is disabled.

About this task
The sysadmin user cannot be deleted. Admin users cannot delete security officers. Only security officers can delete, enable, and disable other security officers.

Procedure
1. Select Administration > Access > Local Users.
   The Local Users view appears.
2. Click one or more user names from the list.
3. Click Delete to delete the user accounts.
   The Delete User dialog box appears.
4. Click OK and Close.

Enabling and disabling local users
Admin users can enable or disable all users except the sysadmin user and users with the security role. The sysadmin user cannot be disabled. Only Security officers can enable or disable other security officers.

Procedure
1. Select Administration > Access > Local Users.
   The Local Users view appears.
2. Click one or more user names from the list.
3. Click either Enable or Disable to enable or disable user accounts.
   The Enable or Disable User dialog box appears.
4. Click OK and Close.

Enabling security authorization
You can use the CLI to enable and disable the security authorization policy.

About this task
For information on the commands used in this procedure, see the DD OS Command Reference Guide.
Note: The DD Retention Lock Compliance license must be installed. You are not permitted to disable the authorization policy on DD Retention Lock Compliance systems.

Procedure
1. Log into the CLI using a security officer username and password.
2. To enable the security officer authorization policy, enter: 
   
   ```
   # authorization policy set security-officer enabled
   ```

Changing user passwords
After you create a user, you can use DD System Manager to change the user's password. Individual users can also change their own passwords.

Procedure
1. Click **Administration** > **Access** > **Local Users**.
   The Local Users view is displayed.
2. Click a username from the list.
3. To change the user password, click **Change Password**.
   The Change Password dialog box is displayed.
4. Enter the old password into the **Old Password** box.
5. Enter the new password into the **New Password** box.
6. Enter the new password again into **Verify New Password** box.
7. Click **OK**.

Only users with an "admin" role may change the password of other users. The administrator can change the password of other users from the CLI by running the `user change password [<user>]` command.

Note: For security reasons, users with an "admin" role cannot change other "admin" users' passwords. If an "admin" user password needs to be changed by logging in as another user, contact DELL-EMC Support by creating a Support Request or chat request for assistance.

Modifying the password policy and login controls
The password policy and login controls define login requirements for all users. Administrators can specify how often a password must be changed, what is required to create a valid password, and how the system responds to invalid login attempts.

Procedure
1. Select **Administration** > **Access**.
2. Select **More Tasks** > **Change Login Options**.
   The Change Login Options dialog appears.
3. Specify the new configuration in the boxes for each option. To select the default value, click **Default** next to the appropriate option.
4. Click **OK** to save the password settings.
Directory user and group management

You can use DD System Manager to manage access to the system for users and groups in Windows Active Directory, Windows Workgroup, and NIS. Kerberos authentication is an option for CIFS and NFS clients.

Viewing Active Directory and Kerberos information

The Active Directory Kerberos configuration determines the methods CIFS and NFS clients use to authenticate. The Active Directory/Kerberos Authentication panel displays this configuration.

Procedure

1. Select Administration > Access > Authentication.
2. Expand the Active Directory/Kerberos Authentication panel.

Configuring Active Directory and Kerberos authentication

Configuring Active Directory authentication makes the protection system part of a Windows Active Directory realm. CIFS clients and NFS clients use Kerberos authentication.

Procedure

1. Select Administration > Access > Authentication.
   The Authentication view appears.
2. Expand the Active Directory/Kerberos Authentication panel.
3. Click Configure... next to Mode to start the configuration wizard.
   The Active Directory/Kerberos Authentication dialog appears.
4. Select Windows/Active Directory and click Next.
5. Enter the full realm name for the system (for example: domain1.local), the user name, and password for the system. Then click Next.
   Note: Use the complete realm name. Ensure that the user is assigned sufficient privileges to join the system to the domain. The user name and password must be compatible with Microsoft requirements for the Active Directory domain. This user must also be assigned permission to create accounts in this domain.
6. Select the default CIFS server name, or select Manual and enter a CIFS server name.
7. To select domain controllers, select Automatically assign, or select Manual and enter up to three domain controller names.
   You can enter fully qualified domain names, hostnames, or IP (IPv4 or IPv6) addresses.
8. To select an organizational unit, select Use default Computers, or select Manual and enter an organization unit name.
   Note: The account is moved to the new organizational unit.
9. Click Next.
   The Summary page for the configuration appears.
10. Click Finish.
   The system displays the configuration information in the Authentication view.
11. To enable administrative access, click **Enable** to the right of **Active Directory Administrative Access**.

### Authentication mode selections

The authentication mode selection determines how CIFS and NFS clients authenticate using supported combinations of Active Directory, Workgroup, and Kerberos authentication.

#### About this task

DD OS supports the following authentication options.

- **Disabled**: Kerberos authentication is disabled for CIFS and NFS clients. CIFS clients use Workgroup authentication.
- **Windows/Active Directory**: Kerberos authentication is enabled for CIFS and NFS clients. CIFS clients use Active Directory authentication.
- **Unix**: Kerberos authentication is enabled for only NFS clients. CIFS clients use Workgroup authentication.

### Managing administrative groups for Active Directory

You can use the Active Directory/Kerberos Authentication panel to create, modify, and delete Active Directory (Windows) groups and assign management roles (admin, backup-operator, and so on) to those groups.

To prepare for managing groups, select **Administration > Access > Authentication**, expand the Active Directory/Kerberos Authentication panel, and click the **Active Directory Administrative Access Enable** button.

#### Creating administrative groups for Active Directory

Create an administrative group when you want to assign a management role to all the users configured in an Active Directory group.

**Before you begin**

Enable Active Directory Administrative Access on the Active Directory/Kerberos Authentication panel in the **Administration > Access > Authentication** page.

**Procedure**

1. Click **Create**....
2. Enter the domain and group name separated by a backslash. For example: domainname \groupname.
3. Select the management role for the group from the drop-down menu.
4. Click **OK**.

#### Modifying administrative groups for Active Directory

Modify an administrative group when you want to change the administrative domain name or group name configured for an Active Directory group.

**Before you begin**

Enable Active Directory Administrative Access on the Active Directory/Kerberos Authentication panel in the **Administration > Access > Authentication** page.

**Procedure**

1. Select a group to modify under the **Active Directory Administrative Access** heading.
2. Click **Modify**....
3. Modify the domain and group name. These names are separated by a backslash. For example: domainname\groupname.

Deleting administrative groups for Active Directory
Delete an administrative group when you want to terminate system access for all the users configured in an Active Directory group.

Before you begin

Procedure
1. Select a group to delete under the Active Directory Administrative Access heading.
2. Click Delete.

Configuring UNIX Kerberos authentication
Configuring UNIX Kerberos authentication enables NFS clients to use Kerberos authentication. CIFS clients use Workgroup authentication.

Before you begin
NIS must be running for UNIX-mode Kerberos authentication to function. For instructions about enabling Kerberos, see the section regarding enabling NIS services.

Procedure
1. Select Administration > Access > Authentication.
   The Authentication view appears.
2. Expand the Active Directory/Kerberos Authentication panel.
3. Click Configure... next to Mode to start the configuration wizard.
   The Active Directory/Kerberos Authentication dialog appears.
4. Select Unix and click Next.
5. Enter the realm name (for example: domain1.local), and up to three host names or IP addresses (IPv4 or IPv6) for key distribution centers (KDCs).
6. Optionally, click Browse to upload a keytab file, and click Next.
   The Summary page for the configuration appears.
   \[\text{\textbf{Note:}}\] Keytab files are generated on the authentication servers (KDCs) and contain a shared secret between the KDC server and the DDR.
   \[\text{\textbf{NOTICE}}\] A keytab file must be uploaded and imported for Kerberos authentication to operate correctly.
7. Click Finish.
   The system displays the configuration information in the Active Directory/Kerberos Authentication panel.

Disabling Kerberos authentication
Disabling Kerberos authentication prevents CIFS and NFS clients from using Kerberos authentication. CIFS clients use Workgroup authentication.

Procedure
1. Select Administration > Access Management > Authentication.
   The Authentication view appears.
2. Expand the Active Directory/Kerberos Authentication panel.
3. Click **Configure...** next to Mode to start the configuration wizard.
   The Active Directory/Kerberos Authentication dialog appears.
4. Select **Disabled** and click **Next**.
   The system displays a summary page with changes appearing in bold text.
5. Click **Finish**.
   The system displays Disabled next to Mode in the Active Directory/Kerberos Authentication panel.

### Viewing Workgroup authentication information

Use the Workgroup Authentication panel to view Workgroup configuration information.

**Procedure**

1. Select **Administration > Access > Authentication**.
2. Expand the Workgroup Authentication panel.

### Configuring workgroup authentication parameters

Workgroup authentication parameters allow you to configure a Workgroup name and CIFS server name.

**Procedure**

1. Select **Administration > Access > Authentication**.
   The Authentication view appears.
2. Expand the Workgroup Authentication panel.
3. Click **Configure**.
   The Workgroup Authentication dialog appears.
4. For Workgroup Name, select **Manual** and enter a workgroup name to join, or use the default.
   The Workgroup mode joins a protection system to a workgroup domain.
5. For CIFS Server Name, select **Manual** and enter a server name (the DDR), or use the default.
6. Click **OK**.

### Viewing LDAP authentication information

The LDAP Authentication panel displays the LDAP configuration parameters and whether LDAP authentication is enabled or disabled.

**About this task**

Enabling LDAP allows you to use an existing OpenLDAP server or deployment with the protection system for system-level user authentication, NFSv4 ID mapping, NFSv3 Kerberos with LDAP, or NFSv4 Kerberos with LDAP.

**Procedure**

1. Select **Administration > Access > Authentication**.
   The Authentication view appears.
2. Expand the LDAP Authentication panel.

Enabling and disabling LDAP authentication

Use the LDAP authentication panel to enable, disable, or reset LDAP authentication.

Procedure

1. Select Administration > Access > Authentication.
   The Authentication view appears.

2. Expand the LDAP authentication panel.

3. Click Enable next to LDAP Status to enable or Disable to disable LDAP Authentication.
   The Enable or Disable LDAP authentication dialog box appears.
   ![Note: An LDAP server must exist before enabling LDAP authentication.]

4. Click OK.

Resetting LDAP authentication.

The Reset button disables LDAP authentication and clears the LDAP configuration information.

Configuring LDAP authentication

Use the LDAP authentication panel to configure LDAP authentication.

Procedure

1. Select Administration > Access > Authentication.
   The Authentication view appears.

2. Expand the LDAP Authentication panel.

3. Click Configure.
   The Configure LDAP Authentication dialog box appears.

4. Specify the base suffix in the Base Suffix field.
5. Specify the account name to associate with the LDAP server in the Bind DN field.
6. Specify the password for the Bind DN account in the Bind Password field.
7. Optionally select Enable SSL.
8. Optionally select Demand server certificate to require the protection system to import a CA certificate from the LDAP server.
9. Click OK.
10. If necessary at a later time, click Reset to return the LDAP configuration to its default values.

Specifying LDAP authentication servers

Use the LDAP authentication panel to specify LDAP authentication servers.

Before you begin

LDAP authentication must be disabled before configuring an LDAP server.
About this task

**Note:** DD SM performance when logging in with LDAP will decrease as the number of hops between the system and the LDAP server increases.

**Procedure**

1. Select Administration > Access > Authentication.
   
   The Authentication view appears.

2. Expand the LDAP authentication panel.

3. Click the + button to add a server.

4. Specify the LDAP server in one of the following formats:
   * IPv4 address—10.26.16.250
   * IPv6 address—[::ffff:9.53.96.21]
   * Hostname—myldapserver

5. Click OK.

Configuring LDAP groups

Use the LDAP authentication panel to configure LDAP groups.

**About this task**

LDAP group configuration only applies when using LDAP for user authentication on the protection system.

**Procedure**

1. Select Administration > Access > Authentication.
   
   The Authentication view appears.

2. Expand the LDAP authentication panel.

3. Configure the LDAP groups in the LDAP Group table.
   
   - To add an LDAP group, click Add (+), enter the LDAP group name and role, and click OK.
   
   - To modify an LDAP group, select the checkbox of the group name in the LDAP group list and click Edit (pencil). Change the LDAP group name and click OK.
   
   - To remove an LDAP group, select the LDAP group in the list and click Delete (X).

Using the CLI to configure LDAP authentication

You can use the CLI to configure an existing OpenLDAP server or deployment with a protection system for system-level user authentication, NFSv4 ID mapping, NFSv3 Kerberos with LDAP, or NFSv4 Kerberos with LDAP.

**Configure LDAP servers**

You can configure one or more LDAP servers at the same time.

**About this task**

**Note:** LDAP must be disabled when making any changes to the configuration.

Specify the LDAP server in one of the following formats:
- IPv4 address—10. <A>. <B>. <C>
- IPv4 address with port number—10. <A>. <B>. <C>:400
- IPv6 address—[:ffff:9.53.96.21]
- IPv6 address with port number—[:ffff:9.53.96.21]:400
- Hostname—myldapserver
- Hostname with port number—myldapserver:400

When configuring multiple servers:
- Separate each server with a space.
- The first server listed when using the `authentication ldap servers add` command becomes the primary server.
- If any of the servers cannot be configured, the command fails for all servers listed.

Procedure

1. Add one or more LDAP servers by using the `authentication ldap servers add` command:

```
# authentication ldap servers add 10.A.B.C 10.X.Y.Z:400
LDAP server(s) added
LDAP Server(s): 2
#   IP Address/Hostname
---   ---------------------
1. 10.A.B.C (primary)
2. 10.X.Y.Z:400
---   ---------------------
```

2. Remove one or more LDAP servers by using the `authentication ldap servers del` command:

```
# authentication ldap servers del 10.X.Y.Z:400
LDAP server(s) deleted.
LDAP Servers: 1
#   Server
- -----------------   ---------
1  10.A.B.C (primary)
```

3. Remove all LDAP servers by using the `authentication ldap servers reset` command:

```
# authentication ldap servers reset
LDAP server list reset to empty.
```

Configure the LDAP base suffix

The base suffix is the base DN for search and is where the LDAP directory begins searching.

Procedure

1. Set the LDAP base suffix by using the `authentication ldap base set` command:

```
# authentication ldap base set "dc=anvil,dc=team"
LDAP base-suffix set to "dc=anvil,dc=team".
```

2. Reset the LDAP base suffix by using the `authentication ldap base reset` command:

```
# authentication ldap base reset
LDAP base-suffix reset to empty.
```
Configure LDAP client authentication

Configure the account (Bind DN) and password (Bind PW) that is used to authenticate with the LDAP server and make queries.

About this task

You should always configure the Bind DN and password. Normally, LDAP servers require authenticated bind by default. If client-auth is not set, anonymous access is requested, providing no name or password. The output of authentication ldap show is as follows:

```
# authentication ldap show
LDAP configuration
   Enabled:         yes (*)
   Base-suffix:     dc=u2,dc=team
   Binddn:          (anonymous)
   Server(s):       1
   ---------------   ---------
   1  10.207.86.160   (primary)
Secure LDAP configuration
   SSL Enabled:     no
   SSL Method:      off
   tls_reqcert:     demand
```

(*) Requires a filesystem restart for the configuration to take effect.

If binddn is set using client-auth CLI, but bindpw is not provided, unauthenticated access is requested.

```
# authentication ldap client-auth set binddn "cn=Manager,dc=u2,dc=team"
Enter bindpw:
** Bindpw is not provided. Unauthenticated access would be requested.
LDAP client authentication binddn set to "cn=Manager,dc=u2,dc=team".
```

Procedure

1. Set the Bind DN and password by using the authentication ldap client-auth set binddn command:

   ```
   # authentication ldap client-auth set binddn "cn=Administrator,cn=Users,dc=anvil,dc=team"
Enter bindpw:
   LDAP client authentication binddn set to "cn=Administrator,cn=Users,dc=anvil,dc=team".
   ```

2. Reset the Bind DN and password by using the authentication ldap client-auth reset command:

   ```
   # authentication ldap client-auth reset
   LDAP client authentication configuration reset to empty.
   ```

Enable LDAP

Before you begin

An LDAP configuration must exist before enabling LDAP. Additionally, you must disable NIS, ensure that the LDAP server is reachable, and be able to query the root DSE of the LDAP server.

Procedure

1. Enable LDAP by using the authentication ldap enable command:

   ```
   # authentication ldap enable
   ```
The details of the LDAP configuration are displayed for you to confirm before continuing. To continue, type `yes` and restart the file system for LDAP configuration to take effect.

2. View the current LDAP configuration by using the `authentication ldap show` command:

```
# authentication ldap show
LDAP configuration
  Enabled:   no
  Base-suffix:  dc=anvil,dc=team
  Binddn:    cn=Administrator,cn=Users,dc=anvil,dc=team
  Server(s):  2
#   Server   ----------------   --------
1  10.26.16.250       (primary)
2  10.26.16.251:400
#   ----------------   --------

Secure LDAP configuration
  SSL Enabled:      no
  SSL Method:       off
  tls_reqcert:      demand
```

Basic LDAP and secure LDAP configuration details are displayed.

3. View the current LDAP status by using the `authentication ldap status` command:

```
# authentication ldap status
The LDAP status is displayed. If the LDAP status is not good, the problem is identified in the output. For example:
```

```
# authentication ldap status
Status: invalid credentials
```

or

```
# authentication ldap status
Status: invalid DN syntax
```

4. Disable LDAP by using the `authentication ldap disable` command:

```
# authentication ldap disable
LDAP is disabled.
```

Enable secure LDAP

You can configure DDR to use secure LDAP by enabling SSL.

Before you begin

If there is no LDAP CA certificate and `tls_reqcert` is set to `demand`, the operation fails. Import an LDAP CA certificate and try again.

If `tls_reqcert` is set to `never`, an LDAP CA certificate is not required. For more information, see Configure LDAP server certificate verification with imported CA certificates on page 98.

Procedure

1. Enable SSL by using the `authentication ldap ssl enable` command:

```
# authentication ldap ssl enable
Secure LDAP is enabled with ‘ldaps’ method.
```

The default method is secure LDAP, or `ldaps`. You can specify other methods, such as TLS:

```
# authentication ldap ssl enable method start_tls
Secure LDAP is enabled with ‘start_tls’ method.
```
2. Disable SSL by using the `authentication ldap ssl disable` command:

```
# authentication ldap ssl disable
Secure LDAP is disabled.
```

Configure LDAP server certificate verification with imported CA certificates
You can change the TLS request certificate behavior.

Procedure

1. Change the TLS request certificate behavior by using the `authentication ldap ssl set tls_reqcert` command.

   Do not verify the certificate:
   
   ```
   # authentication ldap ssl set tls_reqcert never
   "tls_reqcert" set to "never". LDAP server certificate will not be verified.
   ```

   Verify the certificate:
   
   ```
   # authentication ldap ssl set tls_reqcert demand
   "tls_reqcert" set to "demand". LDAP server certificate will be verified.
   ```

2. Reset the TLS request certificate behavior by using the `authentication ldap ssl reset tls_reqcert` command. The default behavior is demand:

   ```
   # authentication ldap ssl reset tls_reqcert
   tls_reqcert has been set to "demand". LDAP Server certificate will be verified with imported CA certificate.Use "adminaccess" CLI to import the CA certificate.
   ```

Manage CA certificates for LDAP
You can import or delete certificates and show current certificate information.

Procedure

1. Import a CA certificate for LDAP server certificate verification by using the `adminaccess certificate import` command.

   ```
   Specify ldap for ca application:
   
   # adminaccess certificate import {host application {all | aws-federal | ddboost | https | keysecure | <application-list>}} [ca application {all | cloud | ddboost | ldap | login-auth | keysecure | <application-list>}] [file <file-name>]
   ```

2. Delete a CA certificate for LDAP server certificate verification by using the `adminaccess certificate delete` command.

   ```
   Specify ldap for application:
   
   # adminaccess certificate delete {subject <subject-name> | fingerprint <fingerprint>} [application {all | aws-federal | cloud | ddboost | ldap | login-auth | https | keysecure | support | <application-list>}]}
   ```

3. Show current CA certificate information for LDAP server certificate verification by using the `adminaccess certificate show` command:

   ```
   # adminaccess certificate show imported-ca application ldap
   ```
Viewing NIS authentication information
The NIS Authentication panel displays the NIS configuration parameters and whether NIS authentication is enabled or disabled.

Procedure
1. Select Administration > Access > Authentication.
   The Authentication view appears.
2. Expand the NIS Authentication panel.

Enabling and disabling NIS authentication
Use the NIS Authentication panel to enable and disable NIS authentication.

Procedure
1. Select Administration > Access > Authentication.
   The Authentication view appears.
2. Expand the NIS Authentication panel.
3. Click Enable next to NIS Status to enable or Disable to disable NIS Authentication.
   The Enable or Disable NIS dialog box appears.
4. Click OK.

Configuring the NIS domain name
Use the NIS Authentication panel to configure the NIS domain name.

Procedure
1. Select Administration > Access > Authentication.
   The Authentication view appears.
2. Expand the NIS Authentication panel.
3. Click Edit next to Domain Name to edit the NIS domain name.
   The Configure NIS Domain Name dialog box appears.
4. Enter the domain name in the Domain Name box.
5. Click OK.

Specifying NIS authentication servers
Use the NIS Authentication panel to specify NIS authentication servers.

Procedure
1. Select Administration > Access > Authentication.
   The Authentication view appears.
2. Expand the NIS Authentication panel.
3. Below Domain Name, select one of the following:
   - **Obtain NIS Servers from DHCP** The system automatically obtains NIS servers using DHCP
Manually Configure

Use the following procedures to manually configure NIS servers.

- **To add an authentication server, click Add (+) in the server table, enter the server name, and click OK.**
- **To modify an authentication server, select the authentication server name and click the edit icon (pencil). Change the server name, and click OK.**
- **To remove an authentication server name, select a server, click the X icon, and click OK.**

4. Click OK.

### Configuring NIS groups

Use the NIS Authentication panel to configure NIS groups.

**Procedure**

1. Select **Administration > Access > Authentication.**
   
   The Authentication view appears.

2. Expand the NIS Authentication panel.

3. Configure the NIS groups in the NIS Group table.
   
   - **To add a NIS group, click Add (+), enter the NIS group name and role, and click Validate.**
     
     Click OK to exit the add NIS group dialog box. Click OK again to exit the **Configure Allowed NIS Groups** dialog box.
   
   - **To modify an NIS group, select the checkbox of the NIS group name in the NIS group list and click Edit (pencil). Change the NIS group name, and click OK.**
   
   - **To remove an NIS group name, select the NIS group in the list and click Delete X.**

4. Click OK.

### Configuring SSO authentication

The Single Sign-On (SSO) panel displays the SSO configuration parameters and whether SSO is enabled or disabled. Configuring SSO requires action on both the protection system and the SSO provider. SSO is supported on physical protection systems, and locally installed DD VE instances. Cloud-based DD VE instances are not supported.

**About this task**

SSO allows you to register a protection system with a supported SSO provider to use the SSO provider credentials for system-level user authentication. Logging in using single sign-on (SSO) on page 23 describes how to log in using SSO after SSO is configured, an SSO user group is created, and SSO is enabled.

**Note:** Data Protection Central (DPC) is the only supported SSO provider. DPC version 19.1 is required to use SSO.

**Procedure**

1. Select **Administration > Access > Authentication.**
   
   The Authentication view appears.

2. Expand the Single Sign-On (SSO) panel.

### Registering the protection system in Data Protection Central (DPC)

**About this task**

Complete the following steps to register the protection system in DPC.
Procedure
1. Log in to the DPC and navigate to the System Management.
2. Add the system to DPC.
   ![Note] DPC requires sysadmin credentials for the system.
3. Refresh the Single Sign-On (SSO) panel in DD SM to confirm that the system is registered with DPC.

Enabling and disabling SSO
Use the Single Sign-On (SSO) panel to enable or disable SSO.

Procedure
1. Select Administration > Access > Authentication.
   The Authentication view appears.
2. Expand the Single Sign-On (SSO) panel.
3. Click Enable next to Single Sign-On Status to enable or Disable to disable SSO.
   The Enable or Disable SSO dialog box appears.
4. Click OK.

Configuring Single Sign-On (SSO) groups
Use the Single Sign-On (SSO) panel to configure SSO user groups.

About this task
At least one SSO user group is required to use SSO functionality.

Procedure
1. Select Administration > Access > Authentication.
   The Authentication view appears.
2. Expand the Single Sign-On (SSO) panel.
3. Configure the SSO user groups in the table.
   - To add an SSO user group, click Add (+), enter the SSO user group name and domain name, select the management role, and click OK.
     ![Note] Admin users can set a group management role to user, admin, backup-operator, or limited-admin. Limited-admin users can set a group management role to user or backup operator.
   - If a group name belongs to multiple domains, set up the same group name with all domain names on the protection system with the desired role, or make sure the domain name the user will log in with is configured on system with the desired role. This is important for Active Directory configurations with child or sub domains.
   - To modify an SSO user group, select the checkbox of the group name in the SSO group list and click Edit (pencil). Change the management role and click OK.
   - To remove an SSO user group, select the group in the list and click Delete (X).
Diagnosing authentication issues

DD OS provides the ability to diagnose authentication issues for Active Directory from within the DD System Manager interface.

Procedure

1. Select Administration > Access > Authentication
2. Expand the Active Directory/Kerberos Authentication panel.
3. Click Diagnose.
4. Select an issue to investigate, and click Diagnose.
5. Provide the requested information.
   - To diagnose issues logging in as an Active Directory user, provide:
     - Active Directory server IP address
     - Active Directory server FQDN
     - Active Directory service username
     Note: The Active Directory user account specified here requires the following privileges:
       - Read-only access to the base DN identified by the domain name.
       - Read-only access to query attributes of all users in the base DN.
       - Read-only access to query attributes of the machine account for the protection system.
     - Active Directory service password
     - Username experiencing login failure
   - To diagnose issues joining the system to an Active Directory Domain, provide:
     - Active Directory server IP address
     - Active Directory server FQDN
     - Active Directory service username
     - Active Directory service password
6. Click Diagnose.
7. View the report.
   - Click View Report to view the report online. Each item in the Action Items table can be clicked for additional details.
   - Click Download to download a copy of the report.
8. Review and implement the suggested fixes for the issue, and retry the operation.

Change system authentication method

The protection system supports password-based authentication, or certificate-based authentication. Password-based authentication is the default method.

Before you begin
Certificate-based authentication requires SSH keys and CA certificates are imported to allow users to authenticate with the system when password-based authentication is disabled.
About this task
Complete the following steps to change the system authentication method from password-based authentication to certificate-based authentication.

Procedure
1. Select Administration > Access.
   The Access Management view appears.
2. Click Manage CA Certificates.
3. Click Add to create a new certificate.
4. Add the certificate.
   - Select I want to upload the certificate as a .pem file and click Choose File to select the certificate file and upload it to the system.
   - Select I want to copy and paste the certificate text to copy and paste the certificate text into the text field.
5. Click Add.
6. Select More Tasks > Change Login Options.
7. In the Password Based Login drop-down menu, select Disable.
   Note: The drop-down menu is disabled if the required SSH keys and CA certificates are not configured on the system
8. Click OK.
   If a security policy is configured, the system prompts for security officer credentials. Provide the credentials and click OK.

Reset the system authentication method to password-based authentication.

About this task
Complete the following steps to change the system authentication method from certificate-based authentication to password-based authentication.

Procedure
1. Select Administration > Access.
   The Access Management view appears.
2. Select More Tasks > Change Login Options.
3. In the Password Based Login drop-down menu, select Enable.
4. Click OK.
   If a security policy is configured, the system prompts for security officer credentials. Provide the credentials and click OK.

Reset the iDRAC password

If the iDRAC password for DD3300, DD6900, DD9400, and DD9900 systems is lost or forgotten, it is possible to reset the password to the factory default setting.

About this task
The Data Domain system requires that the Integrated Dell Remote Access Controller (iDRAC) is configured for system upgrade and maintenance operations. Additionally, the system supports the use of iDRAC to change security settings, and remotely power the system on and off.
CAUTION Do not use iDRAC to change the storage configuration, system settings, or BIOS settings, as making changes will impact system functionality. Contact Support if changes are required in any of these areas.

Procedure
1. Connect to the system serial console or connect KVM to the system.
2. Reboot the system.
3. During the system boot process, press F2 to access the BIOS menu.
4. Select iDRAC Settings.
5. Select Reset iDRAC configurations to defaults all.
6. Select Yes to confirm the reset.
7. Select Continue.
8. Exit the BIOS and reboot.

Results
The iDRAC configuration resets to the following username and password:
- Username: root
- Password: calvin

Viewing active users
The Active Users tab displays the names of users who are logged into the system and statistics about the current user sessions.

Procedure
1. Select Administration > Access > Active Users.
   The Active Users list appears and displays information for each user.

   Note: To manage local users, click Go to Local Users.
CHAPTER 9

Upgrading the System

This chapter presents the following topics:

- Managing system upgrades ................................................................. 106
- Viewing and obtaining upgrade packages ........................................... 106
- Preparing the system for upgrade ....................................................... 107
- Upgrading the DD system using DD System Manager ...................... 109
- Upgrading HA systems ..................................................................... 110
- Removing an upgrade package ......................................................... 111
- Troubleshooting upgrade errors ....................................................... 112
Managing system upgrades

To ensure that the state of your system can accommodate a successful upgrade, complete the preparation steps outlined in the following sections. After you have verified that the upgrade can complete, transfer the software to the system to be upgraded, and then start the upgrade.

HA system upgrades

The upgrade process on an HA system automatically upgrades both the active and standby nodes. The HA nodes are upgraded one at a time. The standby node is rebooted and upgraded first. The newly upgraded standby node then takes over the active role through an HA failover. After the failover, the second node is rebooted and assumes the role of the standby node after the upgrade.

For an HA system, transfer the software to the active node and start the upgrade from the active node. Use the floating IP address to access DD System Manager to perform software upgrades.

System upgrade operations that require data conversion cannot start until both systems are upgraded to the same level and HA state is fully restored.

Minimally disruptive upgrade

The minimally disruptive upgrade (MDU) feature lets you upgrade specific software components or apply bug fixes without needing to perform a system reboot.

The MDU feature can prevent significant downtime during software upgrades, because the upgrade disrupts only those services that depend on the component being upgraded.

Not all software components qualify for an MDU; some components must be upgraded as part of a regular DD OS system software upgrade.

- A DD OS software upgrade uses a large RPM (upgrade bundle), which performs upgrade actions for all of the components of DD OS.
- MDU uses smaller component bundles, which upgrade specific software components individually. The MDU RPM is much smaller than a full DD OS RPM.

Contact Support to determine if an MDU is available for a specific issue.

Support software

Support software is an MDU package created and signed by Support Engineering to address specific issues.

By default, the DD system does not allow support software to be installed on the system. Contact Support for more information about support software.

Viewing and obtaining upgrade packages

DD System Manager allows you to view and manage up to five upgrade packages on the DD OS system. To upgrade the system, download an upgrade package from the Online Support site to a local computer, and then upload it to the target system.

About this task

Note: You can use FTP, NFS, or SCP to copy an upgrade package to a system. You can manage an unlimited number of system upgrade packages through a network share linked to
the /ddvar/releases directory on the protection system. FTP is disabled by default. To use NFS, export and mount /ddvar from an external host.

Procedure

1. Select Maintenance > System. To view the MD5 and SHA256 checksums, select an upgrade package and click View Checksum.
2. To obtain an upgrade package, click the Dell EMC Online Support link, click Downloads, and use the search function to locate the recommended package for your system. Save the upgrade package to the local computer.
3. If more than four packages are listed in Upgrade Packages Available, remove at least one package before uploading the new package.
4. Click Upload Upgrade Package.
5. In the Upload Upgrade Package dialog box, click Browse, navigate to and select the file, and click Open.
6. Click OK.
   The .rpm file is downloaded and appears in the Upgrade Packages Available list.
7. To verify the upgrade package integrity, click View Checksum and compare the calculated checksum displayed in the dialog box to the authoritative checksum on the Online Support site.
8. To manually initiate an upgrade precheck, select an upgrade package and click Upgrade Precheck.

Preparing the system for upgrade

Perform these manual tasks before attempting an upgrade to avoid potential upgrade failure.

Before you begin
- Reboot the system.
- For HA systems, do not reboot the system until after completing the steps in this procedure.
- Review the section Troubleshooting upgrade errors on page 112 for other issues that can cause failure.

About this task
These tasks are not performed automatically by any process.

Table 4 Prepare the system for upgrade

<table>
<thead>
<tr>
<th>Step</th>
<th>Step description</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Check for current alerts and address any disk or hardware failures before upgrading.</td>
<td># alert show current</td>
</tr>
<tr>
<td>2.</td>
<td>Verify the system network configuration.</td>
<td># net show config</td>
</tr>
<tr>
<td></td>
<td></td>
<td># net show hardware</td>
</tr>
<tr>
<td>3.</td>
<td>Ensure that all network interfaces are up and have appropriate IP addresses.</td>
<td># net show settings</td>
</tr>
<tr>
<td>4.</td>
<td>Check the disk states, and do not perform the upgrade if the system is low on spares or has disks that show in the absent, failed, or reconstructing states.</td>
<td># disk show state</td>
</tr>
</tbody>
</table>
### Table 4 Prepare the system for upgrade (continued)

<table>
<thead>
<tr>
<th>Step</th>
<th>Step description</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td>Check the disk reliability, and replace any disks that have more than 50 reallocated sectors.</td>
<td># disk show reliability-data</td>
</tr>
<tr>
<td>6.</td>
<td>Check that the enclosure status is OK for all devices.</td>
<td># enclosure show all</td>
</tr>
<tr>
<td>7.</td>
<td>Check whether the enclosure topology is correct. Check whether any error appears with an asterisk (*) next to the enc.ctrl.port field. Also check the Error Message field for any errors such as A possible problem was detected for this shelf controller or the cable connected to it.</td>
<td># enclosure show topology</td>
</tr>
<tr>
<td>8.</td>
<td>Check that the device port mapping is correct.</td>
<td># system show hardware</td>
</tr>
<tr>
<td>9.</td>
<td>Check the link speed for connected ports.</td>
<td># system show ports</td>
</tr>
<tr>
<td>10.</td>
<td>Check the status of the file system to determine that file system is enabled and running normally.</td>
<td># filesys status</td>
</tr>
<tr>
<td>11.</td>
<td>Check if file system cleaning is running, and if so, stop it.</td>
<td># filesys clean status # filesys clean stop</td>
</tr>
<tr>
<td>12.</td>
<td>If replication is enabled, check its status.</td>
<td># replication status</td>
</tr>
<tr>
<td>13.</td>
<td>For a system enabled with Cloud Tier, ensure there is no data movement.</td>
<td># data-movement status # data-movement stop all</td>
</tr>
<tr>
<td>14.</td>
<td>Check if cloud cleaning is running, and if so, stop it.</td>
<td># cloud clean status # cloud clean stop</td>
</tr>
<tr>
<td>15.</td>
<td>Check if any backup and restore activity is in progress, and if so, stop it.</td>
<td># system show stats</td>
</tr>
<tr>
<td>16.</td>
<td>Run an Autosupport Report just prior to performing the DD OS upgrade to determine if the system reports errors that need to be resolved before the upgrade.</td>
<td># autosupport send &lt;your_email_address&gt;</td>
</tr>
<tr>
<td>17.</td>
<td>If the Autosupport Report indicated issues with the system, check kern.info log, and if you notice frequent failures in hardware, contact Support to inspect your system before you perform the upgrade. Search for the string ERROR in the log file.</td>
<td># log view debug/platform/kern.info</td>
</tr>
</tbody>
</table>

**After you finish**

For HA systems, follow the reboot instructions described in Upgrading HA systems on page 110.

**Automatic tasks performed by the upgrade script (in the .rpm file) prior to upgrade**

These tests precede the actual system upgrade process. The system:

1. Determines whether two different kinds of NVRAM cards are present.
2. Checks the /ddr partition and / (root) partition sizes for space utilization.
3. Checks the OST version.
4. Determines whether the RAID metagroup is assembled. If it is not assembled, the upgrade process does not begin.
5. Determines available space for the file system.
6. Determines whether sufficient space is available for the upgrade.
7. Checks the VTL version, if VTL is present.
8. Determines whether the file system is enabled, and if it is not enabled, enable it.
9. Determines whether VTL is enabled.
10. Checks the VTL pools to insure that they can be converted to MTrees.
11. Determines whether sufficient VTL space is available.
12. Ensures that the numbers of MTrees and VTL pools do not exceed 100.
13. Determines whether all dg0 disks are located on head unit. If not, the upgrade process does not begin, and the problem must be addressed.
14. Determines whether the file system can be shutdown without problems. If the file system cannot be shut down in a clean manner, the upgrade process will stop.

The upgrade process quits if it encounters a failure in any of the tasks listed.

Upgrading the DD system using DD System Manager

When an upgrade package file is present on the system, you can use DD System Manager to perform an upgrade using that upgrade package.

Before you begin

- Read the DD OS Release Notes for the complete upgrade instructions and coverage of all the issues that can impact the upgrade.
- Log out of any CLI sessions on the system where the upgrade is to be performed.
- Reboot the system to verify that the hardware is in a clean state. Resolve any issues discovered during the reboot. For an MDU upgrade, a reboot might not be needed.

About this task

Note: This topic assumes that you are updating only DD OS. If you make hardware changes, such as adding, swapping, or moving interface cards, you must update the DD OS configuration to correspond with the hardware changes.

Procedure

1. Log into DD System Manager on the protection system where the upgrade is to be performed.
2. Select Maintenance > System.
3. From the Upgrade Packages Available list, select the package to use for the upgrade.
   
   Note: You must select an upgrade package for a newer version of DD OS. DD OS does not support downgrades to previous versions.

4. Click Perform System Upgrade.
   
   The System Upgrade dialog box appears and displays information about the upgrade and a list of users who are currently logged in to the system to be upgraded.

5. Verify the version of the upgrade package, and click OK to continue with the upgrade.

   The System Upgrade dialog box displays the upgrade status and the time remaining.
   
   Wait for the upgrade to complete before using DD System Manager to manage the system. If the system restarts, the upgrade might continue after the restart, and DD System Manager displays the upgrade status after login. If possible, keep the System Upgrade
progress dialog box open until the upgrade completes or the system restarts. A Login link appears when the upgrade is complete.

**Note:** To view the status of an upgrade using the CLI, enter the `system upgrade status` command. Log messages for the upgrade are stored in `/ddvar/log/debug/platform/upgrade-error.log` and `/ddvar/log/debug/platform/upgrade-info.log`.

6. If the system powers down, you must remove AC power from the system to clear the prior configuration. Unplug all power cables for 30 seconds, and then plug them back in. The system powers on and restarts.

7. If the system does not automatically power on and there is a power button on the front panel, press the button.

**After you finish**

The following requirements might apply after completing an upgrade.

- For environments that use self-signed SHA256 certificates, do the following:
  
  1. Run the `adminaccess certificate generate self-signed-cert regenerate-ca` command to regenerate the self-signed CA and host certificates. Regenerating the certificates breaks existing trust relationships with external systems.
  2. Run the `adminaccess trust add host hostname type mutual` command to reestablish mutual trust between the protection system and the external system.

- If the system shows existing or configured FC ports with missing WWPN or WWNN information, or reports that no FC host bus adapter (HBA) driver is installed, run the `scsitarget endpoint enable all` command.

**Note:** With collection replication, no files are visible on the destination system if replication was not finished before starting the upgrade. After the upgrade, wait until replication completes to see files on the destination system.

## Upgrading HA systems

HA systems require additional steps before and after the upgrade operation.

**Before you begin**

Perform the manual checks described in *Preparing the system for upgrade* on page 107 before rebooting the HA system.

**About this task**

When upgrading an HA system, upload the upgrade RPM package to the active node.

**Procedure**

1. Run the `ha status` command to verify the HA system state.

   The HA system must be in a highly available state, with both nodes online before performing the DD OS upgrade.

```bash
# ha status
HA System Name: dd9900-ha3a.example.com
HA System Status: highly available

<table>
<thead>
<tr>
<th>Node Name</th>
<th>Node ID</th>
<th>Role</th>
<th>HA State</th>
</tr>
</thead>
<tbody>
<tr>
<td>dd9900-ha3a-p0.example.com</td>
<td>0</td>
<td>active</td>
<td>online</td>
</tr>
<tr>
<td>dd9900-ha3a-p1.example.com</td>
<td>1</td>
<td>standby</td>
<td>online</td>
</tr>
</tbody>
</table>
```
2. Reboot the standby node (node 1).
3. Run the `ha status` command to verify that the HA system status is highly available.
4. Run the `ha failover` command to initiate a failover from the active node to the standby node.
5. Run the `ha status` command to verify that node 1 is the active node and node 0 is the standby node.

```bash
# ha status
HA System Name: dd9900-ha3a.example.com
HA System Status: highly available
Node Name                  Node ID   Role      HA State
-------------------------- --------- --------- --------
dd9900-ha3a-p0.example.com   0       standby   online
dd9900-ha3a-p1.example.com   1       active    online
-------------------------- --------- --------- --------
```

6. Reboot the standby node (node 0).
7. Run the `ha status` command to verify that the HA system status is highly available.
8. Run the `ha failover` command to initiate a failover from the active node to the standby node.
9. Run the `ha status` command to verify that node 0 is the active node and node 1 is the standby node.

```bash
# ha status
HA System Name: dd9900-ha3a.example.com
HA System Status: highly available
Node Name                  Node ID   Role      HA State
-------------------------- --------- --------- --------
dd9900-ha3a-p0.example.com   0       active    online
dd9900-ha3a-p1.example.com   1       standby   online
-------------------------- --------- --------- --------
```

10. Initiate the upgrade from the active node.
    DD OS automatically recognizes the HA system and performs the upgrade procedure on both nodes. The HA upgrade runs in the following sequence:
    a. The standby node is upgraded, then reboots.
    b. The HA system initiates a failover and the standby node takes over as the active node.
    c. The original active node is upgraded, then reboots and remains as the standby node.

**Results**

After both nodes are upgraded, the system does not perform another failover to return the nodes to their original configuration.

**After you finish**

After the upgrade procedure is complete, run the `ha status` command again to verify that the system is in a highly available state, and both nodes are online.

Optionally run the `ha failover` command to return the nodes to their pre-upgrade roles.

## Removing an upgrade package

Use this procedure to make room for a new upgrade package.

**Procedure**

1. Select Maintenance > System.
2. From the list titled Upgrade Packages Available on <protection system>, select the package to remove. One package can be removed at a time.

3. Click Remove Upgrade Package.

Troubleshooting upgrade errors

DD OS upgrade performs certain tests before a system upgrade. If a test fails, the upgrade could fail.

The following circumstances could cause the upgrade to fail:

Running tasks

- A replication initialization is in progress.
- The file system did not shutdown cleanly, resulting in a core dump.
- A previous upgrade did not complete successfully.

Configuration issues

- The system is not configured correctly. For example, NFS mount points were manually created under root.
- Inspection of digests and signatures that are contained in .rpm file indicates that the signature is not valid. The valid signatures are SHA1 or MD5.
- NFS mount points are unknown.
- The RAID metagroup is not assembled.
- All dg0 disks are not located on the head unit.
- The file system cannot be shut down in a clean manner.
- Two different kinds of NVRAM cards are present.
- The OST version is not compatible.
- A VTL version is incompatible.
- The file system is not enabled and cannot be enabled automatically.
- VTL is not enabled.
- A check of the VTL pools indicates that they cannot be converted to MTrees.
- Features are incompatible between the original and target versions of DD OS:
  - DD OS versions 7.0 and later do not support DD Extended Retention. Any system with DD Extended Retention enabled cannot be upgraded to DD OS 7.0. Migrate the data to a system running DD OS 6.1.X or 6.2.X without DD Extended Retention running. After the migration, upgrade the DD OS 6.1.X or 6.2.X system without DD Extended Retention to DD OS 7.0.
  - DD OS versions 7.0 and later do not support the RSA key manager for data at rest encryption. If a DD OS 6.X system uses the RSA key manager for data at rest encryption, upgrades to DD OS 7.0 and later are not permitted. Disable data at rest encryption to proceed with the DD OS upgrade.
  - DD OS versions 7.0 and later use a newer version of OpenSSH than DD OS versions 6.2 and earlier. Upgrades to DD OS 7.0 will overwrite unsupported cipher-list and mac-list values with the default values for DD OS versions 7.0 and later, and the commands to set cipher-list and mac-list values will fail with error messages when unsupported values are specified after the upgrade.
Space issues

- Storage is functionally deficient, such as an enclosure is missing.
- The / (root) or /ddr partition is full with log files, core dumps, and so forth.
- Available space for the file system is insufficient.
- Available space for the upgrade is insufficient.
- Available space for VTL is insufficient.
- The number of MTrees or VTL pools exceeds 100.

Slow connection

**Note:** For security reasons, there is a 30-minute time limit for the upload of RPM packages for DDMC and DD system upgrades using the DDMC GUI. If you have a slow connection from a client machine to the DDMC and the upload takes more than 30 minutes, the connection drops and you cannot use DDMC to upload the package.

Workaround: Use the CLI to upload the package into DDMC (for example, use `SCP/PSCP` from a Unix terminal or Windows CMD).

For DDMC upgrades, upload the package to `/ddr/var/releases`.
For DD System upgrades, upload the package to `/ddr/var/ddr-releases`. 
CHAPTER 10
Managing Network Connections

This chapter presents the following topics:

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- Managing network interfaces ............................................................... 116
- General network settings management ................................................ 129
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Managing network connections

Network connection management features allow you view and configure network interfaces, general network settings, and network routes.

Managing HA system network connections

The HA system relies on two different types of IP addresses: fixed and floating. Each type has specific behaviors and limitations.

On an HA system, fixed IP addresses:

- Are used for node management via the CLI
- Are attached ("fixed") to the node
- Can be static or DHCP, IPv6 SLAAC, and IPv6 Linklocal

**Note:** SLAAC and Linklocal are auto-generated addresses that appear when the interface is in a running state. Users have no control over these addresses, but they are available to transfer data.

- Configuration is done on the specific node with the `type fixed` argument

**Note:** All file system access should be done through a floating IP address.

Floating IP addresses exist only in the two-node HA system. During failover, the IP addresses "float" to the new active node and are:

- Only configured on the active node
- Used for file system access and most configuration
- Can only be static
- Configuration requires the `type floating` argument

Managing network interfaces

You can manage the physical interfaces that connect the system to a network and create logical interfaces to support link aggregation, load balancing, and link or node failover.

Viewing interface information

The Interfaces tab enables you to manage physical and virtual interfaces, VLANs, DHCP, DDNS, and IP addresses and aliases.

About this task

Consider the following guidelines when managing IPv6 interfaces.

- The command-line interface (CLI) supports IPv6 for basic network, replication, and backup commands. CLI commands manage the IPv6 addresses. You can set and view IPv6 addresses using the DD System Manage.
- Collection, directory, and MTree replication are supported over IPv6 networks, which allows you to take advantage of the IPv6 address space. Simultaneous replication over IPv6 and IPv4 networks is also supported, as is Managed File Replication using DD Boost.
- There are some restrictions for interfaces with IPv6 addresses. For example, the minimum MTU is 1280. If you try to set the MTU lower than 1280 on an interface with an IPv6 address, an error message appears and the new MTU size is rejected. If you try to set an IPv6 address
on an interface with an MTU lower than 1280, an error message appears. An IPv6 address set
on a VLAN which is on a physical or virtual interface will impact that physical or virtual
interface. If the MTU of the physical or virtual is given an MTU less than 1280 but it has a
VLAN with an IPv6 address on it, the setting of the MTU will be rejected with an error
message. In addition, if the physical or virtual interface is has an MTU less than 1280 and an
associated VLAN interface is given an IPv6 address, that address is rejected because the base
MTU is too small.

Procedure

1. Select Hardware > Ethernet > Interfaces.
2. To filter the interface list by interface name, enter a value in the Interface Name field and
click Update.
   Filters support wildcards, such as eth*, veth*, or eth1*
3. To filter the interface list by interface type, select a value from the Interface Type menu and
click Update.
   On an HA system, there is a filter dropdown to filter by IP Address Type (Fixed, Floating, or
   Interconnect).
4. To return the interfaces table to the default listing, click Reset.
5. Select an interface in the table to populate the Interface Details area.
6. To view IPMI interface configuration and management options, click View IPMI Interfaces.
   This link displays the Maintenance > IPMI information.

Physical interface names

The layout of physical interface names varies on different protection systems and option cards.
The physical interface name format is ethXY, where X is the slot number for an on-board port or an
option card and Y is an alphanumeric string. For example, eth0a.

- DD4200, DD4500, and DD7200 systems provide one on-board Ethernet port, which is ethMa.
- DD6300, DD6800, and DD9300 systems provide one on-board 1G Base-T NIC port: ethMa.
- DD9500 and DD9800 systems provide four on-board 1G Base-T NIC ports: ethMa (bottom
  left), ethMb (top left), ethMc (bottom right), and ethMd (top right).
- For vertical I/O module NIC interfaces, the port numbering goes from top to bottom, with
  ethXa at the top.
- The vertical I/O module slots on the DD4200, DD4500, and DD7200 systems are inverted. The
  port numbering on the I/O modules in these slots goes from bottom to top, with with ethXa on
  the bottom.
- For most horizontal I/O module NIC interfaces, the port numbering goes from left to right,
  with ethXa on the left.
- The horizontal I/O module slots on the left-hand side (expansion riser 1) of the DD3300,
  DD6900, DD9400, and DD9900 systems are inverted. The port numbering on the I/O modules
  in these slots goes from right to left, with ethXa on the right.
General interface configuration guidelines

Review the general interface configuration guidelines before configuring system interfaces.

- When supporting both backup and replication traffic, if possible, use different interfaces for each traffic type so that neither traffic type impacts the other.
- When replication traffic is expected to be less than 1 Gb/s, if possible, do not use 10 GbE interfaces for replication traffic because 10 GbE interfaces are optimized for faster traffic.
- If a service uses a non-standard port and the user wants to upgrade to DD OS 7.0, or the user wants to change a service to use a non-standard port on a DD OS 7.0 system, add a net filter function for all the clients using that service to allow the client IP addresses to use the new port.
- For systems that use IPMI, if possible, reserve interface ethMa for IPMI traffic and system management traffic (using protocols such as HTTP, Telnet, and SSH). Backup data traffic should be directed to other interfaces.

Configuring physical interfaces

You must configure at least one physical interface before the system can connect to a network.

Procedure

1. Select Hardware > Ethernet > Interfaces.
2. Select an interface to configure.
3. Click Configure.
4. In the Configure Interface dialog box, determine how the interface IP address is to be set:
   - Use DHCP to assign the IP address—in the IP Settings area, select Obtain IP Address using DHCP and select either DHCPv4 for IPv4 access or DHCPv6 for IPv6 access. Setting a physical interface to use DHCP automatically enables the interface.
   - Specify IP Settings manually—in the IP Settings area, select Manually configure IP Address. The IP Address and Netmask fields become active.
   - If you chose to manually enter the IP address, enter an IPv4 or IPv6 address. If you entered an IPv4 address, enter a netmask address.
   - Specify Speed/Duplex settings.
      - The combination of speed and duplex settings define the rate of data transfer through the interface. Select one of these options:
• **Autonegotiate Speed/Duplex** — Select this option to allow the network interface card to autonegotiate the line speed and duplex setting for an interface. Autonegotiation is not supported on the following DD4200, D4500, DD6300, DD6800, DD7200, DD9300, DD9500, and DD9800 I/O modules:
  - Dual port 10GbE SR Optical with LC connectors (using SFPs)
  - Dual port 10GbE Direct Attach Copper (SFP+ cables)
  - Quad port 2 port 1GbE Copper (RJ45) /2 port 1Gbe SR Optical
  - **Autonegotiate Speed/Duplex** is required for all I/O modules on the DD6900, DD9400, and DD9900 systems:
    - Quad port 10GbE Base-T
    - Quad port 10GbE SFP+
    - Dual port 25GbE SFP28
    - Dual port 100GbE QSFP28

• **Manually configure Speed/Duplex** — Select this option to manually set an interface data transfer rate. Select the speed and duplex from the menus.
  
  **Note:** This option is not available on DD6900, DD9400, and DD9900 systems.
  - Duplex options are half-duplex, full-duplex, and unknown.
  - Speed options listed are limited to the capabilities of the hardware device. Options are 10 Mb, 100 Mb, 1000 Mb (1 Gb), 10 Gb, and unknown. The 10G Base-T hardware supports only the 100 Mb, 1000 Mb and 10 Gb settings.
  - Half-duplex is only available for 10 Mb and 100 Mb speeds.
  - 1 Gb and 10 Gb line speeds require full-duplex.
  - On DD4200, DD4500, and DD7200 10 GbE I/O modules, copper interfaces support only the 10 Gb speed setting.
  - The default setting for 10G Base-T interfaces is Autonegotiate Speed/Duplex. If you manually set the speed to 1000 Mb or 10 Gb, you must set the Duplex setting to Full.

7. Specify the MTU (Maximum Transfer Unit) size for the physical (Ethernet) interface.
   Do the following:
   - Click the Default button to return the setting to the default value.
   - Ensure that all of your network components support the size set with this option.

8. Optionally, select **Dynamic DNS Registration**.
   Dynamic DNS (DDNS) is a protocol that registers local IP addresses on a Domain Name System (DNS) server. In this release, DD System Manager supports Windows mode DDNS. To use UNIX mode DDNS, use the `net ddns` CLI command.
   The DDNS must be registered to enable this option.
   
   **Note:** This option disables DHCP for this interface.

9. Click **Next**.
   The Configure Interface Settings summary page appears. The values listed reflect the new system and interface state, which are applied after you click Finish.

10. Click **Finish** and **OK**.
MTU size values

The MTU size must be set properly to optimize the performance of a network connection. An incorrect MTU size can negatively affect interface performance.

Supported values for setting the maximum Transfer Unit (MTU) size for the physical (Ethernet) interface range from 350 to 9000 for IPv4, and 1280 to 9000 for IPv6. For 100 Base-T and gigabit networks, 1500 is the standard default.

Note: The minimum MTU for IPv6 interfaces is 1280. The interface fails if you try to set the MTU lower than 1280.

Moving a static IP address

A specific static IP address must be assigned to only one interface on a system. A static IP address must be properly removed from one interface before it is configured on another interface.

Procedure

1. If the interface that hosts the static IP address is part of a DD Boost interface group, remove the interface from that group.
2. Select Hardware > Ethernet > Interfaces.
3. Remove the static IP address that you want to move.
   a. Select the interface that is currently using the IP address you want to move.
   b. In the Enabled column, select No to disable the interface.
   c. Click Configure.
   d. Set the IP Address to 0.
   e. Click Next, and click Finish.
4. Add the removed static IP address to another interface.
   a. Select the interface to which you want to move the IP address.
   b. In the Enabled column, select No to disable the interface.
   c. Click Configure.
   d. Set the IP Address to the match the static IP address you removed.
   e. Click Next, and click Finish.
   f. In the Enabled column, select Yes to enable the updated interface.

Virtual interface configuration guidelines

Virtual interface configuration guidelines apply to failover and aggregate virtual interfaces. There are additional guidelines that apply to either failover or aggregate interfaces but not both.

- The virtual-name must be in the form vethx where x is a number. The recommended maximum number is 99 because of name size limitations.
- You can create as many virtual interfaces as there are physical interfaces.
- Each interface used in a virtual interface must first be disabled. An interface that is part of a virtual interface is seen as disabled for other network configuration options.
After a virtual interface is destroyed, the physical interfaces associated with it remain disabled. You must manually re-enable the physical interfaces.

The number and type of cards installed determines the number of Ethernet ports available.

Each physical interface can belong to one virtual interface.

A system can support multiple mixed failover and aggregation virtual interfaces, subject to the restrictions above.

Virtual interfaces must be created from identical physical interfaces. For example, all copper, all optical, all 1 Gb, or all 10 Gb. However, 1 Gb interfaces support bonding a mix of copper and optical interfaces. This applies to virtual interfaces across different cards with identical physical interfaces, except for Chelsio cards. For Chelsio cards, only failover is supported, and that is only across interfaces on the same card.

Failover and aggregate links improve network performance and resiliency by using two or more network interfaces in parallel, thus increasing the link speed for aggregated links and reliability over that of a single interface.

Remove functionality is available using the Configure button. Click a virtual interface in the list of interfaces on the Interfaces tab and click Configure. From the list of interfaces in the dialog box, clear the checkbox for the interface to remove it from bonding (failover or aggregate), and click Next.

For a bonded interface, the bonded interface is created with remaining slaves if the hardware for a slave interface fails. If no slaves, the bonded interface id created with no slaves. This slave hardware failure will generate managed alerts, one per failed slave.

**Note:** The alert for a failed slave disappears after the failed slave is removed from the system. If new hardware is installed, the alerts disappear and the bonded interface uses the new slave interface after the reboot.

On DD3300 DD4200, DD4500, and DD7200 systems, the ethMa interface does not support failover or link aggregation.

### Guidelines for configuring a virtual interface for link aggregation

Link aggregation provides improved network performance and resiliency by using one or more network interfaces in parallel, thus increasing the link speed and reliability over that of a single interface. These guidelines are provided to help you optimize your use of link aggregation.

- Changes to disabled Ethernet interfaces flush the routing table. It is recommended that you make interface changes only during scheduled maintenance downtime. Afterwards, re-configure the routing rules and gateways.
- Enable aggregation on an existing virtual interface by specifying the physical interfaces and mode and giving it an IP address.
- 10 Gb single-port optical Ethernet cards do not support link aggregation.
- 1 GbE and 10 GbE interfaces cannot be aggregated together.
- Copper and optical interfaces cannot be aggregated together.

### Guidelines for configuring a virtual interface for failover

Link failover provides improved network stability and performance by identifying backup interfaces that can support network traffic when the primary interface is not operating. These guidelines are provided to help you optimize your use of link failover.

- A primary interface must be part of the failover. If a primary interface removal is attempted from a failover, an error message appears.
When a primary interface is used in a failover configuration, it must be explicitly specified and
must also be a bonded interface to the virtual interface. If the primary interface goes down and
multiple interfaces are still available, the next interface is randomly selected.

All interfaces in a virtual interface must be on the same physical network. Network switches
used by a virtual interface must be on the same physical network.

The recommended number of physical interfaces for failover is greater than one. You can,
however, configure one primary interface and one or more failover interfaces, except with 10
Gb CX4 Ethernet cards, which are restricted to one primary interface and one failover
interface from the same card

Virtual interface creation

Create a virtual interface to support link aggregation or failover. The virtual interface serves as a
container for the links to be aggregated or associated for failover.

Creating a virtual interface for link aggregation

Create a virtual interface for link aggregation to serve as a container to associate the links that
participate in aggregation.

About this task

A link aggregation interface must specify a link bonding mode and may require a hash selection.
For example, you might enable link aggregation on virtual interface veth1 to physical interfaces
eth1 and eth2 in mode LACP (Link Aggregation Control Protocol) and hash XOR-L2L3.

Procedure

1. Select Hardware > Ethernet > Interfaces.
2. In the Interfaces table, disable the physical interface where the virtual interface is to be
   added by clicking No in the Enabled column.
3. From the Create menu, select Virtual Interface.
4. In the Create Virtual Interface dialog box, specify a virtual interface name in the veth
   box.
   Enter a virtual interface name in the form vethx, where x is a unique ID (typically one or two
digits). A typical full virtual interface name with VLAN and IP Alias is veth56.3999:199. The
maximum length of the full name is 15 characters. Special characters are not allowed.
   Numbers must be between 0 and 4094, inclusively.
5. In the Bonding Type list, select Aggregate.

   Note: Registry settings can be different from the bonding configuration. When
   interfaces are added to the virtual interface, the information is not sent to the bonding
   module until the virtual interface is given an IP address and brought up. Until that time
   the registry and the bonding driver configuration are different.
6. In the Mode list, select a bonding mode.

   Specify the mode that is compatible with the requirements of the system to which the
interfaces are directly attached.
   • Round-robin
     Transmit packets in sequential order from the first available link through the last in the
     aggregated group.
   • Balanced
     Data is sent over interfaces as determined by the hash method selected. This requires
     the associated interfaces on the switch to be grouped into an Ether channel (trunk) and
given a hash via the Load Balance parameter.
LACP
Link Aggregation Control Protocol is similar to Balanced, except that it uses a control protocol that communicates to the other end and coordinates which links within the bond are available for use. LACP provides a kind of heartbeat failover and must be configured at both ends of the link.

7. If you selected Balanced or LACP mode, specify a bonding hash type in the Hash list. Options are: XOR-L2, XOR-L2L3, or XOR-L3L4.

   XOR-L2 transmits through a bonded interface with an XOR hash of Layer 2 (inbound and outbound MAC addresses).
   XOR-L2L3 transmits through a bonded interface with an XOR hash of Layer 2 (inbound and outbound MAC addresses) and Layer 3 (inbound and outbound IP addresses).
   XOR-L3L4 transmits through a bonded interface with an XOR hash of Layer 3 (inbound and outbound IP addresses) and Layer 4 (inbound and outbound ports).

8. To select an interface to add to the aggregate configuration, select the checkbox that corresponds to the interface, and then click Next.

   The Create virtual interface veth_name dialog box appears.

9. Enter an IP address, or enter 0 to specify no IP address.

10. Enter a netmask address or prefix.

11. Specify Speed/Duplex options.

   The combination of speed and duplex settings define the rate of data transfer through the interface. Select either:

   - **Autonegotiate Speed/Duplex**
     Select this option to allow the network interface card to autonegotiate the line speed and duplex setting for an interface.

   - **Manually configure Speed/Duplex**
     Select this option to manually set an interface data transfer rate.

     - Duplex options are half-duplex or full-duplex.
     - Speed options listed are limited to the capabilities of the hardware device. Options are 10 Mb, 100 Mb, 1000 Mb, and 10 Gb.
     - Half-duplex is only available for 10 Mb and 100 Mb speeds.
     - 1000 Mb and 10 Gb line speeds require full-duplex.
     - Optical interfaces require the Autonegotiate option.
     - The 10 GbE copper NIC default is 10 Gb. If a copper interface is set to 1000 Mb or 10 Gb line speed, duplex must be full-duplex.

12. Specify the MTU setting.

   - To select the default value (1500), click Default.
   - To select a different setting, enter the setting in the MTU box. Ensure that all of your network components support the size set with this option.

13. Optionally, select Dynamic DNS Registration option.

   Dynamic DNS (DDNS) is a protocol that registers local IP addresses on a Domain Name System (DNS) server. In this release, DD System Manager supports Windows mode DDNS. To use UNIX mode DDNS, use the `net ddns` CLI command.

   The DDNS must be registered to enable this option.
14. Click **Next**.
   The Configure Interface Settings summary page appears. The values listed reflect the new system and interface state.

15. Click **Finish** and **OK**.

Creating a virtual interface for link failover

Create a virtual interface for link failover to serve as a container to associate the links that will participate in failover.

**About this task**

The failover-enabled virtual interface represents a group of secondary interfaces, one of which can be specified as the primary. The system makes the primary interface the active interface whenever the primary interface is operational. A configurable Down Delay failover option allows you to configure a failover delay in 900 millisecond intervals. The failover delay guards against multiple failovers when a network is unstable.

**Procedure**

1. Select **Hardware > Ethernet > Interfaces**.
2. In the interfaces table, disable the physical interface to which the virtual interface is to be added by clicking **No** in the **Enabled** column.
3. From the **Create** menu, select **Virtual Interface**.
4. In the Create Virtual Interface dialog box, specify a virtual interface name in the **veth** box.
   Enter a virtual interface name in the form `vethx`, where `x` is a unique ID (typically one or two digits). A typical full virtual interface name with VLAN and IP Alias is `veth56.3999:199`. The maximum length of the full name is 15 characters. Special characters are not allowed. Numbers must be between 0 and 4094, inclusively.
5. In the **Bonding Type** list, select **Failover**.
6. Select an interface to add to the failover configuration, and click **Next**. Virtual aggregate interfaces can be used for failover.
   The Create virtual interface `veth_name` dialog box appears.
7. Enter an IP address, or enter 0 to specify no IP address.
8. Enter a netmask or prefix.
9. Specify the Speed/Duplex options.
   The combination of speed and duplex settings defines the rate of data transfer through the interface.
   - Select **Autonegotiate Speed/Duplex** to allow the network interface card to autonegotiate the line speed and duplex setting for an interface.
   - Select **Manually configure Speed/Duplex** to manually set an interface data-transfer rate.

   **Note:** This option is not available on DD6900, DD9400, and DD9900 systems.
   - Duplex options are either half duplex or full duplex.
   - Speed options listed are limited to the capabilities of the hardware device. Options are 10 Mb, 100 Mb, 1000 Mb, and 10 Gb.
   - Half-duplex is available for 10 Mb and 100 Mb speeds only.
- 1000 Mb and 10 Gb line speeds require full-duplex.
- Optical interfaces require the Autonegotiate option.
- The copper interface default is 10 Gb. If a copper interface is set to 1000 Gb or 10 Gb line speed, the duplex must be full-duplex.

10. Specify MTU setting.
   - To select the default value (1500), click Default.
   - To select a different setting, enter the setting in the MTU box. Ensure that all of your network path components support the size set with this option.

11. Optionally, select Dynamic DNS Registration option.
    Dynamic DNS (DDNS) is a protocol that registers local IP addresses on a Domain Name System (DNS) server. In this release, DD System Manager supports Windows mode DDNS. To use UNIX mode DDNS, use the `net ddns` CLI command.
    The DDNS must be registered to enable this option.
    
    ![Note:](image) This option disables DHCP for this interface.

12. Click Next.
    The Configure Interface Settings summary page appears. The values listed reflect the new system and interface state.

13. Complete the Interface, click Finish and OK.

### Modifying a virtual interface

After you create a virtual interface, you can update the settings to respond to network changes or resolve issues.

**Procedure**

1. Select Hardware > Ethernet > Interfaces.
2. In the Interfaces column, select the interface and disable the virtual interface by clicking No in the Enabled column. Click OK in the warning dialog box.
3. In the Interfaces column, select the interface and click Configure.
4. In the Configure Virtual Interface dialog box, change the settings.
5. Click Next and Finish.

### Configuring a VLAN

Create a new VLAN interface from either a physical interface or a virtual interface.

**About this task**

The recommended total VLAN count is 80. You can create up to 100 interfaces (minus the number of aliases, physical and virtual interfaces) before the system prevents you from creating any more.

**Procedure**

1. Select Hardware > Ethernet > Interfaces.
2. In the interfaces table, select the interface to which you want to add the VLAN.
3. Click Create and select VLAN.
4. In the Create VLAN dialog box, specify a VLAN ID by entering a number in the **VLAN Id** box. The range of a VLAN ID is between 1 and 4094 inclusive.

5. Enter an IP address, or enter 0 to specify no IP address.

   The Internet Protocol (IP) address is the numerical label assigned to the interface. For example, 192.168.10.23.

6. Enter a netmask or prefix.

7. Specify the MTU setting.

   The VLAN MTU must be less than or equal to the MTU defined for the physical or virtual interface to which it is assigned. If the MTU defined for the supporting physical or virtual interface is reduced below the configured VLAN value, the VLAN value is automatically reduced to match the supporting interface. If the MTU value for the supporting interface is increased above the configured VLAN value, the VLAN value is unchanged.

   - To select the default value (1500), click **Default**.
   - To select a different setting, enter the setting in the MTU box. DD System Manager does not accept an MTU size that is larger than that defined for the physical or virtual interface to which the VLAN is assigned.

8. Specify Dynamic DNS Registration option.

   Dynamic DNS (DDNS) is a protocol that registers local IP addresses on a Domain Name System (DNS) server. In this release, DD System Manager supports Windows mode DDNS. To use UNIX mode DDNS, use the `net ddns` CLI command.

   The DDNS must be registered to enable this option.

9. Click **Next**.

   The Create VLAN summary page appears.

10. Review the configuration settings, click **Finish**, and click **OK**.

### Modifying a VLAN interface

After you create a VLAN interface, you can update the settings to respond to network changes or resolve issues.

**Procedure**

1. Select **Hardware > Ethernet > Interfaces**.

2. In the **Interfaces** column, select the checkbox of the interface and disable the VLAN interface by clicking **No** in the **Enabled** column. Click **OK** in the warning dialog box.

3. In the Interfaces column, select the checkbox of the interface and click **Configure**.

4. In the **Configure VLAN Interface** dialog box, change the settings.

5. Click **Next** and **Finish**.

### Configuring an IP alias

An IP alias assigns an additional IP address to a physical interface, a virtual interface, or a VLAN.

**About this task**

The recommended total number of IP aliases, VLAN, physical, and virtual interfaces that can exist on the system is 80. Although up to 100 interfaces are supported, as the maximum number is approached, you might notice slowness in the display.
**Note:** When using an HA pair, aliases cannot be created on the standby node. Create the alias on the active node then configure it on the standby node.

**Procedure**

1. Select **Hardware > Ethernet > Interfaces**.
2. Click **Create**, and select **IP Alias**.
   
   The Create IP Alias dialog box appears.

3. Specify an IP alias ID by entering a number in the **IP ALIAS Id** box.
   
   The range is 1 to 4094 inclusive.

4. Enter an IPv4 or IPv6 address.
5. If you entered an IPv4 address, enter a netmask address.
6. Specify Dynamic DNS Registration option.
   
   Dynamic DNS (DDNS) is a protocol that registers local IP addresses on a Domain Name System (DNS) server. In this release, DD System Manager supports Windows mode DDNS. To use UNIX mode DDNS, use the `net ddns` CLI command.
   
   The DDNS must be registered to enable this option.

7. Click **Next**.

   The Create IP Alias summary page appears.

8. Review the configuration settings, click **Finish**, and **OK**.

**Modifying an IP alias interface**

After you create an IP alias, you can update the settings to respond to network changes or resolve issues.

**Procedure**

1. Select **Hardware > Ethernet > Interfaces**.

2. In the **Interfaces** column, select the checkbox of the interface and disable the IP alias interface by clicking **No** in the **Enabled** column. Click **OK** in the warning dialog box.

3. In the **Interfaces** column, select the checkbox of the interface and click **Configure**.

4. In the Configure IP Alias dialog box, change the settings as described in the procedure for creating an IP Alias.

5. Click **Next** and **Finish**.

**Registering interfaces with DDNS**

Dynamic DNS (DDNS) is a protocol that registers local IP addresses on a Domain Name System (DNS) server.

**About this task**

In this release, DD System Manager supports Windows mode DDNS. To use UNIX mode DDNS, use the `net ddns` CLI command. You can do the following.

- Manually register (add) configured interfaces to the DDNS registration list.
- Remove interfaces from the DDNS registration list.
- Enable or disable DNS updates.
- Display whether DDNS registration is enabled or not.
- Display interfaces in the DDNS registration list.

**Procedure**

1. Select **Hardware > Ethernet > Interfaces > DDNS Registration**.
2. In the DDNS Windows Mode Registration dialog box, click **Add** to add an interface to the DDNS.
   - The Add Interface dialog box appears.
   - a. Enter a name in the **Interface** field.
   - b. Click **OK**.
3. Optionally, to remove an interface from the DDNS:
   - a. Select the interface to remove, and click **Remove**.
   - b. In the Confirm Remove dialog box, click **OK**.
4. Specify the DDNS Status.
   - Select **Enable** to enable updates for all interfaces already registered.
   - Click **Default** to select the default settings for DDNS updates.
   - Clear **Enable** to disable DDNS updates for the registered interfaces.
5. To complete the DDNS registration, click **OK**.

**Destroying an interface**

You can use DD System Manager to destroy or delete virtual, VLAN, and IP alias interfaces.

**About this task**

When a virtual interface is destroyed, the system deletes the virtual interface, releases its bonded physical interface, and deletes any VLANs or aliases attached to the virtual interface. When you delete a VLAN interface, the OS deletes the VLAN and any IP alias interfaces that are created under it. When you destroy an IP alias, the OS deletes only that alias interface.

**Procedure**

1. Select **Hardware > Ethernet > Interfaces**.
2. Click the box next to each interface you want to destroy (Virtual or VLAN or IP Alias).
3. Click **Destroy**.
4. Click **OK** to confirm.

**Viewing an interface hierarchy in the tree view**

The Tree View dialog box displays the association between physical and virtual interfaces.

**Procedure**

1. Select **Hardware > Ethernet > Interfaces > Tree View**.
2. In the Tree View dialog box, click the plus or minus boxes to expand or contract the tree view that shows the hierarchy.
3. Click **Close** to exit this view.
General network settings management

The configuration settings for hostname, domain name, search domains, host mapping, and DNS list are managed together on the Settings tab.

Viewing network settings information

The Settings tab displays the current configuration for the hostname, domain name, search domains, host mapping, and DNS.

Procedure

1. Select **Hardware** > **Ethernet** > **Settings**.

Setting the DD System Manager hostname

You can configure the DD System Manager hostname and domain name manually, or you can configure DD OS to automatically receive the host and domain names from a Dynamic Host Configuration Protocol (DHCP) server.

About this task

One advantage to manually configuring the host and domain names is that you remove the dependency on the DHCP server and the interface leading to the DHCP server. To minimize the risk of service interruption, if possible, manually configure the host and domain names.

When configuring the hostname and domain name, consider the following guidelines.

- Do not include an underscore in the hostname; it is incompatible with some browsers.
- Replication and CIFS authentication must be reconfigured after you change the names.
- If a system was previously added without a fully qualified name (no domain name), a domain name change requires that you remove and add the affected system or update the Search Domain List to include the new domain name.

| Note: For steps on changing an established hostname, see KB article 182164. |

Procedure

1. Select **Hardware** > **Ethernet** > **Settings**.
2. Click **Edit** in the **Host Settings** area. The **Configure Host** dialog opens.
3. To manually configure the host and domain names:
   a. Select **Manually configure host**.
   b. Enter a hostname in the **Host Name** box.
      For example, `id##.yourcompany.com`
   c. Enter a domain name in the **Domain Name** box.
      This is the domain name that is associated with your protection system and, usually, your company’s domain name. For example, `yourcompany.com`
   d. Click **OK**.
      The system displays progress messages as the changes are applied.
4. To obtain the host and domain names from a DHCP server, select **Obtain Settings using DHCP** and click **OK**.
At least one interface must be configured to use DHCP.

**Managing the domain search list**

Use the domain search list to define which domains the system can search.

**Procedure**
1. Select **Hardware > Ethernet > Settings**.
2. Click **Edit** in the Search Domain List area.
3. To add a search domain using the Configure Search Domains dialog:
   a. Click **Add (+]**.
   b. In the Add Search Domain dialog, enter a name in the **Search Domain** box.
      For example, `id##.yourcompany.com`
   c. Click **OK**.
      The system adds the new domain to the list of searchable domains.
   d. Click **OK** to apply changes and return to the Settings view.
4. To remove a search domain using the Configure Search Domains dialog:
   a. Select the search domain to remove.
   b. Click **Delete (X)**.
      The system removes the selected domain from the list of searchable domains.
   c. Click **OK** to apply changes and return to the Settings view.

**Adding and deleting host maps**

A host map links an IP address to a hostname, so that either the IP address or the hostname can be used to specify the host.

**Procedure**
1. Select **Hardware > Ethernet > Settings**.
2. To add a host map, do the following.
   a. In the Hosts Mapping area, click **Add**.
   b. In the Add Hosts dialog, enter the IP address of the host in the **IP Address** box.
   c. Click **Add (+]**.
   d. In the Add Host dialog, enter a hostname, such as `id##.yourcompany.com`, in the **Host Name** box.
   e. Click **OK** to add the new hostname to the Host Name list.
   f. Click **OK** to return to the Settings tab.
3. To delete a host map, do the following.
   a. In the Hosts Mapping area, select the host mapping to delete.
   b. Click **Delete (X)**.
Configuring DNS IP addresses

DNS IP addresses specify the DNS servers the system can use to get IP addresses for host names that are not in the host mapping table.

About this task

You can configure the DNS IP addresses manually, or you can configure DD OS to automatically receive IP addresses from a DHCP server. One advantage to manually configuring DNS IP addresses is that you remove the dependency on the DHCP server and the interface leading to the DHCP server. To minimize the risk of service interruption, EMC recommends that you manually configure the DNS IP addresses.

Procedure

1. Select **Hardware > Ethernet > Settings**.
2. Click **Edit** in the DNS List area.
3. To manually add a DNS IP address:
   a. Select **Manually configure DNS list**.
      The DNS IP address checkboxes become active.
   b. Click **Add (+)**.
   c. In the Add DNS dialog box, enter the DNS IP address to add.
   d. Click **OK**.
      The system adds the new IP address to the list of DNS IP addresses.
   e. Click **OK** to apply the changes.
4. To delete a DNS IP address from the list:
   a. Select **Manually configure DNS list**.
      The DNS IP address checkboxes become active.
   b. Select the DNS IP address to delete and click **Delete (X)**.
      The system removes the IP address from the list of DNS IP addresses.
   c. Click **OK** to apply the changes.
5. To obtain DNS addresses from a DHCP server, select **Obtain DNS using DHCP** and click **OK**.
   At least one interface must be configured to use DHCP.

Network route management

Routes determine the path taken to transfer data to and from the localhost (the protection system) to another network or host.

Data Domain and PowerProtect systems do not generate or respond to any of the network routing management protocols (RIP, EGRP/EIGRP, and BGP). The only routing implemented on a protection system is IPv4 policy-based routing, which allows only one route to a default gateway per routing table. There can be multiple routing tables and multiple default gateways. A routing table is created for each address that has the same subnet as a default gateway. The routing rules send the packets with the source IP address that matches the IP address used to create the table to that routing table. All other packets that do not have source IP addresses that match a routing table are sent to the main routing table.
Within each routing table, static routes can be added, but because source routing is used to get packets to the table, the only static routes that will work are static routes that use the interface that has the source address of each table. Otherwise it needs to be put into the main table.

Static routes are also required in the main routing table to direct which source addresses to use with connections initiated from DD OS if the destination program does not bind the IP address.

**Note:** DD Replicator sets a static route between the source and target systems when the replication context is created, therefore it does not require the creation of additional static routes.

Other than the IPv4 source routing done to these other routing tables, Data Domain and PowerProtect systems use source-based routing for the main routing IPv4 and IPv6 tables, which means that outbound network packets that match the subnet of multiple interfaces are routed only over the physical interface whose IP address matches the source IP address of the packets, which is where they originated.

For IPv6, set static routes when multiple interfaces contain the same IPv6 subnets, and the connections are being made to IPv6 addresses with this subnet. Normally, static routes are not needed with IPv4 addresses with the same subnet, such as for backups. There are cases in which static addresses may be required to allow connections to work, such as connections from the protection system to remote systems.

Static routes can be added and deleted from individual routing tables by adding or deleting the table from the route specification. This provides the rules to direct packets with specific source addresses through specific route tables. If a static route is required for packets with those source addresses, the routes must be added the specific table where the IP address is routed.

**Note:** Routing for connections initiated from the protection system, such as for replication, depends on the source address used for interfaces on the same subnet. To force traffic for a specific interface to a specific destination (even if that interface is on the same subnet as other interfaces), configure a static routing entry between the two systems: this static routing overrides source routing. This is not needed if the source address is IPv4 and has a default gateway associated with it. In that case, the source routing is already handled via its own routing table.

### Viewing route information

The Routes tab displays the default gateways, static routes, and dynamic routes.

**Procedure**

1. Select **Hardware > Ethernet > Routes**.

   **Tip:** If this does not display all the routing tables configured on the system, run the `net route show tables` command to display all the tables. The *DD OS Command Reference Guide* provides additional information.

**Results**

The Static Routes area lists the route specification used to configure each static route. The Dynamic Routes table lists information for each of the dynamically assigned routes.
Setting the default gateway

You can configure the default gateway manually, or you can configure DD OS to automatically receive the default gateway IP addresses from a DHCP server.

About this task

One advantage to manually configuring the default gateway is that you remove the dependency on the DHCP server and the interface leading to the DHCP server. To minimize the risk of service interruption, if possible, manually configure the default gateway IP address.

Note: The system supports the use of additional default gateways that are configured on specific NICs. Use the `net route add gateway` command to configure additional default gateways. The *DD OS Command Reference Guide* provides additional information.

Procedure

1. Select **Hardware > Ethernet > Routes**.
2. Click **Edit** next to the default gateway type (IPv4 or IPv6) you want to configure.
3. To manually configure the default gateway address:
   a. Select **Manually Configure**.
   b. Enter the gateway address in the **Gateway** box.
   c. Click **OK**.
4. To obtain the default gateway address from a DHCP server, select **Use DHCP value** and click **OK**.
   At least one interface must be configured to use DHCP.

Creating static routes

Static routes define destination hosts or networks that they system can communicate with.

About this task

Note: The steps for adding a static route using the CLI can be found in [KB article 500223](#).

Procedure

1. Select **Hardware > Ethernet > Routes**.
2. Click **Create** in the Static Routes area.
3. In the **Create Routes** dialog, select the interface you want to host the static route, and click **Next**.
4. Specify the Destination.
   - To specify a destination network, select **Network** and enter the network address and netmask for the destination network.
   - To specify a destination host, select **Host** and enter the hostname or IP address of the destination host.
5. Optionally, specify the gateway to use to connect to the destination network or host.
   a. Select **Specify a gateway for this route**.
   b. Enter the gateway address in the **Gateway** box.
6. Review the configuration and click **Next**.
   The create routes Summary page appears.
7. Click Finish.
8. After the process is completed, click OK.
   The new route specification is listed in the Route Spec list.

Deleting static routes

Delete a static route when you no longer want the system to communicate with a destination host or network.

Procedure
1. Select Hardware > Ethernet > Routes.
2. Select the Route Spec of the route specification to delete.
3. Click Delete.
4. Click Delete to confirm and then click Close.
   The selected route specification is removed from the Route Spec list.
CHAPTER 11
Managing Storage

This chapter includes:

- Managing DD system storage ................................................................. 136
- Viewing system storage information ..................................................... 136
- Physically locating an enclosure .......................................................... 137
- Physically locating a disk .................................................................. 137
- Configuring storage ............................................................................ 137
- Expanding DD3300 capacity .............................................................. 138
- Failing and unfailing a disk ................................................................. 139
Managing DD system storage

Storage management features enable you to view the status and configuration of your storage space, flash a disk LED to facilitate disk identification, and change the storage configuration.

**Note:** All storage that is connected or used by the two-node Active-Standby HA system can be viewed as a single system.

**Using the CLI to calculate usable storage space**

The following values are required to calculate the usable storage on a protection system after accounting for RAID overhead:

- \( N = \) Number of disks in use in the disk group (dg).
- \( C = \) Capacity of each disk after formatting.
- \( R = 2 \) (Number of disks used for RAID 6 parity)

This calculation does not work for Cache Tier storage, because the Cache Tier disks are not RAID protected.

Run the `storage show all` command to get the values for \( N \) and \( C \).

**Figure 2 Example of `storage show all` command**

In this example there are 14 disks in use in dg2 and each disk has a capacity of 2.7 TiB, therefore \( N=14 \) and \( C=2.7 \) TiB.

Use the formula \((N-R) \times C\) to get the usable capacity. In this example, the equation is \((14-2) \times 2.7 \) TiB.

\[12 \times 2.7 \text{ TiB} = 32.4 \text{ TiB}, \text{ or } 35.6 \text{ TB}.

**Note:** The calculated value may not match exactly with the output of the `storage show all` command due to the way the capacity values are rounded for display. The `disk show hardware` command displays the disk capacity with additional decimal places.

**Viewing system storage information**

The storage status area shows the current status of the storage, such as Operational or Non-Operational, and the storage migration status. Below the Status area are tabs that organize how the storage inventory is presented.

**Procedure**

1. To display the storage status, select **Hardware > Storage**.
2. If an alerts link appears after the storage status, click the link to view the storage alerts.
3. If the Storage Migration Status is Not licensed, you can click **Add License** to add the license for this feature.

### Physically locating an enclosure

If you have trouble determining which physical enclosure corresponds to an enclosure displayed in DD System Manager, you can use the CLI beacon feature to flash the enclosure IDENT LEDs and all the disk LEDs that indicate normal operation.

**Procedure**

1. Establish a CLI session with the system.
2. Type `enclosure beacon enclosure`.
3. Press `Ctrl-C` to stop the LED flashing.

### Physically locating a disk

If you have trouble determining which physical disk corresponds to a disk displayed in DD System Manager, you can use the beacon feature to flash an LED on the physical disk.

**Procedure**

1. Select **Hardware > Storage > Disks**.
2. Select a disk from the **Disks** table and click **Beacon**.
   
   **Note:** You can select one disk at a time.

   The Beaconing Disk dialog box appears, and the LED light on the disk begins flashing.
3. Click **Stop** to stop the LED beaoning.

### Configuring storage

Storage configuration features allow you to add and remove storage expansion enclosures from the active, retention, and cloud tiers. Storage in an expansion enclosure (also called an expansion shelf) is not available for use until it is added to a tier.

**About this task**

**Note:** Additional storage requires the appropriate license or licenses and sufficient memory to support the new storage capacity. Error messages appear if more licenses or memory is needed.

DD6300 systems support the option to use ES30 enclosures with 4 TB drives (43.6 TiB) at 50% utilization (21.8 TiB) in the active tier if the available licensed capacity is exactly 21.8 TiB.

The following guidelines apply to using partial capacity shelves:

- No other enclosure types or drive sizes are supported for use at partial capacity.
- A partial shelf can only exist in the Active tier.
- Only one partial ES30 can exist in the Active tier.
- Once a partial shelf exists in a tier, no additional ES30s can be configured in that tier until the partial shelf is added at full capacity. You must license enough additional capacity to use the remaining 21.8 TiB of the partial shelf.
- If the available capacity exceeds 21.8 TB, you cannot add a partial shelf.
Deleting a 21 TiB license does not automatically convert a fully used shelf to a partial shelf. You must remove the shelf and add it back as a partial shelf.

For DD6900, DD9400, and DD9900 systems, storage capacity licenses are available in increments of 60 TB raw (48 TB usable) capacity. For systems with 8 TB drives, the licensed capacity might not equal the full capacity of the disks that are installed in the disk shelves. For example, if the system has one pack of 8 TB disks (96 TB usable capacity) but the licensed capacity is 48 TB, only half the system capacity is available for use.

Procedure

1. Select **Hardware > Storage > Overview**.
2. Expand the dialog box for the **Active Tier, Cache Tier, or Cloud Tier**.
3. Click **Configure**.
4. In the **Configure Storage** dialog box, select the storage from the **Addable Storage** list.
5. In the **Configure** list, select **Active Tier**.
   - The maximum amount of storage that can be added to the active tier depends on the active DD controller.
   
   Note: The licensed capacity bar shows the portion of licensed capacity (used and remaining) for the installed enclosures.

6. Select the shelf and click **Add to Tier**.
7. Click **OK** to add the storage.
   
   Note: To remove an added shelf, select it in the Tier Configuration list, click **Remove from Configuration**, and click **OK**.

Expanding DD3300 capacity

The DD3300 system is available in four different capacity configurations. You can expand capacity from one configuration to another.

**Before you begin**

All capacity expansions require the installation of additional disks and memory in the system. Do not attempt to expand the capacity until the hardware upgrades are complete.

**About this task**

The DD3300 system is available in 4 TB, 8 TB, 16 TB, and 32 TB capacity configurations. Capacity expansion is a one-time process.

The following table shows the available expansion paths and required hardware:

**Table 5 DD3300 upgrade requirements for capacity expansion**

<table>
<thead>
<tr>
<th>Capacity expansion</th>
<th>Additional memory</th>
<th>Additional HDDs</th>
<th>Additional SSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 TB to 16 TB</td>
<td>32 GB</td>
<td>6 x 4 TB HDDs</td>
<td>1 x 480 GB SSD</td>
</tr>
<tr>
<td>8 TB to 16 TB</td>
<td>8 TB to 16 TB expansion requires licensing and configuration changes only. No hardware upgrades are required.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 TB to 32 TB</td>
<td>16 GB</td>
<td>6 x 4 TB HDDs</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Procedure

1. select Maintenance > System.

The Capacity Expansion History table displays details about the capacity of the system, including the initial capacity of the system, the date of the initial software installation, and the expanded capacity and the date of the expansion operation if applicable.

2. If the system has not been expanded, select the target capacity from the Select Capacity list box and click Capacity Expand to initiate the capacity expansion.

The DD3300 Field Replacement and Upgrade Guide provides detailed instructions for expanding system capacity.

| Note: Insufficient memory, insufficient physical capacity (HDDs), the system has already been expanded, or the target for capacity expansion is not supported can prevent a capacity expansion. If the capacity expansion cannot be completed, the system displays the reason. |

Failing and unfailing a disk

Disk fail functionality allows you to manually set a disk to a failed state to force reconstruction of the data stored on the disk. Disk unfail functionality allows you to take a disk in a failed state and return it to operation.

Procedure

- To fail a disk and force reconstruction:
  a. Select Hardware > Storage > Disks > Fail.
  b. Select a disk from the table and click Fail.
- To make a disk marked Failed or Foreign usable to the system:
  a. Select Hardware > Storage > Disks > Unfail.
  b. Select a disk from the table and click Unfail.
CHAPTER 12
Migrating Storage

This chapter presents the following topics:

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- Migration planning considerations .................................................... 142
- Viewing migration status ........................................................................ 144
- Evaluating migration readiness ............................................................. 144
- Migrating storage using DD System Manager ......................................... 145
- Storage migration dialog descriptions .................................................. 146
- Migrating storage using the CLI ............................................................ 148
- CLI storage migration example .............................................................. 149
Storage migration overview

Storage migration supports the replacement of existing storage enclosures with new enclosures that may offer higher performance, higher capacity, and a smaller footprint.

After new enclosures are installed, you can migrate the data from the older enclosures to the new enclosures while the system continues to support other processes such as data access, expansion, cleaning, and replication. The storage migration does require system resources, but you can control this with throttle settings that give the migration a relatively higher or lower priority. You can also suspend a migration to make more resources available to other processes, then resume the migration when resource demand is lower.

During the migration, the system uses data on the source and destination enclosures. New data is written to the new enclosures. Non-migrated data is updated on the source enclosures, and migrated data is updated on the destination enclosures. If the migration is interrupted, the migration can resume migrating blocks that have not been marked as migrated.

During the migration, each block of data is copied and verified, the source block is freed and marked as migrated, and the system index is updated to use the new location. New data that was destined to land in the source block will now be redirected to destination block. All new data block allocations that would have been allocated from source are allocated from the destination.

The Migration copy process is done at the shelf level, not the logical data level, so all disk sectors on the source shelf are accessed and copied over regardless of whether there is data on them. Therefore, the Storage Migration Utility cannot be used to shrink a logical data footprint.

Note: Because the data set is divided between the source and destination enclosures during migration, you cannot halt a migration and resume use of only the source enclosures. Once started, the migration must complete. If a failure, such as a faulty disk drive, interrupts the migration, address the issue and resume the migration.

Depending on the amount of data to migrate and the throttle settings selected, a storage migration can take days or weeks. When all data is migrated, the finalize process, which must be manually initiated using the storage migration finalize command, restarts the filesystem. During the restart, the source enclosures are removed from the system configuration and the destination enclosures become part of the filesystem. When the finalize process is complete, the source enclosures can be removed from the system.

After a storage migration, the disk shelf numbers reported by DD OS might not be sequential. This is because shelf numbering is tied to the serial number of each individual disk shelf. KB article 499019, Data Domain: Storage enclosure numbering is not sequential, available on https://support.emc.com, provides additional details. In DD OS version 5.7.3.0 and later, the enclosure show persistent-id command described in the KB article requires administrator access, not SE access.

Migration planning considerations

Consider the following guidelines before starting a storage migration.

- Storage migration requires a single-use license and operates on system models supported by DD OS version 5.7 or later.
  
  Note: Multiple storage migration operations require multiple licenses. However, multiple source enclosures can be migrated to multiple destination enclosures during a single operation.

- Two licenses are required for storage migration:
  
  - The storage migration feature license
The capacity and shelf type license for the destination enclosures.

Storage migration is based on capacity, not enclosure count. Therefore:

- One source enclosure can be migrated to one destination enclosure.
- One source enclosure can be migrated to multiple destination enclosures.
- Multiple source enclosures can be migrated to one destination enclosure.
- Multiple source enclosures can be migrated to multiple destination enclosures.

The storage migration licensing process consists of:

1. Updating the elicense installed on the system with the storage migration feature license and the capacity and shelf type license for the destination enclosures before running the migration operation.
2. Updating the elicense installed on the system to remove the original capacity and shelf type license and the storage migration feature license after the migration operation is complete.

The destination enclosures must:

- Be unassigned shelves with the drives in an unused state.
- Be licensed for sufficient capacity to receive the data from the source enclosures, with the license installed on the system.
- Be supported on the DD system model.
- Contain at least as much usable capacity as the enclosures they are replacing.

\( \text{Note: It is not possible to determine the utilization of the source shelf. The system performs all calculations based on the capacity of the shelf.} \)

The DD system model must have sufficient memory to support the active tier storage capacity of the new enclosures.

Data migration is not supported for disks in the system controller.

\( \text{CAUTION} \) Do not upgrade DD OS until the in-progress storage migration is complete.

Storage migration cannot start when the file system is disabled or while a DD OS upgrade is in progress, another migration is in progress, or a RAID reconstruction is in progress.

\( \text{Note: If a storage migration is in progress, a new storage migration license is required to start a new storage migration operation after the in-progress migration completes. The presence or absence of a storage migration license is reported as part of the upgrade precheck.} \)

All specified source enclosures must be in the same tier (active).

There can be only one disk group in each source enclosure, and all disks in the disk group must be installed in within the same enclosure.

All disks in each destination enclosure must be of the same type (for example, all SATA or all SAS).

After migration begins, the destination enclosures cannot be removed.

Source enclosures cannot be removed until migration is complete and finalized.

The storage migration duration depends on the system resources (which differ for different system models), the availability of system resources, and the data quantity to migrate. Storage migration can take days or weeks to complete.

**DS60 shelf considerations**

The DS60 dense shelf can hold 60 disks, allowing the customer to use the full amount of space in the rack. The drives are accessed from the top of the shelf, by extending the shelf from the
cabinet. Due to the weight of the shelves, approximately 225 lbs when fully loaded, read this section before proceeding with a storage migration to DS60 shelves.

Be aware of the following considerations when working with the DS60 shelf:

⚠️ CAUTION

- Storage migrations are not supported when the source DS60 shelves contain 8 TB drives.
- Loading shelves at the top of the rack may cause the shelf to tip over.
- Validate that the floor can support the total weight of the DS60 shelves.
- Validate that the racks can provide enough power to the DS60 shelves.
- When adding more than five DS60s in the first rack, or more than six DS60s in the second rack, stabilizer bars and a ladder are required to maintain the DS60 shelves.

### Viewing migration status

DD System Manager provides two ways to view storage migration status.

**Procedure**

1. Select **Hardware > Storage**.
   
   In the Storage area, review the Storage Migration Status line. If the status is Not Licensed, you must add a license before using any storage migration features. If the storage migration license is installed, the status can be one of the following: None, Starting, Migrating, Paused by User, Paused by System, Copy Completed - Pending Finalization, Finalizing, Failed during Copy, or Failed during Finalize.

2. If a storage migration is in progress, click **View Storage Migration** to view the progress dialogs.

   **Note:** The migration status shows the percentage of blocks transferred. In a system with many free blocks, the free blocks are not migrated, but they are included in the progress indication. In this situation, the progress indication will climb quickly and then slow when the data migration starts.

3. When a storage migration is in progress, you can also view the status by selecting **Health > Jobs**.

### Evaluating migration readiness

You can use the system to evaluate storage migration readiness without committing to start the migration.

**Procedure**

1. Install the destination enclosures using the instructions in the product installation guides.
2. Select **Administration > Licenses** and verify that the storage migration license is installed.
3. If the storage migration license is not installed, click **Add Licenses** and add the license.
4. Select **Hardware > Storage**, then click **Migrate Data**.
5. In the Select a Task dialog, select **Estimate**, then click **Next**.
6. In the Select Existing Enclosures dialog, use the checkboxes to select each of the source enclosures for the storage migration, then click **Next**.
7. In the Select New Enclosures dialog, use the checkboxes to select each of the destination enclosures for the storage migration, then click Next.

   The Add Licenses button allows you to add storage licenses for the new enclosures as needed, without interrupting the current task.

8. In the Review Migration Plan dialog, review the estimated migration schedule, then click Next.

9. Review the precheck results in the Verify Migration Preconditions dialog, then click Close.

Results
If any of the precheck tests fail, resolve the issue before you start the migration.

Migrating storage using DD System Manager

The storage migration process evaluates system readiness, prompts you to confirm that you want to start the migration, migrates the data, and then prompts you to finalize the process.

Procedure

1. Install the destination enclosures using the instructions in the product installation guides.
2. Select Administration > Licenses and verify that the storage migration license is installed.
3. If the storage migration license is not installed, click Add Licenses and add the license.
4. Select Hardware > Storage, then click Migrate Data.
5. In the Select a Task dialog, select Migrate, then click Next.
6. In the Select Existing Enclosures dialog, use the checkboxes to select each of the source enclosures for the storage migration, then click Next.
7. In the Select New Enclosures dialog, use the checkboxes to select each of the destination enclosures for the storage migration, then click Next.

   The Add Licenses button allows you to add storage licenses for the new enclosures as needed, without interrupting the current task.

8. In the Review Migration Plan dialog, review the estimated migration schedule, then click Start.
9. In the Start Migration dialog, click Start.

   The Migrate dialog appears and updates during the three phases of the migration: Starting Migration, Migration in Progress, and Copy Complete.

10. When the Migrate dialog title displays Copy Complete and a filesystem restart is acceptable, click Finalize.

   Note: This task restarts the filesystem and typically takes 10 to 15 minutes. The system is unavailable during this time.

Results
When the migration finalize task is complete, the system is using the destination enclosures and the source enclosures can be removed.
Storage migration dialog descriptions

The DD System Manager dialog descriptions provide additional information on storage migration. This information is also available by clicking the help icon in the dialogs.

Select a Task dialog

The configuration in this dialog determines whether the system will evaluate storage migration readiness and stop, or evaluate readiness and begin storage migration.

Select **Estimate** to evaluate system readiness and stop.

Select **Migrate** to start migration after the system evaluation. Between the system evaluation and the start of the migration, a dialog prompts you to confirm or cancel the storage migration.

Select Existing Enclosures dialog

The configuration in this dialog selects either the active or the retention tier and the source enclosures for the migration.

The Existing Enclosures list displays the enclosures that are eligible for storage migration. Select the checkbox for each of the enclosures to migrate. Click **Next** when you are ready to continue.

Select New Enclosures dialog

The configuration in this dialog selects the destination enclosures for the migration. This dialog also displays the storage license status and an **Add Licenses** button.

The Available Enclosures list displays the enclosures that are eligible destinations for storage migration. Select the checkbox for each of the desired destination enclosures.

The license status bar represents all of the storage licenses installed on the system. The green portion represents licenses that are in use, and the and clear portion represents the licensed storage capacity available for destination enclosures. If you need to install additional licenses to support the selected destination controllers, click **Add Licenses**.

Click **Next** when you are ready to continue.

Review Migration Plan dialog

This dialog presents an estimate of the storage migration duration, organized according to the three stages of storage migration.

Stage 1 of the storage migration runs a series of tests to verify that the system is ready for the migration. The test results appear in the Verify Migration Preconditions dialog.

During Stage 2, the data is copied from the source enclosures to the destination enclosures. When a large amount of data is present, the copy can take days or weeks to complete because the copy takes place in the background, while the system continues to serve backup clients. A setting in the Migration in Progress dialog allows you to change the migration priority, which can speed up or slow down the migration.

Stage 3, which is manually initiated from the Copy Complete dialog, updates the system configuration to use the destination enclosures and removes the configuration for the source controllers. During this stage, the file system is restarted and the system is unavailable to backup clients.
Verify Migration Preconditions dialog

This dialog displays the results of the tests that execute before the migration starts.

The following list shows the test sequence and provides additional information on each of the tests.

P1. This system's platform is supported.
   Older DD system models do not support storage migration.

P2. A storage migration license is available.
   A storage migration license is required.

P3. No other migration is currently running.
   A previous storage migration must complete before you can start another.

P4. The current migration request is the same as the interrupted migration request.
   Resume and complete the interrupted migration.

P5. Check the disk group layout on the existing enclosures.
   Storage migration requires that each source enclosure contain only one disk group, and all the
   disks in the group must be in that enclosure.

P6. Verify the final system capacity.
   The total system capacity after migration and the removal of the source enclosures must not
   exceed the capacity supported by the DD system model.

P7. Verify the replacement enclosures' capacity.
   The usable capacity of the destination enclosures must be greater than that of the source
   enclosures.

P8. Source enclosures are in the same active tier or retention unit.
   The system supports storage migration from either the active tier or the retention tier. It does
   not support migration of data from both tiers at the same time.

P9. Source enclosures are not part of the head unit.
   Although the system controller is listed as an enclosure in the CLI, storage migration does not
   support migration from disks installed in the system controller.

P10. Replacement enclosures are addable to storage.
    All disks in each destination enclosure must be of the same type (for example, all SATA or all
    SAS), with the capacity and shelf type license installed on the system.

P11. No RAID reconstruction is occurring in the source controllers.
    Storage migration cannot start while a RAID reconstruction is in progress.

P12. Source shelf belongs to a supported tier.
    The source disk enclosure must be part of a tier supported on the migration destination.

Migration progress dialogs

This series of dialogs presents the storage migration status and the controls that apply at each stage.

Migrate - Starting Migration

During the first stage, the progress is shown on the progress bar and no controls are available.
**Migrate - Migration in Progress**

During the second stage, data is copied from the source enclosures to the destination enclosures and the progress is shown on the progress bar. Because the data copy can take days or weeks to complete, controls are provided so that you can manage the resources used during migration and suspend migration when resources are needed for other processes.

You can click **Pause** to suspend the migration and later click **Resume** to continue the migration.

The **Low**, **Medium**, and **High** buttons define throttle settings for storage migration resource demands. A low throttle setting gives storage migration a lower resource priority, which results in a slower migration and requires fewer system resources. Conversely, a high throttle setting gives storage migration a higher resource priority, which results in a faster migration and requires more system resources. The medium setting selects an intermediate priority.

You do not have to leave this dialog open for the duration of the migration. To check the status of the migration after closing this dialog, select **Hardware** > **Storage** and view the migration status. To return to this dialog from the Hardware/Storage page, click **Manage Migration**. The migration progress can also be viewed by selecting **Health** > **Jobs**.

**Migrate - Copy Complete**

When the copy is complete, the migration process waits for you to click **Finalize**. During this final stage, which takes 10 to 15 minutes, the filesystem is restarted and the system is not available. It is a good practice to start this stage during a maintenance window or a period of low system activity.

---

**Migrating storage using the CLI**

**About this task**

A migration simply requires moving all of the allocated blocks from the blocksets formatted over source DGs (e.g., source blocksets) to the blocksets formatted over destination DGs (e.g., destination blocksets). Once all of the allocated blocks have been moved from the source blocksets, those blocksets can be removed from the file system, their disks can be removed from their storage tier, and the physical disks and enclosures can be removed from the DDR.

**Note:** The preparation of new enclosures for storage migration is managed by the storage migration process. Do not prepare destination enclosures as you would for an enclosure addition. For example, use of the `filesys expand` command is appropriate for an enclosure addition, but this command prevents enclosures from being used as storage migration destinations.

A DS60 disk shelf contains four disk packs, of 15 disks each. When a DS60 shelf is the migration source or destination, the disk packs are referenced as `enclosure:pack`. In this example, the source is enclosure 7, pack 2 (7:2), and the destination is enclosure 7, pack 4 (7:4).

**Procedure**

1. Install the destination enclosures using the instructions in the product installation guides.
2. Check to see if the storage migration feature license is installed.
   
   ```
   # elicense show
   ```
3. If the license is not installed, update the elicense to add the storage migration feature license.
   
   ```
   # elicense update
   ```
4. View the disk states for the source and destination disks.
   
   ```
   # disk show state
   ```

   The source disks should be in the active state, and the destination disks should be in the unknown state.
5. Run the storage migration precheck command to determine if the system is ready for the migration.

```
# storage migration precheck source-enclosures 7:2 destination-enclosures 7:4
```

6. View the migration throttle setting.

```
storage migration option show throttle
```

7. When the system is ready, begin the storage migration.

```
# storage migration start source-enclosures 7:2 destination-enclosures 7:4
```

8. Optionally, view the disk states for the source and destination disks during the migration.

```
# disk show state
```

   During the migration, the source disks should be in the migrating state, and the destination disks should be in the destination state.

9. Review the migration status as needed.

```
# storage migration status
```

10. View the disk states for the source and destination disks.

```
# disk show state
```

   During the migration, the source disks should be in the migrating state, and the destination disks should be in the destination state.

11. When the migration is complete, update the configuration to use the destination enclosures.

   ☑ **Note:** This task restarts the file system and typically takes 10 to 15 minutes. The system is unavailable during this time.

```
storage migration finalize
```

12. If you want to remove all data from each of the source enclosures, remove the data now.

```
storage sanitize start enclosure <enclosure-id>[:<pack-id>]
```

   ☑ **Note:** The storage sanitize command does not produce a certified data erasure. Dell EMC offers certified data erasure as a service. For more information, contact your Dell EMC representative.

13. View the disk states for the source and destination disks.

```
# disk show state
```

   After the migration, the source disks should be in the unknown state, and the destination disks should be in the active state.

**Results**

When the migration finalize task is complete, the system is using the destination storage and the source storage can be removed.

### CLI storage migration example

```
elicense show
```

```
# elicense show
Feature licenses:
## Feature     Count Mode            Expiration Date
-- ----------- ----- --------------- ---------------
```

### Storage Migration

- **Precheck:**
  - Use `storage migration precheck` to verify system readiness.
- **Start:**
  - Use `storage migration start` to begin the migration.
- **View States:**
  - Use `disk show state` to view disk states.
- **Finish:**
  - Use `storage migration finalize` to complete the migration.
- **Sanitize:**
  - Use `storage sanitize` to remove data from source enclosures.

### Results

After successful migration, disk states should reflect:
- Source disks: unknown (migration complete)
- Destination disks: active (destination ready)
eLicense update

```
# elicense update mylicense.lic
New licenses: Storage Migration
Feature licenses:
```

```
<table>
<thead>
<tr>
<th>Feature</th>
<th>Count</th>
<th>Mode</th>
<th>Expiration Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 REPLICATION</td>
<td>1</td>
<td>permanent (int)</td>
<td>n/a</td>
</tr>
<tr>
<td>2 VTL</td>
<td>1</td>
<td>permanent (int)</td>
<td>n/a</td>
</tr>
<tr>
<td>3 Storage Migration</td>
<td>1</td>
<td>permanent (int)</td>
<td></td>
</tr>
</tbody>
</table>
```

** This will replace all existing Data Domain licenses on the system with the above EMC ELMS licenses.

Do you want to proceed? (yes|no) [yes]: yes

eLicense(s) updated.

disk show state

```
Figure 3 disk show state
```

```
# disk show state
```

```
<table>
<thead>
<tr>
<th>Enclosure</th>
<th>Disk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Row(disk-id)</td>
<td>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15</td>
</tr>
<tr>
<td>------------</td>
<td>-----</td>
</tr>
<tr>
<td>1</td>
<td>.</td>
</tr>
<tr>
<td>2</td>
<td>U</td>
</tr>
<tr>
<td>3</td>
<td>U</td>
</tr>
<tr>
<td>4</td>
<td>U</td>
</tr>
<tr>
<td>5</td>
<td>U</td>
</tr>
<tr>
<td>6</td>
<td>.</td>
</tr>
<tr>
<td>7</td>
<td>U</td>
</tr>
</tbody>
</table>
```

Legend

<table>
<thead>
<tr>
<th></th>
<th>State</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>In Use Disks</td>
<td>14</td>
</tr>
<tr>
<td>s</td>
<td>spare disks</td>
<td>1</td>
</tr>
<tr>
<td>v</td>
<td>available</td>
<td>15</td>
</tr>
<tr>
<td>U</td>
<td>unknown disks</td>
<td>105</td>
</tr>
</tbody>
</table>

storage migration precheck

```
#storage migration precheck source-enclosures 2 destination-enclosures 11
```

Source enclosures:

```
<table>
<thead>
<tr>
<th>Disks</th>
<th>Count</th>
<th>Disk</th>
<th>Disk</th>
<th>Enclosure</th>
<th>Enclosure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-----</td>
<td>---</td>
<td>---</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>2.1-2.15</td>
<td>15</td>
<td>dg1</td>
<td>1.81 TiB</td>
<td>ES30</td>
<td>APM00111103820</td>
</tr>
</tbody>
</table>
```

Total source disk size: 27.29 TiB

Destination enclosures:

```
<table>
<thead>
<tr>
<th>Disks</th>
<th>Count</th>
<th>Disk</th>
<th>Disk</th>
<th>Enclosure</th>
<th>Enclosure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-----</td>
<td>---</td>
<td>---</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>11.1-11.15</td>
<td>15</td>
<td>unknown</td>
<td>931.51 GiB</td>
<td>ES30</td>
<td>APM00111103840</td>
</tr>
</tbody>
</table>
```

Total destination disk size: 13.64 TiB

1 "Verifying platform support................................................PASS"
2 "Verifying valid storage migration license exists....................PASS"
storage migration show history

Figure 4: storage migration show history

storage migration start

#storage migration start  source-enclosures 2  destination-enclosures 11

Source enclosures:

<table>
<thead>
<tr>
<th>Disks</th>
<th>Count</th>
<th>Disk</th>
<th>Disk Size</th>
<th>Enclosure</th>
<th>Serial No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>------</td>
<td>-------</td>
<td>------</td>
<td>---------</td>
<td>----------</td>
<td>------------</td>
</tr>
<tr>
<td>2.1-2.15</td>
<td>15</td>
<td>dg1</td>
<td>1.81 TiB</td>
<td>ES30</td>
<td>APM00111103820</td>
</tr>
<tr>
<td>------</td>
<td>-------</td>
<td>------</td>
<td>---------</td>
<td>----------</td>
<td>------------</td>
</tr>
</tbody>
</table>

Total source disk size: 27.29 TiB

Destination enclosures:

<table>
<thead>
<tr>
<th>Disks</th>
<th>Count</th>
<th>Disk</th>
<th>Disk Size</th>
<th>Enclosure</th>
<th>Serial No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>------</td>
<td>-------</td>
<td>------</td>
<td>---------</td>
<td>----------</td>
<td>------------</td>
</tr>
<tr>
<td>11.1-11.15</td>
<td>15</td>
<td>unknown</td>
<td>931.51 GiB</td>
<td>ES30</td>
<td>APM00111103840</td>
</tr>
<tr>
<td>------</td>
<td>-------</td>
<td>------</td>
<td>---------</td>
<td>----------</td>
<td>------------</td>
</tr>
</tbody>
</table>

Total destination disk size: 13.64 TiB

Expected time to migrate data: 84 hrs 40 min

** Storage migration once started cannot be aborted.
Existing data on the destination shelves will be overwritten.

Do you want to continue with the migration? (yes|no) [no]: yes

Performing migration pre-check:

1 Verifying platform support.................................PASS
2 Verifying valid storage migration license exists.................PASS
3 Verifying no other migration is running...................PASS
4 Verifying request matches interrupted migration............PASS
5 Verifying data layout on the source shelves..............PASS
6 Verifying final system capacity..........................PASS
7 Verifying destination capacity............................PASS
8 Verifying source shelves belong to same tier..............PASS
9 Verifying enclosure 1 is not used as source...............PASS
10 Verifying destination shelves are addable to storage.........PASS
11 Verifying no RAID reconstruction is going on in source shelves........PASS

Migration pre-check PASSED

Storage migration will reserve space in the filesystem to migrate data.
Space reservation may add up to an hour or more based on system resources.
Migrating Storage

Storage migration process initiated. Check storage migration status to monitor progress.

storage migration status

Figure 5 storage migration status

<table>
<thead>
<tr>
<th>#</th>
<th>Source</th>
<th>Destination</th>
<th>State</th>
<th>Percent Complete</th>
<th>Estimated Time to Complete</th>
<th>Current Throttle Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>7:2</td>
<td>7:4</td>
<td>migrating</td>
<td>45%</td>
<td>30 hrs 18 mins</td>
<td>high</td>
</tr>
</tbody>
</table>

disk show state, migration in progress

Figure 6 disk show state, migration in progress

<table>
<thead>
<tr>
<th>Enclosure</th>
<th>Disk State</th>
</tr>
</thead>
<tbody>
<tr>
<td>-----------</td>
<td>------------</td>
</tr>
</tbody>
</table>
| 1         | U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U U
storage migration finalize

Figure 7 storage migration finalize

```
# storage migration finalize

Storage migration finalize restarts the filesystem.
This can take several minutes and the filesystem is unavailable until the operation completes.
Do you want to continue? (yes/no) [no]: yes

Performing migration finalization pre-check:
(P1) Verifying storage migration is ready for finalization....PASS
(P2) Verifying there are no foreign disks....................PASS
(P3) Verifying data layout on the source shelves.............PASS

Migration finalization pre-check PASSED
Finalizing the storage migration with id 5:
Notifying filesystem to finalize migration...

Done.
Disabling the filesystem
Please wait...........
The filesystem is now disabled.
Removing source enclosures from filesystem...

Done.
Removing source enclosures from storage tier...

Done.
Enabling the filesystem
Please wait..................
The filesystem is now enabled.
Storage migration with id 5 from enclosure(s) 7.2 to enclosure(s) 7.4 has been finalized.
```

disk show state, migration complete

Figure 8 disk show state, migration complete

```
```

Note: Currently storage migration is only supported on the active node. Storage migration is not supported on the standby node of an HA cluster.
CHAPTER 13
Managing File Systems

This chapter presents the following topics:

- Supported interfaces .......................................................................................................... 156
- File system limitations..........................................................................................................156
- Best practices for data streams sent to DD systems ...........................................................157
- Monitoring the file system................................................................................................... 159
- Performing basic operations .............................................................................................. 160
- Performing cleaning .............................................................................................................162
- Performing sanitization ...................................................................................................... 164
- Modifying basic settings ..................................................................................................... 166
- Fast copy operations ..........................................................................................................168
Supported interfaces

The file system supports the following interfaces:

- NFS
- CIFS
- DD Boost
- DD VTL

File system limitations

Review the file system limitations.

- HA failover—Access to files may be interrupted for up to 10 minutes during failover on High Availability systems. (DD Boost and NFS require additional time.)
- Path name length—The maximum length of a full path name (including the characters in `/data/coll/backups`) is 1023 characters. The maximum length of a symbolic link is also 1023 characters.
- Battery—For systems that use NVRAM, the operating system creates a low battery alert if the battery charge falls below 80% capacity and the file system is disabled.
- Inodes—An NFS or CIFS client request causes a DD system to report a capacity of about two billion inodes (files and directories). Systems can exceed that number, but the reporting on the client might be incorrect.
- Number of files—Dell EMC recommends storing a total of no more than 1 billion files on a system. This limitation applies to the combined number of files stored in both the Active and Cloud storage tiers. Storing a larger number of files can adversely affect the performance and the length of cleaning, and some processes, such as file system cleaning, may run much longer with a very large number of files. For example, the enumeration phase of cleaning may take from a few minutes to several hours depending upon the number of files in the system.

  **Note:** The overall system performance will fall to unacceptable levels if the system is required to support the maximum file amount and the workload from the client machines is not carefully controlled.

When the file system passes the billion file limit, several processes or operations might be adversely affected, for example:

- Cleaning may take a very long time to complete, perhaps several days.
- AutoSupport operations may take more time.
- Any process or command that needs to enumerate all the files.

If there are many small files, other considerations arise:

- The number of separate files that can be created per second, (even if the files are very small) may be more of a limitation than the number of MB/s that can be ingested. When files are large, the file creation rate is not significant, but when files are small, the file creation rate dominates and may become a factor. The file creation rate is about 100 to 200 files per second depending upon the number of MTrees and CIFS connections. This rate should be taken into account during system sizing when a bulk ingest of a large number of files is needed by a customer environment.
- File access latencies are affected by the number of files in a directory. To the extent possible, we recommend directory sizes of less than 250,000. Larger directory sizes might experience slower responses to metadata operations such as listing the files in the directory and opening or creating a file.

### Best practices for data streams sent to DD systems

For optimal performance, Dell EMC recommends limits on simultaneous streams between DD systems, and your backup servers.

A data stream, in the context of the following table, refers to a large byte stream associated with sequential file access, such as a write stream to a backup file or a read stream from a restore image. A Replication source or destination stream refers to a directory replication operation or a DD Boost file replication stream associated with a file replication operation.

Table 6 Data streams sent to a protection system

<table>
<thead>
<tr>
<th>Model</th>
<th>RAM / NVRAM</th>
<th>Backup write streams</th>
<th>Backup read streams</th>
<th>Repl$^a$ source streams</th>
<th>Repl$^a$ dest streams</th>
<th>Mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD4200</td>
<td>128 GB / 4 GB</td>
<td>270</td>
<td>75</td>
<td>150</td>
<td>270</td>
<td>w&lt;=270; r&lt;=75; ReplSrc&lt;=150; ReplDest&lt;=270; ReplDestDest&lt;=270; Total&lt;=270</td>
</tr>
<tr>
<td>DD4500</td>
<td>192 GB / 4 GB</td>
<td>270</td>
<td>75</td>
<td>150</td>
<td>270</td>
<td>w&lt;=270; r&lt;=75; ReplSrc&lt;=150; ReplDest&lt;=270; ReplDestDest&lt;=270; Total&lt;=270</td>
</tr>
<tr>
<td>DD6300</td>
<td>48 or 96 GB / 8 GB</td>
<td>270</td>
<td>75</td>
<td>150</td>
<td>270</td>
<td>w&lt;=270; r&lt;=75; ReplSrc&lt;=150; ReplDest&lt;=270; ReplDestDest&lt;=270; Total&lt;=270</td>
</tr>
<tr>
<td>DD6800</td>
<td>192 GB / 8 GB</td>
<td>400</td>
<td>110</td>
<td>220</td>
<td>400</td>
<td>w&lt;=400; r&lt;=110; ReplSrc&lt;=220; ReplDest&lt;=400; ReplDestDest&lt;=400; Total&lt;=400</td>
</tr>
<tr>
<td>DD6900</td>
<td>288 GB / 16 GB</td>
<td>400</td>
<td>110</td>
<td>220</td>
<td>400</td>
<td>w&lt;=400; r&lt;=110; ReplSrc&lt;=220; ReplDest&lt;=400; ReplDestDest&lt;=400; Total&lt;=400</td>
</tr>
<tr>
<td>DD7200</td>
<td>128 or 256 GB / 4 GB</td>
<td>540</td>
<td>150</td>
<td>270</td>
<td>540</td>
<td>w&lt;=540; r&lt;=150; ReplSrc&lt;=270; ReplDest&lt;=540; ReplDestDest&lt;=540; Total&lt;=540</td>
</tr>
<tr>
<td>DD9300</td>
<td>192 or 384 GB / 8 GB</td>
<td>800</td>
<td>220</td>
<td>440</td>
<td>800</td>
<td>w&lt;=800; r&lt;=220; ReplSrc&lt;=440; ReplDest&lt;=800; ReplDestDest&lt;=800; Total&lt;=800</td>
</tr>
<tr>
<td>DD9400</td>
<td>576 GB / 16 GB</td>
<td>800</td>
<td>220</td>
<td>440</td>
<td>800</td>
<td>w&lt;=800; r&lt;=220; ReplSrc&lt;=440;</td>
</tr>
</tbody>
</table>
### Table 6: Data streams sent to a protection system (continued)

<table>
<thead>
<tr>
<th>Model</th>
<th>RAM / NVRAM</th>
<th>Backup write streams</th>
<th>Backup read streams</th>
<th>Replication source streams</th>
<th>Replication dest streams</th>
<th>Mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD9500</td>
<td>256 or 512 GB / 8 GB</td>
<td>1885</td>
<td>300</td>
<td>540</td>
<td>1080</td>
<td>(\text{ReplDest} \leq 800; \text{ReplDest +w} \leq 800; \text{Total} \leq 800)</td>
</tr>
<tr>
<td>DD9800</td>
<td>256 or 768 GB / 8 GB</td>
<td>1885</td>
<td>300</td>
<td>540</td>
<td>1080</td>
<td>(\text{ReplDest} \leq 800; \text{ReplDest +w} \leq 800; \text{Total} \leq 800)</td>
</tr>
<tr>
<td>DD9900</td>
<td>1152 GB / 16 GB</td>
<td>1885</td>
<td>300</td>
<td>540</td>
<td>1080</td>
<td>(\text{ReplDest} \leq 800; \text{ReplDest +w} \leq 800; \text{Total} \leq 800)</td>
</tr>
<tr>
<td>DD VE 8 TB</td>
<td>8 GB / 512 MB</td>
<td>20</td>
<td>16</td>
<td>20</td>
<td>20</td>
<td>(\text{w} \leq 20; \text{r} \leq 16 \text{ ReplSrc} \leq 20; \text{ReplDest} \leq 20; \text{ReplDest +w} \leq 20; \text{w+r+ReplSrc} \leq 20; \text{Total} \leq 20)</td>
</tr>
<tr>
<td>DD VE 16 TB</td>
<td>16 GB / 512 MB or 24 GB / 1 GB</td>
<td>45</td>
<td>30</td>
<td>45</td>
<td>45</td>
<td>(\text{w} \leq 45; \text{r} \leq 30 \text{ ReplSrc} \leq 45; \text{ReplDest} \leq 45; \text{ReplDest +w} \leq 45; \text{w+r+ReplSrc} \leq 45; \text{Total} \leq 45)</td>
</tr>
<tr>
<td>DD VE 32 TB</td>
<td>24 GB / 1 GB</td>
<td>90</td>
<td>50</td>
<td>90</td>
<td>90</td>
<td>(\text{w} \leq 90; \text{r} \leq 50 \text{ ReplSrc} \leq 90; \text{ReplDest} \leq 90; \text{ReplDest +w} \leq 90; \text{w+r+ReplSrc} \leq 90; \text{Total} \leq 90)</td>
</tr>
<tr>
<td>DD VE 48 TB</td>
<td>36 GB / 1 GB</td>
<td>90</td>
<td>50</td>
<td>90</td>
<td>90</td>
<td>(\text{w} \leq 90; \text{r} \leq 50 \text{ ReplSrc} \leq 90; \text{ReplDest} \leq 90; \text{ReplDest +w} \leq 90; \text{w+r+ReplSrc} \leq 90; \text{Total} \leq 90)</td>
</tr>
<tr>
<td>DD VE 64 TB</td>
<td>48 GB / 1 GB</td>
<td>90</td>
<td>50</td>
<td>90</td>
<td>90</td>
<td>(\text{w} \leq 90; \text{r} \leq 50 \text{ ReplSrc} \leq 90; \text{ReplDest} \leq 90; \text{ReplDest +w} \leq 90; \text{w+r+ReplSrc} \leq 90; \text{Total} \leq 90)</td>
</tr>
<tr>
<td>DD VE 96 TB</td>
<td>64 GB / 2 GB</td>
<td>180</td>
<td>50</td>
<td>90</td>
<td>180</td>
<td>(\text{w} \leq 180; \text{r} \leq 50 \text{ ReplSrc} \leq 90; \text{ReplDest} \leq 180; \text{ReplDest +w} \leq 180; \text{w+r+ReplSrc} \leq 180; \text{Total} \leq 180)</td>
</tr>
<tr>
<td>DD3300 4 TB</td>
<td>12 GB (virtual memory) / 512 MB</td>
<td>20</td>
<td>16</td>
<td>30</td>
<td>20</td>
<td>(\text{w} \leq 20; \text{r} \leq 16 \text{ ReplSrc} \leq 30; \text{ReplDest} \leq 20; \text{ReplDest +w} \leq 20; \text{w+r+ReplSrc} \leq 30; \text{Total} \leq 30)</td>
</tr>
</tbody>
</table>
Table 6 Data streams sent to a protection system (continued)

<table>
<thead>
<tr>
<th>Model</th>
<th>RAM / NVRAM</th>
<th>Backup write streams</th>
<th>Backup read streams</th>
<th>Repl&lt;sup&gt;a&lt;/sup&gt; source streams</th>
<th>Repl&lt;sup&gt;a&lt;/sup&gt; dest streams</th>
<th>Mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD3300 8 TB</td>
<td>32 GB (virtual memory) / 1.536 GB</td>
<td>90</td>
<td>50</td>
<td>90</td>
<td>90</td>
<td>$w \leq 90; r \leq 50; ReplSrc \leq 90; ReplDest \leq 90; ReplDest +w \leq 90; w+r+ReplSrc \leq 90; Total \leq 90$</td>
</tr>
<tr>
<td>DD3300 16 TB</td>
<td>32 GB (virtual memory) / 1.536 GB</td>
<td>90</td>
<td>50</td>
<td>90</td>
<td>90</td>
<td>$w \leq 90; r \leq 50; ReplSrc \leq 90; ReplDest \leq 90; ReplDest +w \leq 90; w+r+ReplSrc \leq 90; Total \leq 90$</td>
</tr>
<tr>
<td>DD3300 32 TB</td>
<td>46 GB (virtual memory) / 1.536 GB</td>
<td>90</td>
<td>50</td>
<td>90</td>
<td>90</td>
<td>$w \leq 90; r \leq 50; ReplSrc \leq 90; ReplDest \leq 90; ReplDest +w \leq 90; w+r+ReplSrc \leq 90; Total \leq 140$</td>
</tr>
</tbody>
</table>

a. DirRepl, OptDup, MTreeRepl streams

Monitoring the file system

View real-time data storage statistics and manage file system cleaning, expansion, copying, and destruction.

About this task

The File System view provides the following tabs for viewing details:

- **Status**—Display the status of file system services.
- **Summary**—Shows space usage statistics for the active and cloud tiers and enables you to view file system status, configure file system settings, and perform Fast Copy, expand capacity, and destroy file system operations. For Cloud Tier, the **Cloud File Recall** field contains a Recall link to initiate a file recall from the Cloud Tier. A Details link is available if any active recalls are underway. For more information, see the "Recalling a File from the Cloud Tier" topic.
- **Settings**—Display and change system options as well as the current cleaning schedule.
- **Cloud Units**—Display summary information for cloud units, add and modify cloud units, and manage certificates. Shown only when the optional Cloud Tier license is enabled. This view lists summary information (status, network bandwidth, read access, local compression, data movement and data status) the name of the cloud provider, the used capacity, and the licensed capacity. Controls are provided for editing the cloud unit, managing certificates, and adding a new cloud unit.
- **Encryption**—Display encryption status, progress, algorithms, and so on.
- **Space Usage**—Display a visual (but static) representation of data use for the file system at certain points in time.
- **Consumption**—Display space used over time, in relation to total system capacity.
- **Daily Written**—Display the flow of data over time. The data amounts are shown over time for pre- and post-compression amounts.

Procedure

- Select **Data Management > File System**.
Managing file system capacity

DD systems have three progressive levels of capacity. As each level is reached, more operations are progressively disallowed. At each level, deleting data and then performing a file system cleaning operation makes disk space available.

Note: The process of deleting files and removing snapshots does not immediately reclaim disk space, but the next cleaning operation reclaims the space.

- Level 1—At the first capacity level, no more new data can be written to the file system. An informative out-of-space alert is generated. 
  Remedy—Delete unneeded data sets, reduce the retention period, delete snapshots, and perform a file system cleaning operation.

- Level 2—At the second capacity level, files cannot be deleted because deleting files also requires free space. At this level, the system does not have enough free space available to delete files. 
  Remedy—Expire snapshots and perform a file system cleaning operation.

- Level 3—At the third and final capacity level, attempts to expire snapshots, delete files, or write new data fail. 
  Remedy—Perform a file system cleaning operation to free enough space to delete some files or expire some snapshots and then rerun cleaning.

Monitor the capacity with email alerts

Alerts are generated when the file system is at 90%, 95%, and 100% full. To send these alerts to a specific user, add the user to the alert emailing list.

See Managing Alerts.

Performing basic operations

Basic file system operations include enabling and disabling the file system, and in the rare occasion, destroying a file system.

Creating the file system

Create a file system from the Data Management > File System page using the Summary tab.

About this task

There are three reasons to create a file system:

- For a new system.
- When a system is started after a clean installation.
- After a file system has been destroyed.

To create the file system:

Procedure

1. Verify that storage has been installed and configured (see the section on viewing system storage information for more information). If the system does not meet this prerequisite, a warning message is displayed. Install and configure the storage before attempting to create the file system.

2. Select Data Management > File System > Summary > Create.
The File System Create Wizard is launched. Follow the instructions provided.

### Enabling or disabling the file system

The option to enable or disable the file system is dependent on the current state of the file system—if its enabled, you can disable it and vice versa.

**About this task**

- Enabling the file system allows system operations to begin. This ability is available to administrative users only.
- Disabling the file system halts all system operations, including cleaning. This ability is available to administrative users only.

⚠️ **CAUTION** Disabling the file system when a backup application is sending data to the system can cause the backup process to fail. Some backup software applications are able to recover by restarting where they left off when they are able to successfully resume copying files; others might fail, leaving the user with an incomplete backup.

**Procedure**

1. Select **Data Managment > File System > Summary**.
2. For **File System**, click **Enable** or **Disable**.
3. On the confirmation dialog, click **Close**.

### Expanding the file system

You might need to expand the size of a file system if the suggestions given in "When the File System Is Full or Nearly Full" do not clear enough space for normal operations.

**About this task**

A file system may not be expandable, however, for these reasons:

- The file system is not enabled.
- There are no unused disks or enclosures in the Active or Cloud tiers.
- An expanded storage license is not installed.
- There are not enough capacity licenses installed.

DD6300 systems support the option to use ES30 enclosures with 4 TB drives (43.6 TiB) at 50% utilization (21.8 TiB) in the active tier if the available licensed capacity is exactly 21.8 TiB. The following guidelines apply to using partial capacity shelves.

- No other enclosure types or drive sizes are supported for use at partial capacity.
- A partial shelf can only exist in the Active tier.
- Only one partial ES30 can exist in the Active tier.
- Once a partial shelf exists in a tier, no additional ES30s can be configured in that tier until the partial shelf is added at full capacity.

⚠️ **Note:** This requires licensing enough additional capacity to use the remaining 21.8 TiB of the partial shelf.

- If the available capacity exceeds 21.8 TB, a partial shelf cannot be added.
- Deleting a 21 TiB license will not automatically convert a fully-used shelf to a partial shelf. The shelf must be removed, and added back as a partial shelf.

For DD6900, DD9400, and DD9900 systems, storage capacity licenses are available in increments of 60 TB raw (48 TB usable) capacity. Therefore, systems with 8 TB drives may encounter situations where the licensed capacity does not the full capacity of the disks installed in the disk.
shelves. For example, if a system has a licensed capacity of 48 TB usable capacity, and has one pack of 8 TB disks for a total of 96 TB usable capacity, only half the system capacity is available for use.

To expand the file system:

Procedure

1. Select Data Management > File System > Summary > Expand Capacity.

   The Expand File System Capacity wizard is launched. The Storage Tier drop-down list always contains Active Tier, and it may contain Cloud Tier as a secondary choice. The wizard displays the current capacity of the file system for each tier as well as how much additional storage space is available for expansion.

   - Note: File system capacity can be expanded only if the physical disks are installed on the system and file system is enabled.

2. From the Storage Tier drop-down list, select a tier.

3. In the Addable Storage area, select the storage devices to use and click Add to Tier.

4. Follow the instructions in the wizard. When the confirmation page is displayed, click Close.

Destroying the file system

Destroying the file system should be done only under the direction of Customer Support. This action deletes all data in the file system, including virtual tapes. Deleted data is not recoverable. This operation also removes Replication configuration settings.

About this task

This operation is used when it is necessary to clean out existing data, to create a new collection replication destination, or to replace a collection source, or for security reasons because the system is being removed from operation.

- CAUTION The optional Write zeros to disk operation writes zeros to all file system disks, effectively removing all traces of data. If the system contains a large amount of data, this operation can take many hours, or a day, to complete.

   - Note: As this is a destructive procedure, this operation is available to administrative users only.

Procedure

1. Select Data Management > File System > Summary > Destroy.

2. In the Destroy File System dialog box, enter the sysadmin password (it is the only accepted password).

3. Optionally, click the checkbox for Write zeros to disk to completely remove data.

4. Click OK.

Performing cleaning

This section provides information about cleaning and describes how to start, stop, and modify cleaning schedules.

DD OS attempts to maintain a counter called 'Cleanable GiB' for the active tier. This number is an estimation of how much physical (postcomp) space could potentially be reclaimed in the active tier by running clean/garbage collection. This counter is shown using the filesys show space and df commands.

Active Tier:
Resource Size GiB Used GiB Avail GiB Use% Cleanable GiB*

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Run active tier clean if either:

- The value for 'Cleanable GiB' is large
- DDFS has become 100% full (and is therefore read-only)

Clean may not reclaim all potential space in a single run. On systems containing very large datasets, clean works against the portion of the file system containing the most superfluous data and may need to be run multiple times before all potential space is reclaimed.

Starting cleaning

To immediately start a cleaning operation.

Procedure

1. Select Data Management > File System > Summary > Settings > Cleaning.

   The Cleaning tab of the File System Setting dialog displays the configurable settings for each tier.

2. For the active tier:
   a. In the Throttle % text box, enter a system throttle amount. This is the percentage of CPU usage dedicated to cleaning. The default is 50 percent.
   b. In the Frequency drop-down list, select one of these frequencies: Never, Daily, Weekly, Biweekly, and Monthly. The default is Weekly.
   c. For At, configure a specific time.
   d. For On, select a day of the week.

3. For the cloud tier:
   a. In the Throttle % text box, enter a system throttle amount. This is the percentage of CPU usage dedicated to cleaning. The default is 50 percent.
   b. In the Frequency drop-down list, select one of these frequencies: Never, After every 'N' Active Tier cleans.

   ![Note: If a cloud unit is inaccessible when cloud tier cleaning runs, the cloud unit is skipped in that run. Cleaning on that cloud unit occurs in the next run if the cloud unit becomes available. The cleaning schedule determines the duration between two runs. If the cloud unit becomes available and you cannot wait for the next scheduled run, you can start cleaning manually.](image)

4. Click Save.

   ![Note: To start the cleaning operation using the CLI, use the `filesys clean start` command.](image)

   # filesys clean start
   Cleaning started. Use `filesys clean watch` to monitor progress.

   To confirm that cleaning is in progress, use the `filesys status` command.

   # filesys status
   The filesystem is enabled and running.
Cleaning started at 2017/05/19 18:05:58: phase 1 of 12 (pre-merge)
50.6% complete, 64942 GiB free; time: phase 0:01:05, total 0:01:05

If cleaning is already running, the following message is displayed when it is attempted to be started.
**** Cleaning already in progress. Use 'filesys clean watch' to monitor progress.

Note: If clean is not able to start, contact the contracted support provider for further assistance. This issue may indicate that the system has encountered a missing segment error, causing clean to be disabled.

Scheduling or stopping cleaning
To immediately stop or schedule a cleaning operation.

Procedure
1. Select Data Management > File System > Summary > Settings > Cleaning.
   The Cleaning tab of the File System Setting dialog displays the configurable settings for each tier.
2. For the active tier:
   a. In the Frequency drop-down list, select wanted frequency.
3. For the cloud tier:
   a. In the Frequency drop-down list, select wanted frequency.
4. Click Save.

Note: The CLI can be used to check that a clean schedule has been set.
# filesys clean show schedule
If necessary, set an active tier clean schedule. The following example sets cleaning to run every Tuesday at 6 AM:
# filesys clean set schedule Tue 0600
Filesystem cleaning is scheduled to run "Tue" at "0600".

Performing sanitization
To comply with government guidelines, system sanitization, also called data shredding, must be performed when classified or sensitive data is written to any system that is not approved to store such data.

When an incident occurs, the system administrator must take immediate action to thoroughly eradicate the data that was accidentally written. The goal is to effectively restore the storage device to a state as if the event never occurred. If the data leakage is with sensitive data, the entire storage will need to be sanitized using Dell EMC Professional Services' Secure Data erasure practice.

The sanitization command exists to enable the administrator to delete files at the logical level, whether a backup set or individual files. Deleting a file in most file systems consists of just flagging the file or deleting references to the data on disk, freeing up the physical space to be consumed at a later time. However, this simple action introduces the problem of leaving behind a residual representation of underlying data physically on disks. Deduplicated storage environments are not immune to this problem.

Shredding data in a system implies eliminating the residual representation of that data and thus the possibility that the file may be accessible after it has been shredded. Dell EMC's sanitization
approach ensures is compliant with the 2007 versions of Department of Defense (DoD) 5220.22 of the following specifications:

- US Department of Defense 5220.22-M Clearing and Sanitization Matrix
- National Institute of Systems and Technology (NIST) Special Publication 800-88 Guidelines for Media Sanitization

Sanitizing deduplicated data

Protection systems sanitize data in place, in its native deduplicated state.

Deduplication storage systems extract common data patterns from files sent to the system and store only unique copies of these patterns, referencing all the redundant instances. Because these data patterns or segments may potentially be shared among many files in the system, the sanitization process must first determine whether each of the segments of the contaminated file are shared with a clean file and then erase only those segments that are not shared, along with any contaminated metadata.

All storage tiers, caches, unused capacity, and free space are cleared so that every copy of every segment that belongs exclusively to the deleted files is eradicated. The system reclaims and overwrites all of the storage occupied by these segments to effectively restore the storage device to a state as if the contaminated files never existed in that system.

Sanitization level 1: data clearing or shredding

If the data you need to remove is unclassified, as defined in the "US Department of Defense 5220.22-M Clearing and Sanitization Matrix," Level 1 sanitization can be used to overwrite the affected storage once. This provides the basis for handling most data shredding and system sanitization cases.

About this task

The system sanitization feature ensures that every copy of every segment that belongs only to erased files is overwritten using a single-pass zerotization mechanism. Clean data in the system being sanitized is online and available to users.

Procedure

1. Delete the contaminated files or backups through the backup software or corresponding client. In the case of backups, be sure to manage the backup software appropriately to ensure that related files on that image are reconciled, catalog records are managed as required, and so forth.

2. Run the system sanitize start command on the contaminated system to cause all previously used space in it to be overwritten once (see the figure below).

3. Wait for the affected system to be sanitized. Sanitization can be monitored by using the system sanitize watch command.

If the affected system has replication enabled, all the systems containing replicas need to be processed in a similar manner. Depending on how much data exists in the system and how it is distributed, the system sanitize command could take some time. However, during this time, all clean data in the system is available to users.
Sanitization level 2: full system sanitization

If the data you need to remove is classified, as defined in the "US Department of Defense 5220.22-M Clearing and Sanitization Matrix," Level 2 sanitization, or full system sanitization, is now required.

About this task

Dell EMC recommends Blancco for multi-pass overwrites with any overwrite pattern and a certificate. This provides the basis for handling universal Department of Defense requirements where complete system sanitization is required. For more information, go to:


Modifying basic settings

Change the type of compression used, marker types, Replica write status, and Staging Reserve percentage, as described in this section.

Changing local compression

Use the General tab of the File System Settings dialog to configure the local compression type.

About this task

>Note: Do not change the type of local compression unless it is necessary.

Procedure

2. From the Local Compression Type drop-down list, select a compression type.

<table>
<thead>
<tr>
<th>Table 7 Compression type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Option</strong></td>
</tr>
<tr>
<td>NONE</td>
</tr>
<tr>
<td>LZ</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
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</tr>
<tr>
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<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>GZFAST</td>
</tr>
</tbody>
</table>
Table 7 Compression type (continued)

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMC recommends the gzfast option, which is the default setting, for the following systems:</td>
<td></td>
</tr>
<tr>
<td>• DD6900</td>
<td></td>
</tr>
<tr>
<td>• DD9400</td>
<td></td>
</tr>
<tr>
<td>• DD9900</td>
<td></td>
</tr>
<tr>
<td>GZ</td>
<td>A zip-style compression that uses the least amount of space for data storage (10% to 20% less than lz on average; however, some datasets get much higher compression). This also uses the most CPU cycles (up to five times as much as lz). The gz compression type is commonly used for nearline storage applications in which performance requirements are low.</td>
</tr>
</tbody>
</table>

3. Click Save.

Changing read-only settings

Change the replica to writable. Some backup applications must see the replica as writable to do a restore or vault operation from the replica.

Procedure

2. In the Report Replica as Writable area, toggle between Disabled and Enabled as appropriate.
3. Click Save.

Working with disk staging

Disk staging enables a protection system to serve as a staging device, where the system is viewed as a basic disk via a CIFS share or NFS mount point.

Disk staging can be used in conjunction with your backup software, such as NetWorker and Veritas NetBackup (NBU), it does not require a license, and is disabled by default.

Note: The DD VTL feature is not required or supported when the system is used as a Disk Staging device.

The reason that some backup applications use disk staging devices is to enable tape drives to stream continuously. After the data is copied to tape, it is retained on disk for as long as space is available. Should a restore be needed from a recent backup, more than likely the data is still on disk and can be restored from it more conveniently than from tape. When the disk fills up, old backups can be deleted to make space. This delete-on-demand policy maximizes the use of the disk.

In normal operation, the system does not reclaim space from deleted files until a cleaning operation is done. This is not compatible with backup software that operates in a staging mode, which expects space to be reclaimed when files are deleted. When you configure disk staging, you reserve a percentage of the total space—typically 20 to 30 percent—in order to allow the system to simulate the immediate freeing of space.

The amount of available space is reduced by the amount of the staging reserve. When the amount of data stored uses all of the available space, the system is full. However, whenever a file is deleted, the system estimates the amount of space that will be recovered by cleaning and borrows from the staging reserve to increase the available space by that amount. When a cleaning operation runs, the space is actually recovered and the reserve restored to its initial size. Since the amount of space made available by deleting files is only an estimate, the actual space reclaimed by...
cleaning may not match the estimate. The goal of disk staging is to configure enough reserve so that you do not run out before cleaning is scheduled to run.

**Configuring disk staging**

Enable disk staging and specify the staging reserve percentage.

**Procedure**

2. In the Staging Reserve area, toggle between Disabled and Enabled as appropriate.
3. If Staging Reserve is enabled, enter a value in the % of Total Space box.
   - This value represents the percentage of the total disk space to be reserved for disk staging, typically 20 to 30%.
4. Click Save.

**Tape marker settings**

Backup software from some vendors insert markers (tape markers, tag headers, or other names are used) in all data streams (both file system and DD VTL backups) sent to a protection system.

Markers can significantly degrade data compression. As such, the default marker type auto is set and cannot be changed by the user. If this setting is not compatible with your backup software, contact your contracted support provider.

*Note:* For information about how applications work, see *How EMC Data Domain Systems Integrate into the Storage Environment*. You can use these matrices and integration guides to troubleshoot vendor-related issues.

**SSD Random workload share**

The value for the threshold at which to cap random I/O on the protection system can be adjusted from the default value to accommodate changing requirements and I/O patterns.

By default, the SSD random workload share is set at 40%. This value can be adjusted up or down as needed. Select Data Managment > File System > Summary > Settings > Workload Balance, and adjust the slider.

Click Save.

**Fast copy operations**

A fast copy operation clones files and directory trees of a source directory to a target directory on a protection system.

The force option allows the destination directory to be overwritten if it exists. Executing the fast copy operation displays a progress status dialog box.

*Note:* A fast copy operation makes the destination equal to the source, but not at a specific time. There are no guarantees that the two are or were ever equal if you change either folder during this operation.
Performing a fast copy operation

Copy a file or directory tree from a protection system source directory to another destination on the same system.

Procedure

1. Select Data Management > File System > Summary > Fast Copy.
   The Fast Copy dialog is displayed.

2. In the Source text box, enter the pathname of the directory where the data to be copied resides. For example, /data/co1/backup/.snapshot/snapshot-name/dir1.
   
   | Note: co1 uses a lower case L followed by the number 1.

3. In the Destination text box, enter the pathname of the directory where the data will be copied to. For example, /data/co1/backup/dir2. This destination directory must be empty, or the operation fails.
   
   - If the Destination directory exists, click the checkbox Overwrite existing destination if it exists.

4. Click OK.

5. In the progress dialog box that appears, click Close to exit.
CHAPTER 14

Managing MTrees

This chapter includes:

- MTrees overview .................................................................................................................. 172
- Monitoring MTree usage ...................................................................................................... 173
- Understanding physical capacity measurement ................................................................. 173
- Managing MTree operations .............................................................................................. 176
MTrees overview

An MTree is a logical partition of the file system.

You can use MTrees for CIFS shares, DD Boost storage units, DD VTL pools, or NFS exports. MTrees allow granular management of snapshots, quotas, and DD Retention Lock.

Note:
The maximum number of configurable MTrees on the system can be designated for MTree replication contexts.

Do not place user files in the top-level directory of an MTree. Create subdirectories within the MTree to store user data.

MTree limits

MTree limits for DD systems

Table 8 Number of supported MTrees

<table>
<thead>
<tr>
<th>System</th>
<th>DD OS Version</th>
<th>Supported configurable MTrees</th>
<th>Supported concurrently active MTrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD9900</td>
<td>7.0 and later</td>
<td>256</td>
<td>256</td>
</tr>
<tr>
<td>DD6900, DD9400</td>
<td>7.0 and later</td>
<td>128</td>
<td>128</td>
</tr>
<tr>
<td>DD9800</td>
<td>6.0 and later</td>
<td>256</td>
<td>256</td>
</tr>
<tr>
<td>DD9500</td>
<td>5.7 and later</td>
<td>256</td>
<td>256</td>
</tr>
<tr>
<td>DD6800, DD9300</td>
<td>6.0 and later</td>
<td>128</td>
<td>128</td>
</tr>
<tr>
<td>DD4200, DD4500, DD7200</td>
<td>5.7 and later</td>
<td>128</td>
<td>128</td>
</tr>
<tr>
<td>DD6300</td>
<td>6.0 and later</td>
<td>100</td>
<td>32</td>
</tr>
</tbody>
</table>

MTree Quotas

MTree quotas apply only to the logical data written to the MTree.

An administrator can set storage space restrictions for an MTree, Storage Unit, or DD VTL pool to prevent it from consuming excess space. MTrees have hard quota limits and soft quota limits. You can set soft, hard, or a combination of both limits. The values must be integers, and the soft value must be less than the hard value.

When a soft limit is set, an alert is generated when the MTree size exceeds the limit, but data can still be written to it. When a hard limit is set and the limit is reached, data cannot be written to the MTree and all write operations fail until data is deleted from the MTree.

See Configure MTree quotas on page 177 for more information.

Quota enforcement

Enable or disable quota enforcement.
Viewing and monitoring MTree usage

You can view active MTrees and real-time data storage statistics. Information in the overview area is helpful for visualizing space usage trends.

Select Data Management > MTree.

The MTree view shows a list of configured MTrees. Details of the selected MTree are shown in the Summary tab. The Space Usage and Daily Written tabs show graphs that visually display space usage amounts and data written trends for the selected MTree. The view also contains options that enable MTree configuration for CIFS, NFS, and DD Boost, as well as sections for managing snapshots and DD Retention Lock for an MTree.

To filter for specific MTree names, enter text (wildcards are supported) in the Filter By MTree Name box and click Update.

Note: Physical capacity measurement (PCM) provides space usage information for MTrees. For more information about PCM, see the section regarding understanding physical capacity measurement.

Monitoring MTree usage

Display space usage and data written trends for an MTree.

Procedure

1. Select Data Management > MTree.

   The MTree view shows a list of configured MTrees. Details of the selected MTree are shown in the Summary tab. The Space Usage and Daily Written tabs show graphs that visually display space usage amounts and data written trends for the selected MTree. The view also contains options that enable MTree configuration for CIFS, NFS, and DD Boost, as well as sections for managing snapshots and DD Retention Lock for an MTree.

   Note: Physical capacity measurement (PCM) provides space usage information for MTrees. For more information about PCM, see the section regarding understanding physical capacity measurement.

Understanding physical capacity measurement

Physical capacity measurement (PCM) provides space usage information for a sub-set of storage space.

From the DD System Manager, PCM provides space usage information for MTrees. Using the command line interface you can view space usage information for MTrees, tenants, tenant units, and path sets.

Once a path is selected for PCM, all paths under it are automatically included.

The DD OS Command Reference Guide provides more information about using PCM from the command line.

Enabling, disabling, and viewing physical capacity measurement

Physical capacity measurement provides space usage information for an MTree.

Procedure

1. Select Data Management > File System > Summary.

   The system displays the Summary tab in the File System panel.
2. Click ^ in the bottom-right corner to view the status panel.
3. Click Enable to the right of Physical Capacity Measurement Status to enable PCM.
4. Click Details to the right of Physical Capacity Measurement Status to view currently running PCM jobs.
   - **MTree**: The MTree that PCM is measuring.
   - **Priority**: The priority (normal or urgent) for the task.
   - **Submit Time**: The time the task was requested.
   - **Duration**: The length of time PCM ran to accomplish the task.
5. Click Disable to the right of Physical Capacity Measurement Status to disable PCM and cancel all currently running PCM jobs.

**Initializing physical capacity measurement**

Physical capacity measurement (PCM) initialization is a one-time action that can take place only if PCM is enabled and the cache has not been initialized. It cleans the caches and enhances measuring speed. During the initialization process, you can still manage and run PCM jobs.

**Procedure**
   1. Select **Data Management > File System > Configuration**.
   2. Click **Initialize** under Physical Capacity Measurement to the right of Cache.
   3. Click **Yes**.

**Managing physical capacity measurement schedules**

Create, edit, delete, and view physical capacity measurement schedules. This dialog only displays schedules created for MTrees and schedules that currently have no assignments.

**Procedure**
   1. Select **Data Management > MTree > Manage Schedules**.
      - Click **Add (+)** to create a schedule.
      - Select a schedule and click **Modify** (pencil) to edit the schedule.
      - Select a schedule and click **Delete** (X) to delete a schedule.
      2. Optionally, click the heading names to sort by schedule: **Name**, **Status** (Enabled or Disabled), **Priority** (Urgent or Normal), **Schedule** (schedule timing), and **MTree Assignments** (the number of MTrees the schedule is assigned to).

**Creating physical capacity measurement schedules**

Create physical capacity measurement schedules and assign them to MTrees.

**Procedure**
   1. Select **Data Management > MTree > Manage Schedules**.
   2. Click **Add (+)** to create a schedule.
   3. Enter the name of the schedule.
   4. Select the status:
      - **Normal**: Submits a measurement task to the processing queue.
      - **Urgent**: Submits a measurement task to the front of the processing queue.
5. Select how often the schedule triggers a measurement occurrence: every Day, Week, or Month.
   - For Day, select the time.
   - For Week, select the time and day of the week.
   - For Month, select the time, and days during the month.

6. Select MTree assignments for the schedule (the MTrees that the schedule will apply to):

7. Click Create.

8. Optionally, click on the heading names to sort by schedule: Name, Status (Enabled or Disabled) Priority (Urgent or Normal), Schedule (schedule timing), and MTree Assignments (the number of MTrees the schedule is assigned to).

**Editing physical capacity measurement schedules**

Edit a physical capacity measurement schedule.

**Procedure**

1. Select Data Management > MTree > Manage Schedules.
2. Select a schedule and click Modify (pencil).
3. Modify the schedule and click Save.
   
   Schedule options are described in the Creating physical capacity measurement schedules topic.
4. Optionally, click the heading names to sort by schedule: Name, Status (Enabled or Disabled) Priority (Urgent or Normal), Schedule (schedule timing), and MTree Assignments (the number of MTrees the schedule is assigned to).

**Assigning physical capacity measurement schedules to an MTree**

Attach schedules to an MTree.

**Before you begin**

Physical capacity measurement (PCM) schedules must be created.

**About this task**

Note: Administrators can assign up to three PCM schedules to an MTree.

**Procedure**

1. Select Data Management > MTree > Summary.
2. Select MTrees to assign schedules to.
3. Scroll down to the Physical Capacity Measurements area and click Assign to the right of Schedules.
4. Select schedules to assign to the MTree and click Assign.

**Starting physical capacity measurement immediately**

Start the measurement process as soon as possible.

**Procedure**

1. Select Data Management > MTree > Summary.
2. Scroll down to the Physical Capacity Measurements area and click Measure Now to the right of Submitted Measurements.
3. Select **Normal** (Submits a measurement task to the processing queue), or **Urgent** (Submits a measurement task to the front of the processing queue).

4. Click **Submit**.

**Setting the physical capacity measurement throttle**

Set the percentage of system resources that are dedicated to physical capacity measurement.

**Procedure**

1. Select **Data Management > File System > Settings**.
2. In the Physical Capacity Measurement area, click **Edit** to the left of Throttle.
3. | Option               | Description                                                                 |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Click Default</td>
<td>Enters the 20% system default.</td>
</tr>
<tr>
<td>Type throttle percent</td>
<td>The percentage of system resources that are dedicated to physical capacity measurement.</td>
</tr>
</tbody>
</table>
4. Click **Save**.

**Managing MTree operations**

This section describes MTree creation, configuration, how to enable and disable MTree quotas, and so on.

**Creating an MTree**

An MTree is a logical partition of the file system. Use MTrees CIFS shares, DD Boost storage units, DD VTL pools, or NFS exports.

**About this task**

MTrees are created in the area `/data/col1/mtree_name`.

**Procedure**

1. Select **Data Management > MTree**.
2. In the MTree overview area, click **Create**.
3. Enter the name of the MTree in the MTree Name text box. MTree names can be up to 50 characters. The following characters are acceptable:
   - Upper- and lower-case alphabetical characters: A-Z, a-z
   - Numbers: 0-9
   - Embedded space
   - comma (,)
   - period (.), as long as it does not precede the name.
   - explanation mark (!)
   - number sign (#)
   - dollar sign ($)
   - per cent sign (%)
   - plus sign (+)
Set storage space restrictions for the MTree to prevent it from consuming excessive space. Enter a soft or hard limit quota setting, or both. With a soft limit, an alert is sent when the MTree size exceeds the limit, but data can still be written to the MTree. Data cannot be written to the MTree when the hard limit is reached.

Note: The quota limits are pre-compressed values. To set quota limits for the MTree, select Set to Specific value and enter the value. Select the unit of measurement: MiB, GiB, TiB, or PiB.

Note: When setting both soft and hard limits, a quota’s soft limit cannot exceed the quota’s hard limit.

Click OK.

The new MTree displays in the MTree table.

Note: You may need to expand the width of the MTree Name column to see the entire pathname.

Configure and enable/disable MTrees

Set the storage space restriction for an MTree, Storage Unit, or DD VTL pool.

The Data Management > Quota page shows the administrator how many MTrees have no soft or hard quotas set. For MTrees with quotas set, the page shows the percentage of pre-compressed soft and hard limits used.

Consider the following information when managing quotas:

- MTTree quotas apply to ingest operations. These quotas can be applied to DD VTL, DD Boost, CIFS, and NFS.
- Snapshots are not counted.
- Quotas cannot be set on the /data/coll/backup directory.
- The maximum quota value allowed is 4096 PiB.

Configure MTrees

Use the MTree tab or the Quota tab to configure MTree quotas.
### Configuring MTree quotas

Enter values for hard and soft quotas and select the unit of measurement.

**Procedure**

1. In the Configure Quota for MTrees dialog box, enter values for hard and soft quotas and select the unit of measurement: MiB, GiB, TiB, or PiB.
2. Click OK.

### Deleting an MTree

Removes the MTree from the MTree table. The MTree data is deleted at the next cleaning.

**About this task**

- **Note:** Because the MTree and its associated data are not removed until file cleaning is run, you cannot create a new MTree with the same name as a deleted MTree until the deleted MTree is completely removed from the file system by the cleaning operation.

**Procedure**

1. Select Data Management > MTree.
2. Select an MTree.
3. In the MTree overview area, click Delete.
4. Click OK at the Warning dialog box.
5. Click Close in the Delete MTree Status dialog box after viewing the progress.

### Undeleting an MTree

Undelete retrieves a deleted MTree and its data and places it back in the MTree table.

**About this task**

An undelete of an MTree retrieves a deleted MTree and its data and places it back in the MTree table.

An undelete is possible only if file cleaning has not been run after the MTree was marked for deletion.

- **Note:** You can also use this procedure to undelete a storage unit.

**Procedure**

1. Select Data Management > MTree > More Tasks > Undelete.
2. Select the checkboxes of the MTrees you wish to bring back and click OK.
3. Click **Close** in the Undelete MTree Status dialog box after viewing the progress.
   The recovered MTree displays in the MTree table.

**Renaming an MTree**

Use the Data Management MTree GUI to rename MTrees.

**Procedure**

1. Select **Data Management > MTree**.
2. Select an MTree in the MTree table.
3. Select the Summary tab.
4. In the Detailed Information overview area, click **Rename**.
5. Enter the name of the MTree in the New MTree Name text box.
   See the section about creating an MTree for a list of allowed characters.
6. Click **OK**.
   The renamed MTree displays in the MTree table.
Managing MTrees
CHAPTER 15
Managing Snapshots

This chapter includes:

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- Monitoring snapshots and their schedules ................................ 182
- Managing snapshots ............................................................... 182
- Managing snapshot schedules ................................................. 184
- Recover data from a snapshot .................................................. 186
Snapshots overview

A snapshot is a read-only copy of a designated MTree at a specific time. You can use a snapshot as a restore point, you can manage MTree snapshots and schedules, and you can view the status of existing snapshots.

Snapshots for the MTree named backup are created in the system directory /data/coll/backup/.snapshot. Each directory under /data/coll/backup also has a .snapshot directory with the name of each snapshot that includes the directory. Each MTree has the same structure. As an example, an MTree named SantaClara would have a system directory /data/coll/SantaClara/.snapshot, and each subdirectory in /data/coll/SantaClara would have a .snapshot directory as well.

Snapshots and CIFS Protocol

As of DD OS 5.0, the .snapshot directory is no longer visible in the directory listing in Windows Explorer or DOS CMD shell. You can access the .snapshot directory by entering its name in the Windows Explorer address bar or the DOS CMD shell. For example, \dd\backup\.snapshot or Z:\.snapshot when Z: is mapped as \dd\backup).

Snapshot limitations

- Snapshots created on the source DD system are replicated to the destination system with collection and MTree replication. You cannot create snapshots on a system that is a replica for collection replication. You cannot create a snapshot on the destination MTree of an MTree replication. Directory replication does not replicate the snapshots, and you must create snapshots separately on the destination system.
- The maximum number of snapshots allowed per MTree is 750. Warnings are sent when the number of snapshots per MTree reaches 90% of the maximum allowed number (from 675 to 749 snapshots), and an alert is generated when the maximum number is reached. To clear the warning, expire snapshots, and then run the file system cleaning operation. An expired snapshot remains available until the next file system cleaning operation. To identify an MTree that is nearing the maximum number of snapshots, check the Snapshots panel of the MTree page regarding viewing MTree snapshot information.
- Snapshot retention for an MTree does not take any extra space, but if a snapshot exists and the original file no longer exists, the space cannot be reclaimed.
- The .snapshot directory is not visible if only /data is mounted. When the MTree itself is mounted, the .snapshot directory is visible.

Monitoring snapshots and their schedules

This section provides detailed and summary information about the status of snapshots and snapshot schedules.

Managing snapshots

This section describes how to manage snapshots.
Creating a snapshot

Create a snapshot when an unscheduled snapshot is required.

About this task

Procedure

1. Select Data Management > Snapshots to open the Snapshots view.
2. In the Snapshots view, click Create.
3. In the Name text field, enter the name of the snapshot.
4. In the MTree(s) area, select a checkbox of one or more MTrees in the Available MTrees panel and click Add.
5. In the Expiration area, select one of these expiration options:
   a. Never Expire.
   b. Enter a number for the In text field, and select Days, Weeks, Month, or Years from the drop-down list. The snapshot will be retained until the same time of day as when it is created.
   c. Enter a date (using the format mm/dd/yyyy) in the On text field, or click Calendar and click a date. The snapshot will be retained until midnight (00:00, the first minute of the day) of the given date.
6. Click OK and Close.

Modifying a snapshot expiration date

Modify snapshot expiration dates to remove them or extend their life for auditing or compliance.

Procedure

1. Select Data Management > Snapshots to open the Snapshots view.
2. Click the checkbox of the snapshot entry in the list and click Modify Expiration Date.
   - Note: More than one snapshot can be selected by clicking additional checkboxes.
3. In the Expiration area, select one of the following for the expiration date:
   a. Never Expire.
   b. In the In text field, enter a number and select Days, Weeks, Month, or Years from the drop-down list. The snapshot will be retained until the same time of day as when it is created.
   c. In the On text field, enter a date (using the format mm/dd/yyyy) or click Calendar and click a date. The snapshot will be retained until midnight (00:00, the first minute of the day) of the given date.
4. Click OK.

Renaming a snapshot

Use the Snapshot tab to rename a snapshot.

Procedure

1. Select Data Management > Snapshots to open the Snapshots view.
2. Select the checkbox of the snapshot entry in the list and click Rename.
3. In the Name text field, enter a new name.
4. Click OK.

**Expiring a snapshot**

Snapshots cannot be deleted. To release disk space, expire snapshots and they will be deleted in the next cleaning cycle after the expiry date.

**Procedure**

1. Select **Data Management > Snapshots** to open the Snapshots view.
2. Click the checkbox next to snapshot entry in the list and click **Expire**.

   ![Note: More than one snapshot can be selected by selecting additional checkboxes. The snapshot is marked as Expired in the Status column and will be deleted at the next cleaning operation.]

**Managing snapshot schedules**

Set up and manage a series of snapshots that will be automatically taken at regular intervals (a snapshot schedule).

Multiple snapshot schedules can be active at the same time.

![Note: If multiple snapshots with the same name are scheduled to occur at the same time, only one is retained. Which one is retained is indeterminate, thus only one of the snapshots with that name should be scheduled for a given time.]

**Creating a snapshot schedule**

Create a weekly or monthly snapshot schedule using the Data Management GUI.

**Procedure**

1. Select **Data Management > Snapshots > Schedules** to open the Schedules view.
2. Click **Create**.
3. In the **Name** text field, enter the name of the schedule.
4. In the **Snapshot Name Pattern** text box, enter a name pattern.

   Enter a string of characters and variables that translates to a snapshot name (for example, `scheduled-%Y-%m-%d-%H-%m`, translates to "scheduled-2012-04-17T17-33"). Use alphabetic characters, numbers, _, -, and variables that translate into current values.

5. Click **Validate Pattern & Update Sample**.
6. Click **Next**.
7. Select the date when the schedule will be executed:
   a. Weekly—Click checkboxes next to the days of the week or select **Every Day**.
   b. Monthly—Click the **Selected Days** option and click the dates on the calendar, or select the **Last Day of the Month** option.
   c. Click **Next**.
8. Select the time of day when the schedule will be executed:
   a. At Specific Times—Click **Add** and in the Time dialog that appears, enter the time in the format `hh:mm`, and click **OK**.
b. In Intervals—Click the drop-down arrows to select the start and end time \textit{hh:mm} and AM or PM. Click the \textit{Interval} drop-down arrows to select a number and then the hours or minutes of the interval.

c. Click \textit{Next}.

9. In the Retention Period text entry field, enter a number and click the drop-down arrow to select days, months, or years, and click \textit{Next}.

Schedules must explicitly specify a retention time.

10. Review the parameters in the schedule summary and click \textit{Finish} to complete the schedule or \textit{Back} to change any entries.

11. If an MTree is not associated with the schedule, a warning dialog box asks if you would like to add an MTree to the schedule. Click \textit{OK} to continue (or \textit{Cancel} to exit).

12. To assign an MTree to the schedule, in the MTree area, click the checkbox of one or more MTrees in the Available MTrees panel, then click \textit{Add} and \textit{OK}.

**Naming conventions for snapshots created by a schedule**

The naming convention for scheduled snapshots is the word scheduled followed by the date when the snapshot is to occur, in the format \textit{scheduled-yyyy-mm-dd-hh-mm}. For example, \textit{scheduled-2009-04-27-13-30}.

The name “\textit{mon_thurs}” is the name of a snapshot schedule. Snapshots generated by that schedule might have the names \textit{scheduled-2008-03-24-20-00}, \textit{scheduled-2008-03-25-20-00}, etc.

**Modifying a snapshot schedule**

Change the snapshot schedule name, date, and retention period.

**Procedure**

1. In the schedule list, select the schedule and click \textit{Modify}.

2. In the Name text field, enter the name of the schedule and click \textit{Next}.

   Use alphanumeric characters, and the \_ and -. 

3. Select the date when the schedule is to be executed:

   a. Weekly—Click checkboxes next to the days of the week or select \textit{Every Day}.

   b. Monthly—Click the \textit{Selected Days} option and click the dates on the calendar, or select the \textit{Last Day of the Month} option.

   c. Click \textit{Next}.

4. Select the time of day when the schedule is to be executed:

   a. At Specific Times—Click the checkbox of the scheduled time in the Times list and click \textit{Edit}. In the Times dialog that appears, enter a new time in the format \textit{hh:mm}, and click \textit{OK}. Or click \textit{Delete} to remove the scheduled time.

   b. In Intervals—Click the drop-down arrows to select the start and end time \textit{hh:mm} and AM or PM. Click the Interval drop-down arrows to select a number and then the hours or minutes of the interval.

   c. Click \textit{Next}.

5. In the Retention Period text entry field, enter a number and click the drop-down arrow to select days, months, or years, and click \textit{Next}.
6. Review the parameters in the schedule summary and click **Finish** to complete the schedule or **Back** to change any entries.

**Deleting a snapshot schedule**

Delete a snapshot schedule from the schedule list.

**Procedure**

1. In the schedule list, click the checkbox to select the schedule and click **Delete**.
2. In the verification dialog box, click **OK** and then **Close**.

**Recover data from a snapshot**

Use the fastcopy operation to retrieve data stored in a snapshot. See the section regarding fast copy operations.
CHAPTER 16

CIFS

This chapter includes:

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- Performing CIFS setup ......................................................... 188
- Working with shares ............................................................ 190
- Configuring SMB signing .................................................... 195
- Managing access control ..................................................... 196
- Monitoring CIFS operation ................................................ 200
- Performing CIFS troubleshooting ...................................... 203
CIFS overview

Common Internet File System (CIFS) clients can have access to the system directories on the protection system.

- The /data/coll/backup directory is the destination directory for compressed backup server data.
- The /ddvar/core directory contains system core and log files (remove old logs and core files to free space in this area).

**Note:** You can also delete core files from the /ddvar or the /ddvar/ext directory if it exists.

Clients, such as backup servers that perform backup and restore operations need access to the /data/coll/backup directory, at a minimum. Clients that have administrative access need to be able to access the /ddvar/core directory to retrieve core and log files.

As part of the initial protection system configuration, CIFS clients were configured to access these directories. This chapter describes how to modify these settings and how to manage data access using the DD System Manager and the cifs command.

**Note:**
- The DD System Manager Protocols > CIFS page allows you to perform major CIFS operations such as enabling and disabling CIFS, setting authentication, managing shares, and viewing configuration and share information.
- The cifs command contains all the options to manage CIFS backup and restores between Windows clients and protection systems, and to display CIFS statistics and status. For complete information about the cifs command, see the DD OS Command Reference Guide.
- For information about setting up clients to use the protection system as a server, see the related tuning guide, such as the CIFS Tuning Guide, which is available from the support.emc.com web site. Search for the complete name of the document using the Search field.

Performing CIFS setup

This section contains instructions about enabling CIFS services, naming the CIFS server, and so on.

HA systems and CIFS

HA systems are compatible with CIFS; however, if a CIFS job is in progress during a failover, the job will need to be restarted.

"/ddvar is an ext3 file system, and cannot be shared like a normal MTree-based share. The information in /ddvar will become stale when the active node fails over to the standby node because the filehandles are different on the two nodes. If /ddvar is mounted to access log files or upgrade the system, unmount and remount /ddvar if a failover has occurred since the last time /ddvar was mounted."
Preparing clients for access to protection systems

Find documentation online.

Procedure

1. Log into the Online Support (support.emc.com) web site.
2. In the Search field, enter the name of the document that you are looking for.
3. Select the appropriate document, such as the *CIFS and Data Domain Systems Tech Note*.
4. Follow the instructions in the document.

Enabling CIFS services

Enable the client to access the system using the CIFS protocol.

About this task

After configuring a client for access to protection systems, enable CIFS services, which allows the client to access the system using the CIFS protocol.

Procedure

1. For the system selected in the DD System Manager Navigation tree, click **Protocols > CIFS**.
2. In the CIFS Status area, click **Enable**.

Naming the CIFS server

The hostname for the protection system that serves as the CIFS server is set during the system’s initial configuration.

To change a CIFS server name, see the procedures in the section regarding setting authentication parameters.

A system’s hostname should match the name assigned to its IP address, or addresses, in the DNS table. Otherwise authentication, as well as attempts to join a domain, can fail. If you need to change the system’s hostname, use the `net set hostname` command, and also modify the system’s entry in the DNS table.

When the system acts as a CIFS server, it takes the hostname of the system. For compatibility purposes, it also creates a NetBIOS name. The NetBIOS name is the first component of the hostname in all uppercase letters. For example, the hostname `jp9.oasis.local` is truncated to the NetBIOS name `JP9`. The CIFS server responds to both names.

You can have the CIFS server respond to different names at the NetBIOS levels by changing the NetBIOS hostname.

Changing the NetBIOS hostname

Change the NetBIOS hostname with the CLI.

Procedure

1. Display the current NetBIOS name by entering:

    ```bash
    # cifs show config
    ```

2. Use the

    ```bash
    cifs set nb-hostname nb-hostname
    ```
    command.
Setting authentication parameters

Set the authentication parameters for working with CIFS.
Click the Configure link in to the left of the Authentication label in the Configuration tab. The system will navigate to the Administration > Access > Authentication tab where you can configure authentication for Active Directory, Kerberos, Workgroups, and NIS.

Setting CIFS options

View CIFS configuration, restrict anonymous connections.

Procedure
1. Select Protocols > CIFS > Configuration.
2. In the Options area, click Configure Options.
3. To restrict anonymous connections, click the checkbox of the Enable option in the Restrict Anonymous Connections area.
4. In the Log Level area, click the drop-down list to select the level number.
   The level is an integer from 1 (one) to 5 (five). One is the default system level that sends the least-detailed level of CIFS-related log messages, five results in the most detail. Log messages are stored in the file /ddvar/log/debug/cifs/cifs.log.
   
   ![Note] A log level of 5 degrades system performance. Click the Default in the Log Level area after debugging an issue. This sets the level back to 1.

5. In the Server Signing area, select:
   - Enabled to enable server signing
   - Disabled to disable server signing
   - Required when server signing is required

Disabling CIFS services

Prevent clients from accessing the protection system.

Procedure
1. Select Protocols > CIFS.
2. In the Status area, click Disable.
3. Click OK.
   Even after disabling CIFS access, CIFS authentication services continue to run on the system. This continuation is required to authenticate active directory domain users for management access.

Working with shares

To share data, create shares on the protection system.
Shares are administered on the protection system and the CIFS systems.
Creating shares

When creating shares, you have to assign client access to each directory separately and remove access from each directory separately. For example, a client can be removed from /ddvar and still have access to /data/coll/backup.

About this task

A protection system supports a maximum number of 3000 CIFS shares, and 600 simultaneous connections are allowed. However, the maximum number of connections that are supported is based on system memory. See the section regarding setting the maximum open files on a connection for more information.

Note: If Replication is to be implemented, a system can receive backups from both CIFS clients and NFS clients as long as separate directories are used for each. Do not mix CIFS and NFS data in the same directory.

Do not use the top level of an MTree to host a CIFS share. Create a subdirectory within the MTree, and specify that subdirectory as the path for the CIFS share.

Procedure

1. Select Protocols > CIFS tabs to go to the CIFS view.
2. Ensure that authentication has been configured, as described in the section regarding setting authentication parameters.
3. On the CIFS client, set shared directory permissions or security options.
4. On the CIFS view, click the Shares tab.
5. Click Create.
6. In the Create Shares dialog box, enter the following information:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share Name</td>
<td>A descriptive name for the share.</td>
</tr>
<tr>
<td>Directory Path</td>
<td>The path to the target directory (for example, /data/coll/backup/dir1).</td>
</tr>
<tr>
<td></td>
<td>Note: col1 uses the lower case letter L followed by the number 1.</td>
</tr>
<tr>
<td>Comment</td>
<td>A descriptive comment about the share.</td>
</tr>
</tbody>
</table>

Note: The share name can be a maximum of 80 characters and cannot contain the following characters: \ / : * ? “ < > | + [ ] ; , = or extended ASCII characters.

7. Add a client by clicking Add (+) in the Clients area. The Client dialog box is displayed. Enter the name of the client in the Client text box and click OK.

Consider the following when entering the client name.

- No blanks or tabs (white space) characters are enabled.
- It is not recommended to use both an asterisk (*) and individual client name or IP address for a given share. When an asterisk (*) is present, any other client entries for that share are not used.

---

1. May be affected by hardware limitations.
- It is not required to use both client name and client IP address for the same client on a given share. Use client names when the client names are defined in the DNS table.
- To make share available to all clients, specify an asterisk (*) as the client. All users in the client list can access the share, unless one or more user names are specified, in which case only the listed names can access the share.

Repeat this step for each client that you need to configure.

8. In the Max Connections area, select the text box and enter the maximum number of connections to the share that are enabled at one time. The default value of zero (also settable through the Unlimited button) enforces no limit on the number of connections.

9. Click OK.

The newly created share is displayed at the end of the list of shares, which are located in the center of the Shares panel.

**CLI equivalent**

**Procedure**

1. Run the `cifs status` command to verify that CIFS is enabled.
2. Run the `filesys status` command to verify that file system is enabled.
3. Run the `hostname` command to determine the system hostname.
4. Create the CIFS share.

   ```bash
   cifs share create <share> path <path> {max-connections <max connections> | clients <clients> | users <users> | comment <comment>}
   # cifs share create backup path /backup
   ```

5. Grant client access to the share.

   ```bash
   cifs share modify <share> {max-connections <max connections> | clients <clients> | browsing {enabled | disabled} | writeable {enabled | disabled} | users <users> | comment <comment>}
   # cifs share modify backup clients "srvr24.yourdomain.com,srvr24,10.24.160.116
   ```

6. Optionally make the share visible.

   ```bash
   cifs share <share> browsing enabled
   # cifs share backup browsing enabled
   ```

7. Optionally make the share writeable.

   ```bash
   cifs share <share> writeable enabled
   # cifs share backup writeable enabled
   ```

8. From the Windows system, select Start > Run, and type the hostname and directory of the CIFS share.

   ```bash
   \<DDhostname>.<DDdomain.com><sharename>
   ```

9. If there are problems connecting to the CIFS share, run the `cifs share show` command to verify the status of the share.

   The warning `WARNING: The share path does not exist!` is displayed if the share does not exist or was misspelled on creation.
### cifs share show

```
--------------- share backup ---------------

enabled: yes
path: /backup
```

10. If the CIFS share is still not accessible, verify that all client information is in the access list, and all network connections are functional.

## Modifying a share

Change share information and connections.

### Procedure

1. Select Protocols > CIFS > Shares to navigate to the CIFS view, Shares tab.
2. Click the checkbox next to the share that you wish to modify in the Share Name list.
3. Click **Modify**.
4. Modify share information:
   a. To change the comment, enter new text in the Comment text field.
   b. To modify a User or Group names, in the User/Group list, click the checkbox of the user or group and click **Edit** (pencil icon) or **Delete** (X). To add a user or group, click (+), and in the User/Group dialog box select the Type for User or Group, and enter the user or group name.
   c. To modify a client name, in the Client list click the checkbox of the client and click **Edit** (pencil icon) or **Delete** (X). To add a client, click the Add (+) and add the name in the Client dialog box.
      
      **Note:** To make the share available to all clients, specify an asterisk (*) as the client. All users in the client list can access the share, unless one or more user names are specified, in which case only the listed names can access the share.
   
   d. Click **OK**.
5. In the Max Connections area, in the text box, change the maximum number of connections to the share that are allowed at one time. Or select **Unlimited** to enforce no limit on the number of connections.
6. Click **OK**.

## Creating a share from an existing share

Create a share from an existing share and modify the new share if necessary.

### About this task

**Note:** User permissions from the existing share are carried over to the new share.

### Procedure

1. In the CIFS Shares tab, click the checkbox for the share you wish to use as the source.
2. Click **Create From**.
3. Modify the share information, as described in the section about modifying a share.
Disabling a share

Disable one or more existing shares.

Procedure
1. In the Shares tab, click the checkbox of the share you wish to disable in the Share Name list.
2. Click Disable.
3. Click Close.

Enabling a share

Enable one or more existing shares.

Procedure
1. In the Shares tab, click the checkbox of the shares you wish to enable in the Share Name list.
2. Click Enable.
3. Click Close.

Deleting a share

Delete one or more existing shares.

Procedure
1. In the Shares tab, click the checkbox of the shares you wish to delete in the Share Name list.
2. Click Delete.
   The Warning dialog box appears.
3. Click OK.
   The shares are removed.

Performing MMC administration

Use the Microsoft Management Console (MMC) for administration.

DD OS supports these MMC features:
- Share management, except for browsing when adding a share, or the changing of the offline settings default, which is a manual procedure.
- Session management.
- Open file management, except for deleting files.

Connecting to a protection system from a CIFS client

Use CIFS to connect to a protection system and create a read-only backup subfolder.

Procedure
1. On the system CIFS page, verify that CIFS Status shows that CIFS is enabled and running.
2. In the Control Panel, open Administrative Tools and select Computer Management.
3. In the Computer Management dialog box, right-click Computer Management (Local) and select Connect to another computer from the menu.
4. In the Select Computer dialog box, select Another computer and enter the name or IP address for the protection system.

5. Create a \backup subfolder as read-only. For more information, see the section on creating a /data/col1/backup subfolder as read-only.

Creating a \data\col1\backup subfolder as read-only
Enter a path, share name, and select permissions.

Procedure
1. Right-click Shares in the Shared Folders directory.
2. Select New File Share from the menu.
   The Create a Shared Folder wizard opens. The computer name should be the name or IP address of the protection system.
3. Enter the path for the Folder to share, for example, enter C:\data\col1\backup \newshare.
4. Enter the Share name, for example, enter newshare. Click Next.
5. For the Share Folder Permissions, selected Administrators have full access. Other users have read-only access. Click Next.
6. The Completing dialog box shows that you have successfully shared the folder with all Microsoft Windows clients in the network. Click Finish.
   The newly created shared folder is listed in the Computer Management dialog box.

Displaying CIFS information
Display information about shared folders, sessions, and open files.

Procedure
1. In the Control Panel, open Administrative Tools and select Computer Management.
2. Select one of the Shared Folders (Shares, Sessions, or Open Files) in the System Tools directory.
   Information about shared folders, sessions, and open files is shown in the right panel.

Configuring SMB signing
On a DD OS version that supports it, you can configure the SMB signing feature using the CIFS option called server signing.

This feature is disabled by default because it degrades performance. When enabled, SMB signing can cause a 29 percent (reads) to 50 percent (writes) throughput performance drop, although individual system performance will vary. There are three possible values for SMB signing: disabled, auto and mandatory:

- When SMB signing is set to disabled, SMB signing is disabled, this is the default.
- When SMB signing is set to required, SMB signing is required, and both computers in the SMB connection must have SMB signing enabled.

SMB Signing CLI Commands

cifs option set "server-signing" required
Sets server signing to required.

cifs option reset "server-signing"
Resets server signing to the default (disabled).

As a best practice, whenever you change the SMB signing options, disable and then enable (restart) CIFS service using the following CLI commands:

cifs disable

cifs enable

The DD System Manager interface displays whether the SMB signing option is disabled or set to auto or mandatory. To view this setting in the interface, navigate to: Protocols > CIFS > Configuration tab. In the Options area, the value for the SMB signing option will be disabled, auto or mandatory reflecting the value set using the CLI commands.

Managing access control

Access shared from a Windows client, provide administrative access, and allow access from trusted domain users.

Accessing shares from a Windows client

Use the command line to map a share.

Procedure

- From the Windows client use this DOS command:
  
  `net use drive: backup-location`

For example, enter:

```
# \PP02\backup /USER:PP02\backup22
```

This command maps the backup share from PowerProtect system PP02 to drive H on the Windows system and gives the user named backup22 access to the `\PP_sys\backup` directory.

DD OS supports the SMB Change Notify functionality. This improves CIFS performance on the Windows client by allowing the CIFS server to automatically notify the Windows client about changes on the CIFS share, and eliminate the need for the client to poll the protection system to look for changes to the share.

Providing domain users administrative access

Use the command line to add CIFS and include the domain name in the ssh instruction.

Procedure

- Enter: adminaccess authentication add cifs

  The SSH, Telnet, or FTP command that accesses the protection system must include, in double quotation marks, the domain name, a backslash, and the user name. For example:

```
C:> ssh "domain2\djones" @dd22
```
Allowing administrative access to a protection system for domain users

Use the command line to map a DD system default group number, and then enable CIFS administrative access.

**Procedure**

1. To map a protection system default group number to a Windows group name that differs from the default group name, use the cifs option set "dd admin group2" ["windows grp-name"] command.

   The Windows group name is a group (based on one of the user roles—admin, user, or backup operator) that exists on a Windows domain controller, and you can have up to 50 groups (dd admin group1 to dd admin group50).

   **Note:** For a description of DD OS user roles and Windows groups, see the section about managing protection systems.

2. Enable CIFS administrative access by entering:

   `adminaccess authentication add cifs`

   - The default system group dd admin group1 is mapped to the Windows group Domain Admins.
   - You can map the default system group dd admin group2 to a Windows group named Data Domain that you create on a Windows domain controller.
   - Access is available through SSH, Telnet, FTP, HTTP, and HTTPS.
   - After setting up administrative access to the protection system from the Windows group Data Domain, you must enable CIFS administrative access using the `adminaccess` command.

Restricting administrative access from Windows

Use the command line to prohibit access to users without a DD account.

**Procedure**

- Enter: `adminaccess authentication del cifs`

  This command prohibits Windows users access to the protection system if they do not have an account on the system.

File access

This sections contains information about ACLs, setting DACL and SACL permissions using Windows Explorer, and so on.

NT access control lists

Access control lists (ACLs) are enabled by default on the protection system.

**CAUTION** Dell EMC recommends that you do not disable NTFS ACLs once they have been enabled. Contact Dell EMC Support prior to disabling NTFS ACLs.
**Default ACL Permissions**

The default permissions, which are assigned to new objects created through the CIFS protocol when ACLs are enabled, depend on the status of the parent directory. There are three different possibilities:

- The parent directory has no ACL because it was created through NFS protocol.
- The parent directory has an inheritable ACL, either because it was created through the CIFS protocol or because ACL had been explicitly set. The inherited ACL is set on new objects.
- The parent directory has an ACL, but it is not inheritable. The permissions are as follows:

<table>
<thead>
<tr>
<th>Table 10 Permissions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
</tr>
<tr>
<td>Allow</td>
</tr>
<tr>
<td>Allow</td>
</tr>
</tbody>
</table>

**Note:** CREATOR OWNER is replaced by the user creating the file/folder for normal users and by Administrators for administrative users.

**Permissions for a New Object when the Parent Directory Has No ACL**

The permissions are as follows:

- `BUILTIN\Administrators:(OI)(CI)F`
- `NT AUTHORITY\SYSTEM:(OI)(CI)F`
- `CREATOR OWNER:(OI)(CI)(IO)F`
- `BUILTIN\Users:(OI)(CI)R`
- `BUILTIN\Users:(CI)(special access:)FILE_APPEND_DATA`
- `BUILTIN\Users:(CI)(IO)(special access:)FILE_WRITE_DATA`
- `Everyone:(OI)(CI)R`

These permissions are described in more detail as follows:

<table>
<thead>
<tr>
<th>Table 11 Permissions Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
</tr>
<tr>
<td>Allow</td>
</tr>
<tr>
<td>Allow</td>
</tr>
<tr>
<td>Allow</td>
</tr>
<tr>
<td>Allow</td>
</tr>
<tr>
<td>Allow</td>
</tr>
<tr>
<td>Allow</td>
</tr>
<tr>
<td>Allow</td>
</tr>
</tbody>
</table>
Setting ACL Permissions and Security

Windows-based backup and restore tools such as NetBackup can be used to back up DACL- and SACL-protected files to, and restore them from, the protection system.

Granular and Complex Permissions (DACL)

You can set granular and complex permissions (DACL) on any file or folder object within the file system, either through using Windows commands such as `cacls`, `xcacls`, `xcopy` and `scopy`, or through the CIFS protocol using the Windows Explorer GUI.

Audit ACL (SACL)

You can set audit ACL (SACL) on any object in the file system, either through commands or through the CIFS protocol using the Windows Explorer GUI.

Setting DACL permissions using the Windows Explorer

Use Explorer properties settings to select DACL permissions.

Procedure

1. Right-click the file or folder and select Properties.
2. In the Properties dialog box, click the Security tab.
3. Select the group or user name, such as Administrators, from the list. The permissions appear, in this case for Administrators, Full Control.
4. Click the Advanced button, which enables you to set special permissions.
5. In the Advanced Security Settings for ACL dialog box, click the Permissions tab.
6. Select the permission entry in the list.
7. To view more information about a permission entry, select the entry and click Edit.
8. Select the Inherit from parent option to have the permissions of parent entries inherited by their child objects, and click OK.

Setting SACL permissions using the Windows Explorer

Use Explorer properties settings to select SACL permissions.

Procedure

1. Right-click the file or folder and select Properties from the menu.
2. In the Properties dialog box, click the Security tab.
3. Select the group or user name, such as Administrators, from the list, which displays its permissions, in this case, Full Control.
4. Click the Advanced button, which enables you to set special permissions.
5. In the Advanced Security Settings for ACL dialog box, click the Auditing tab.
6. Select the auditing entry in the list.
7. To view more information about special auditing entries, select the entry and click Edit.
8. Select the Inherit from parent option to have the permissions of parent entries inherited by their child objects, and click OK.

Viewing or changing the current owner security ID (owner SID)

Use the Advanced Security Settings for ACL dialog box.

Procedure

1. In the Advanced Security Settings for ACL dialog box, click the Owner tab.
2. To change the owner, select a name from the Change owner list, and click OK.

**Controlling ID account mapping**

The CIFS option idmap-type controls ID account mapping behavior.

This option has two values: rid (the default) and none. When the option is set to rid, the ID-to-id mapping is performed internally. When the option is set to none, all CIFS users are mapped to a local UNIX user named “cifsuser” belonging to the local UNIX group users.

Consider the following information while managing this option.

- CIFS must be disabled to set this option. If CIFS is running, disable CIFS services.
- The idmap-type can be set to none only when ACL support is enabled.
- Whenever the idmap type is changed, a file system metadata conversion might be required for correct file access. Without any conversion, the user might not be able to access the data. To convert the metadata, consult your contracted support provider.

**Monitoring CIFS operation**

Monitoring CIFS Operation topics.

**Displaying CIFS status**

View and enable/disable CIFS status.

**Procedure**

1. In the DD System Manager, select **Protocols > CIFS**.
   - Status is either enabled and running, or disabled but CIFS authentication is running. To enable CIFS, see the section regarding enabling CIFS services. To disable CIFS, see the section regarding disabling CIFS services.
   - **Connections** lists the tally of open connections and open files.

   **Table 12 Connections Details information**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Connections</td>
<td>Open CIFS connections</td>
</tr>
<tr>
<td>Connection Limit</td>
<td>Maximum allowed connections</td>
</tr>
<tr>
<td>Open Files</td>
<td>Current open files</td>
</tr>
<tr>
<td>Max Open Files</td>
<td>Maximum number of open files</td>
</tr>
</tbody>
</table>

2. Click **Connection Details** to see more connection information.

   **Table 13 Connections Details information**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sessions</td>
<td>Active CIFS sessions</td>
</tr>
<tr>
<td>Computer</td>
<td>IP address or computer name connected with DDR for the session</td>
</tr>
<tr>
<td>User</td>
<td>User operating the computer connected with the DDR</td>
</tr>
</tbody>
</table>
Table 13 Connections Details information (continued)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Files</td>
<td>Number of open files for each session</td>
</tr>
<tr>
<td>Connection Time</td>
<td>Connection length in minutes</td>
</tr>
<tr>
<td>User</td>
<td>Domain name of computer</td>
</tr>
<tr>
<td>Mode</td>
<td>File permissions</td>
</tr>
<tr>
<td>Locks</td>
<td>Number of locks on the file</td>
</tr>
<tr>
<td>Files</td>
<td>File location</td>
</tr>
</tbody>
</table>

Display CIFS configuration

This section displays CIFS Configuration.

Authentication configuration

The information in the Authentication panel changes, depending on the type of authentication that is configured.

Click the Configure link in to the left of the Authentication label in the Configuration tab. The system will navigate to the Administration > Access > Authentication page where you can configure authentication for Active Directory, Kerberos, Workgroups, and NIS.

Active directory configuration

Table 14 Active directory configuration information

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode</td>
<td>The Active Directory mode displays.</td>
</tr>
<tr>
<td>Realm</td>
<td>The configured realm displays.</td>
</tr>
<tr>
<td>DDNS</td>
<td>The status of the DDNS Server displays: either enabled or disabled.</td>
</tr>
<tr>
<td>Domain Controllers</td>
<td>The name of the configured domain controllers display or a * if all controllers are permitted.</td>
</tr>
<tr>
<td>Organizational Unit</td>
<td>The name of the configured organizational units displays.</td>
</tr>
<tr>
<td>CIFS Server Name</td>
<td>The name of the configured CIFS server displays.</td>
</tr>
<tr>
<td>WINS Server Name</td>
<td>The name of the configured WINS server displays.</td>
</tr>
<tr>
<td>Short Domain Name</td>
<td>The short domain name displays.</td>
</tr>
</tbody>
</table>

Workgroup configuration

Table 15 Workgroup configuration authentication information

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode</td>
<td>The Workgroup mode displays.</td>
</tr>
<tr>
<td>Workgroup Name</td>
<td>The configured workgroup name displays.</td>
</tr>
</tbody>
</table>
Table 15 Workgroup configuration authentication information (continued)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDNS</td>
<td>The status of the DDNS Server displays: either enabled or disabled.</td>
</tr>
<tr>
<td>CIFS Server Name</td>
<td>The name of the configured CIFS server displays.</td>
</tr>
<tr>
<td>WINS Server Name</td>
<td>The name of the configured WINS server displays.</td>
</tr>
</tbody>
</table>

Display shares information

This section displays shares information.

Viewing configured shares

View the list of configured shares.

Table 16 Configured shares information

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share Name</td>
<td>The name of the share (for example, share1).</td>
</tr>
<tr>
<td>Share Status</td>
<td>The status of the share: either enabled or disabled.</td>
</tr>
<tr>
<td>Directory Path</td>
<td>The directory path to the share (for example, /data/col1/backup/dir1).</td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> col1 uses the lower case letter L followed by the number 1.</td>
</tr>
<tr>
<td>Directory Path Status</td>
<td>The status of the directory path.</td>
</tr>
</tbody>
</table>

- To list information about a specific share, enter the share name in the Filter by Share Name text box and click **Update**.
- Click **Update** to return to the default list.
- To page through the list of shares, click the < and > arrows at the bottom right of the view to page forward or backward. To skip to the beginning of the list, click [< and to skip to the end, click >].
- Click the **Items per Page** drop-down arrow to change the number of share entries listed on a page. Choices are 15, 30, or 45 entries.

Viewing detailed share information

Display detailed information about a share by clicking a share name in the share list.

Table 17 Share information

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share Name</td>
<td>The name of the share (for example, share1).</td>
</tr>
<tr>
<td>Directory Path</td>
<td>The directory path to the share (for example, /data/col1/backup/dir1).</td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> col1 uses the lower case letter L followed by the number 1.</td>
</tr>
</tbody>
</table>
Table 17 Share information (continued)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directory Path</td>
<td>Indicates whether the configured directory path exists on the DDR. Possible values are Path Exists or Path Does Not Exist, the later indicating an incorrect or incomplete CIFS configuration.</td>
</tr>
<tr>
<td>Status</td>
<td>Max Connections</td>
</tr>
<tr>
<td>Comment</td>
<td>The comment that was configured when the share was created.</td>
</tr>
<tr>
<td>Share Status</td>
<td>The status of the share: either enabled or disabled.</td>
</tr>
</tbody>
</table>

- The Clients area lists the clients that are configured to access the share, along with a client tally beneath the list.
- The User/Groups area lists the names and type of users or groups that are configured to access the share, along with a user or group tally beneath the list.
- The Options area lists the name and value of configured options.

Displaying CIFS statistics

Use the command line to display CIFS statistics.

Procedure

- Enter: `cifs show detailed-stats`
  The output shows number of various SMB requests received and the time taken to process them.

Performing CIFS troubleshooting

This section provides basic troubleshooting procedures.

Note: The `cifs troubleshooting` commands provide detailed information about CIFS users and groups.

Displaying clients current activity

Use the command line to display CIFS sessions and open files information.

Procedure

- Enter: `cifs show active`

Results

Table 18 Sessions

<table>
<thead>
<tr>
<th>Computer</th>
<th>User</th>
<th>Open files</th>
<th>Connect time (sec)</th>
<th>Idle time (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>::ffff:10.25.132.84</td>
<td>ddve-25179109\sysadmin</td>
<td>1</td>
<td>92</td>
<td>0</td>
</tr>
</tbody>
</table>
**Table 19 Open files**

<table>
<thead>
<tr>
<th>User</th>
<th>Mode</th>
<th>Locks</th>
<th>File</th>
</tr>
</thead>
<tbody>
<tr>
<td>ddve-25179109\sysadmin</td>
<td>1</td>
<td>0</td>
<td>C:\data\col1\backup</td>
</tr>
</tbody>
</table>

**Setting the maximum open files on a connection**

Use the command line to set the maximum number of files that can be open concurrently.

**Procedure**

- Enter: `cifs option set max-global-open-files value`.

The value for the maximum global open files can be between 1 and the open files maximum limit. The maximum limit is based on the DDR system memory. For systems with greater than 12 GB, the maximum open files limit is 30,000. For systems with less than or equal to 12 GB, the maximum open files limit is 10,000.

**Table 20 Connection and maximum open file limits**

<table>
<thead>
<tr>
<th>Memory</th>
<th>Connection Limit</th>
<th>Open File Maximum Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 GB</td>
<td>300</td>
<td>10,000</td>
</tr>
<tr>
<td>16 GB and higher</td>
<td>600</td>
<td>30,000</td>
</tr>
</tbody>
</table>

**Note:** The system has a maximum limit of 600 CIFS connections and 250,000 open files. However, if the system runs out of open files, the number of files can be increased.

**Note:** File access latencies are affected by the number of files in a directory. To the extent possible, we recommend directory sizes of less than 250,000. Larger directory sizes might experience slower responses to metadata operations such as listing the files in the directory and opening or creating a file.

**System clock**

When using active directory mode for CIFS access, the system clock time can differ by no more than five minutes from that of the domain controller.

When configured for Active Directory authentication, the system regularly syncs time with the Windows domain controller. Therefore, it is important for the domain controller to obtain the time from a reliable time source. Refer to the Microsoft documentation for your Windows operating system version to configure the domain controller with a time source.

**WARNING** When the system is configured for Active Directory authentication, it uses an alternate mechanism to sync time with the domain controller. To avoid time sync conflicts, do not enable NTP when the system is configured for Active Directory authentication.

**Synchronize from an NTP server**

Configure the time server synchronization, as described in the section regarding working with time and date settings.
CHAPTER 17

NFS

This chapter includes:

- NFS overview ................................................................. 206
- Managing NFS client access to the protection system .................. 206
- Displaying NFS information .............................................. 210
- Integrating a DDR into a Kerberos domain ......................... 211
- Add and delete KDC servers after initial configuration ............ 212
NFS overview

Network File System (NFS) clients can have access to the system directories or MTrees on the protection system.

- The /backup directory is the default destination for non-MTree compressed backup server data.
- The /data/coll/backup path is the root destination when using MTrees for compressed backup server data.
- The /ddvar/core directory contains system core and log files (remove old logs and core files to free space in this area).

**Note:** On protection systems, the /ddvar/core is on a separate partition. If you mount /ddvar only, you will not be able to navigate to /ddvar/core from the /ddvar mountpoint.

Clients, such as backup servers that perform backup and restore operations need access to the /backup or /data/coll/backup areas, at a minimum. Clients that have administrative access need to be able to access the /ddvar/core directory to retrieve core and log files.

As part of the initial system configuration, NFS clients were configured to access these areas. This chapter describes how to modify these settings and how to manage data access.

**Note:**
- The nfs command manages backups and restores between NFS clients and protection systems, and it displays NFS statistics and status. For complete information about the nfs command, see the DD OS Command Reference Guide.
- For information about setting up third-party clients to use the protection system as a server, see the related tuning guide, such as the Solaris System Tuning, which is available from the Dell EMC support web site.

HA systems and NFS

HA systems are compatible with NFS. If a NFS job is in progress during a failover, the job will not need to be restarted.

**Note:** /ddvar is an ext3 file system, and cannot be shared like a normal MTree-based share. The information in /ddvar will become stale when the active node fails over to the standby node because the filehandles are different on the two nodes. If /ddvar is mounted to access log files or upgrade the system, unmount and remount /ddvar if a failover has occurred since the last time /ddvar was mounted.

To create valid NFS exports that will failover with HA, the export needs to be created from the Active HA node, and generally shared over the failover network interfaces.

Managing NFS client access to the protection system

The topics in this section describe how to manage NFS client access to a protection System. The KB article NFS Best Practices for Data Domain and client OS, available at https://support.emc.com/kb/180552, provides additional information about best practices for NFS.
Enabling NFS services

Enable NFS services to allow the client to access the system using the NFS protocol.

Procedure

1. Select Protocols > NFS.
   The NFS view opens displaying the Exports tab.

2. Click Enable.

Disabling NFS services

Disable NFS services to prevent the client access to the system using the NFS protocol.

Procedure

1. Select the Protocols > NFS tabs.
   The NFS view opens displaying the Exports tab.

2. Click Disable.

Creating an export

You can use DD SM’s Create button on the NFS view or use the Configuration Wizard to specify the NFS clients that can access the /backup, /data/coll/backup, /ddvar, /ddvar/core areas, or the /ddvar/ext area if it exists.

About this task

A protection system supports a maximum of 2048 exports\(^2\), with the number of connections scaling in accordance with system memory.

Note: You have to assign client access to each export separately and remove access from each export separately. For example, a client can be removed from /ddvar and still have access to /data/coll/backup.

CAUTION If Replication is to be implemented, a single destination system can receive backups from both CIFS clients and NFS clients as long as separate directories or MTrees are used for each. Do not mix CIFS and NFS data in the same area.

Do not use the top level of an MTree to host an NFS export. Create a subdirectory within the MTree, and specify that subdirectory as the path for the NFS export.

Procedure

1. Select Protocols > NFS.
   The NFS view opens displaying the Exports tab.

2. Click Create.

3. Enter the pathname in the Directory Path text box (for example, /data/coll/backup/dir1).

   Note: coll uses the lower-case letter L followed by the number 1.

4. In the Clients area, select an existing client or click the + icon to create a client.
   The Client dialog box is displayed.

---

2. May be affected by hardware limitations.
a. Enter a server name in the text box.
Enter fully qualified domain names, hostnames, or IP addresses. A single asterisk (*) as a wildcard indicates that all backup servers are to be used as clients.

**Note:** Clients given access to the /data/coll/backup directory have access to the entire directory. A client given access to a subdirectory of /data/coll/backup has access only to that subdirectory.

- A client can be a fully-qualified domain hostname, an IPv4 or IPv6 IP address, an IPv4 address with either a netmask or prefix length, an IPv6 address with prefix length, an NIS netgroup name with the prefix @, or an asterisk (*) wildcard with a domain name, such as *.yourcompany.com.
- A client added to a subdirectory under /data/coll/backup has access only to that subdirectory.
- Enter an asterisk (*) as the client list to give access to all clients on the network.

b. Select the checkboxes of the NFS options for the client.

**General:**
- Read-only permission (ro).
- Allow connections from ports below 1024 (secure) (default).

**Anonymous UID/GID:**
- Map requests from UID (user identifier) or GID (group identifier) 0 to the anonymous UID/GID (root _squash).
- Map all user requests to the anonymous UID/GID (all _squash).
- Use Default Anonymous UID/GID.

**Allowed Kerberos Authentication Modes:**
- Unauthenticated connections (sec=sys). Select to not use authentication.
- Authenticated Connections (sec=krb5).

**Note:** Integrity and Privacy are supported, although they might slow performance considerably.

c. Click OK.

5. Click OK to create the export.

**Modifying an export**

Change the directory path, domain name, and other options using the GUI.

**Procedure**

1. Select Protocols > NFS.
   The NFS view opens displaying the Exports tab.

2. Click the checkbox of an export in the NFS Exports table.

3. Click Modify.

4. Modify the pathname in the Directory Path text box.

5. In the Clients area, select another client and click the pencil icon (modify), or click the + icon to create a client.
a. Enter a server name in the Client text box.

Enter fully qualified domain names, hostnames, or IP addresses. A single asterisk (*) as a wild card indicates that all backup servers are to be used as clients.

**Note:** Clients given access to the /data/coll/backup directory have access to the entire directory. A client given access to a subdirectory of /data/coll/backup has access only to that subdirectory.

- A client can be a fully-qualified domain hostname, an IPv4 or IPv6 IP address, an IPv4 address with either a netmask or prefix length, an IPv6 address with prefix length, an NIS netgroup name with the prefix @, or an asterisk (*) wildcard with a domain name, such as *.yourcompany.com.
- A client added to a subdirectory under /data/coll/backup has access only to that subdirectory.
- Enter an asterisk (*) as the client list to give access to all clients on the network.

b. Select the checkboxes of the NFS options for the client.

General:
- Read-only permission (ro).
- Allow connections from ports below 1024 (secure) (default).

Anonymous UID/GID:
- Map requests from UID (user identifier) or GID (group identifier) 0 to the anonymous UID/GID (root _squash).
- Map all user requests to the anonymous UID/GID (all _squash).
- Use Default Anonymous UID/GID.

Allowed Kerberos Authentication Modes:
- Unauthenticated connections (sec=sys). Select to not use authentication.
- Authenticated Connections (sec=krb5).

**Note:** Integrity and Privacy are not supported.

c. Click OK.

6. Click OK to modify the export.

**Creating an export from an existing export**

Create an export from an existing export and then modify it as needed.

**Procedure**

1. In the NFS Exports tab, click the checkbox of the export you wish to use as the source.
2. Click Create From.
3. Modify the export information, as described in section about modifying an export.
Deleting an export

Delete an export from the NFS Exports tab.

Procedure
1. In the NFS Exports tab, click the checkbox of the export you wish to delete.
2. Click Delete.
3. Click OK and Close to delete the export.

Displaying NFS information

The topics in this section describe how to use the DD System Manager to monitor NFS client status and NFS configuration.

Viewing NFS status

Display whether NFS is active and Kerberos is enabled.

Procedure
- Click Protocols > NFS.
  The top panel shows the operational status of NFS; for example, whether NFS is currently active and running, and whether Kerberos mode is enabled.

  Note: Click Configure to view the Administration > Access > Authentication tab where you can configure Kerberos authentication.

Viewing NFS exports

See the list of clients allowed to access the protection system.

Procedure
1. Click Protocols > NFS.
   The Exports view shows a table of NFS exports that are configured for system and the mount path, status, and NFS options for each export.
2. Click an export in the table to populate the Detailed Information area, below the Exports table.
   In addition to the export’s directory path, configured options, and status, the system displays a list of clients.
   Use the Filter By text box to sort by mount path.
   Click Update for the system to refresh the table and use the filters supplied.
   Click Reset for the system to clear the Path and Client filters.

Viewing active NFS clients

Display all clients that have been connected in the past 15 minutes and their mount path.

Procedure
- Select the Protocols > NFS > Active Clients tab.
The Active Clients view displays, showing all clients that have been connected in the past 15 minutes and their mount path.

Use the Filter By text boxes to sort by mount path and client name.

Click **Update** for the system to refresh the table and use the filters supplied.

Click **Reset** for the system to clear the Path and Client filters.

---

**Integrating a DDR into a Kerberos domain**

Set the domain name, the host name, and the DNS server for the DDR.

**About this task**

Enable the DDR to use the authentication server as a Key Distribution Center (for UNIX) and as a Distribution Center (for Windows Active Directory).

⚠ **CAUTION**: The examples provided in this description are specific to the operating system (OS) used to develop this exercise. You must use commands specific to your OS.

**Note**: For UNIX Kerberos mode, a keytab file must be transferred from the Key Distribution Center (KDC) server, where it is generated, to the DDR. If you are using more than one DDR, each DDR requires a separate keytab file. The keytab file contains a shared secret between the KDC server and the DDR.

**Note**: When using a UNIX KDC, the DNS server does not have to be the KDC server, it can be a separate server.

**Procedure**

1. Set the host name and the domain name for the DDR, using DDR commands.
   
   ```
   net set hostname <host>
   net set {domainname <local-domain-name>}
   ```
   
   **Note**: The host name is the name of the DDR.

2. Configure NFS principal (node) for the DDR on the Key Distribution Center (KDC).
   
   Example:
   
   ```
   addprinc nfs/hostname@realm
   ```
   
   **Note**: Hostname is the name for the DDR.

3. Verify that there are nfs entries added as principals on the KDC.
   
   Example:
   
   ```
   listprincs
   nfs/hostname@realm
   ```

4. Add the DDR principal into a keytab file.
   
   Example:
   
   ```
   ktadd <keytab_file> nfs/hostname@realm
   ```

5. Verify that there is an nfs keytab file configured on the KDC.
   
   Example:
   
   ```
   klist -k <keytab_file>
   ```
6. Copy the keytab file from the location where the keys for NFS DDR are generated to the DDR in the /ddvar/ directory.

**Table 21** Keytab destination

<table>
<thead>
<tr>
<th>Copy file from:</th>
<th>Copy file to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;keytab_file&gt; (The keytab file configured in a previous step.)</td>
<td>/ddvar/</td>
</tr>
</tbody>
</table>

7. Set the realm on the DDR, using the following DDR command:
   
   `authentication kerberos set realm <home realm> kdc-type {unix, windows} kdcs <IP address of server>`

8. When the kdc-type is UNIX, import the keytab file from /ddvar/ to /ddr/etc/, where the Kerberos configuration file expects it. Use the following DDR command to copy the file:
   
   `authentication kerberos keytab import`

   **NOTICE** This step is required only when the kdc-type is UNIX.

Kerberos setup is now complete.

9. To add a NFS mount point to use Kerberos, use the nfs add command. See the *DD OS Command Reference Guide* for more information.

10. Add host, NFS and relevant user principals for each NFS client on the Key Distribution Center (KDC).

    **Example:** `listprincs`
    ```
    host/hostname@realm
    nfs/hostname@realm
    root/hostname@realm
    ```

11. For each NFS client, import all its principals into a keytab file on the client.

    **Example:**
    ```
    ktadd -k <keytab_file> host/hostname@realm
    ktadd -k <keytab_file> nfs/hostname@realm
    ```

**Add and delete KDC servers after initial configuration**

After you have integrated a DDR into a Kerberos domain, and thereby enabled the DDR to use the authentication server as a Key Distribution Center (for UNIX) and as a Distribution Center (for Windows Active Directory), you can use the following procedure to add or delete KDC servers.

**Procedure**

1. Join the DDR to a Windows Active Directory (AD) server or a UNIX Key Distribution Center (KDC).
   
   `authentication kerberos set realm <home-realm> kdc-type {windows [kdcs <kdc-list>] | unix kdcs <kdc-list>}`

   **Example:** `authentication kerberos set realm krb5.test kdc-type unix kdcs nfskrb-kdc.krb5.test`
This command joins the system to the krb5.test realm and enables Kerberos authentication for NFS clients.

1. Note: A keytab generated on this KDC must exist on the DDR to authenticate using Kerberos.

2. Verify the Kerberos authentication configuration.

   `authentication kerberos show config`

<table>
<thead>
<tr>
<th>Home Realm:</th>
<th>krb5.test</th>
</tr>
</thead>
<tbody>
<tr>
<td>KDC List:</td>
<td>nfskrb-kdc.krb5.test</td>
</tr>
<tr>
<td>KDC Type:</td>
<td>unix</td>
</tr>
</tbody>
</table>

3. Add a second KDC server.

   `authentication kerberos set realm <home-realm> kdc-type {windows [kdcs <kdc-list>] | unix kdcs <kdc-list>}`

   Example: `authentication kerberos set realm krb5.test kdc-type unix kdcs ostqa-sparc2.krb5.test nfskrb-kdc.krb5.test`

   1. Note: A keytab generated on this KDC must exist on the DDR to authenticate using Kerberos.

4. Verify that two KDC servers are added.

   `authentication kerberos show config`

<table>
<thead>
<tr>
<th>Home Realm:</th>
<th>krb5.test</th>
</tr>
</thead>
<tbody>
<tr>
<td>KDC List:</td>
<td>ostqa-sparc2.krb5.test, nfskrb-kdc.krb5.test</td>
</tr>
<tr>
<td>KDC Type:</td>
<td>unix</td>
</tr>
</tbody>
</table>

5. Display the value for the Kerberos configuration key.

   `reg show config.keberos`

   ```
   config.kerberos.home_realm = krb5.test
   config.kerberos.home_realm.kdc1 = ostqa-sparc2.krb5.test
   config.kerberos.home_realm.kdc2 = nfskrb-kdc.krb5.test
   config.kerberos.kdc_count = 2
   config.kerberos.kdc_type = unix
   ```

6. Delete a KDC server.

   Delete a KDC server by using the `authentication kerberos set realm <home-realm> kdc-type {windows [kdcs <kdc-list>] | unix kdcs <kdc-list>}` command without listing the KDC server that you want to delete. For example, if the existing KDC servers are kdc1, kdc2, and kdc3, and you want to remove kdc2 from the realm, you could use the following example:

   `authentication kerberos set realm <realm-name> kdc-type <kdc_type> kdcs kdc1,kdc3`
NFS
CHAPTER 18

NFSv4

This chapter includes:

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- Internal Identifier Formats ....................................................... 218
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## Introduction to NFSv4

Because NFS clients are increasingly using NFSv4.x as the default NFS protocol level, protection systems can now employ NFSv4 instead of requiring the client to work in a backwards-compatibility mode.

Clients can work in mixed environments in which NFSv4 and NFSv3 must be able to access the same NFS exports.

The DD OS NFS server can be configured to support NFSv4 and NFSv3, depending on site requirements. You can make each NFS export available to only NFSv4 clients, only NFSv3 clients, or both.

Several factors might affect whether you choose NFSv4 or NFSv3:

- **NFS client support**
  Some NFS clients may support only NFSv3 or NFSv4, or may operate better with one version.

- **Operational requirements**
  An enterprise might be strictly standardized to use either NFSv4 or NFSv3.

- **Security**
  If you require greater security, NFSv4 provides a greater security level than NFSv3, including ACL and extended owner and group configuration.

- **Feature requirements**
  If you need byte-range locking or UTF-8 files, you should choose NFSv4.

- **NFSv3 submounts**
  If your existing configuration uses NFSv3 submounts, NFSv3 might be the appropriate choice.

## NFSv4 compared to NFSv3

NFSv4 provides enhanced functionality and features compared to NFSv3.

The following table compares NFSv3 features to those for NFSv4.

<table>
<thead>
<tr>
<th>Feature</th>
<th>NFSv3</th>
<th>NFSv4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standards-based Network Filesystem</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Kerberos support</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Kerberos with LDAP</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Quota reporting</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Multiple exports with client-based access lists</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>ID mapping</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>UTF-8 character support</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>File/directory-based Access Control Lists (ACL)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Extended owner/group (OWNER@)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>File share locking</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Byte range locking</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>DD-CIFS integration (locking, ACL, AD)</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Table 22 NFSv4 compared to NFSv3 (continued)

<table>
<thead>
<tr>
<th>Feature</th>
<th>NFSv3</th>
<th>NFSv4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stateful file opens and recovery</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Global namespace and pseudoFS</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Multi-system namespace using referrals</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**NFSv4 ports**

You can enable or disable NFSv4 and NFSv3 independently. In addition, you can move NFS versions to different ports; both versions do not need to occupy the same port.

With NFSv4, you do not need to restart the file system if you change ports. Only an NFS restart is required in such instances.

Like NFSv3, NFSv4 runs on Port 2049 as the default if it is enabled.

NFSv4 does not use portmapper (Port 111) or mountd (Port 2052).

**ID Mapping Overview**

NFSv4 identifies owners and groups by a common external format, such as joe@example.com. These common formats are known as identifiers, or IDs.

Identifiers are stored within an NFS server and use internal representations such as ID 12345 or ID S-123-33-667-2. The conversion between internal and external identifiers is known as ID mapping.

Identifiers are associated with the following:

- Owners of files and directories
- Owner groups of files and directories
- Entries in Access Control Lists (ACLs)

Protection systems use a common internal format for NFS and CIFS/SMB protocols, which allows files and directories to be shared between NFS and CIFS/SMB. Each protocol converts the internal format to its own external format with its own ID mapping.

**External formats**

The external format for NFSv4 identifiers follows NFSv4 standards (for example, RFC-7530 for NFSv4.0). In addition, supplemental formats are supported for interoperability.

**Standard identifier formats**

Standard external identifiers for NFSv4 have the format identifier@domain. This identifier is used for NFSv4 owners, owner-groups, and access control entries (ACEs). The domain must match the configured NFSv4 domain that was set using the nfs option command.

The following CLI example sets the NFSv4 domain to mycorp.com for the NFS server:

```
nfs option set nfs4-domain mycorp.com
```

See client-specific documentation you have for setting the client NFS domain. Depending on the operating system, you might need to update a configuration file (for example, /etc/idmapd.conf) or use a client administrative tool.
ACE extended identifiers

For ACL ACE entries, protection system NFS servers also support the following standard NFSv4 ACE extended identifiers defined by the NFSv4 RFC:

- OWNER@, The current owner of the file or directory
- GROUP@, the current owner group of the file or directory.
- The special identifiers INTERACTIVE@, NETWORK@, DIALUP@, BATCH@, ANONYMOUS@, AUTHENTICATED@, SERVICE@.

Alternative formats

To allow interoperability, NFSv4 servers on protection systems support some alternative identifier formats for input and output.

- Numeric identifiers; for example, “12345”.
- Windows compatible Security identifiers (SIDs) expressed as “S-NNN-NNN-...”

See the sections on input mapping and output mapping for more information about restrictions to these formats.

Internal Identifier Formats

The DD file system stores identifiers with each object (file or directory) in the filesystem. All objects have a numeric user ID (UID) and group ID (GID). These, along with a set of mode bits, allow for traditional UNIX/Linux identification and access controls.

Objects created by the CIFS/SMB protocol, or by the NFSv4 protocol when NFSv4 ACLs are enabled, also have an extended security descriptor (SD). Each SD contains the following:

- An owner security identifier (SID)
- An owner group SID
- A discretionary ACL (DACL)
- (Optional) A system ACL (SACL)

Each SID contains a relative ID (RID) and a distinct domain in a similar manner to Windows SIDs. See the section on NFSv4 and CIFS interoperability for more information on SIDs and the mapping of SIDs.

When ID mapping occurs

The protection system NFSv4 server performs mapping in the following circumstances:

- Input mapping
  The NFS server receives an identifier from an NFSv4 client. See Input mapping on page 219.
- Output mapping:
  An identifier is sent from the NFS server to the NFSv4 client. See Output mapping on page 219.
- Credential mapping
The RPC client credentials are mapped to an internal identity for access control and other operations. See Credential mapping on page 219.

**Input mapping**

Input mapping occurs when an NFSv4 client sends an identifier to the protection system NFSv4 server—setting up the owner or owner-group of a file, for example. Input mapping is distinct from credential mapping.

Standard format identifiers such as joe@mycorp.com are converted into an internal UID/GID based on the configured conversion rules. If NFSv4 ACLs are enabled, a SID will also be generated, based on the configured conversion rules.

Numeric identifiers (for example, “12345”) are directly converted into corresponding UID/GIDs if the client is not using Kerberos authentication. If Kerberos is being used, an error will be generated as recommended by the NFSv4 standard. If NFSv4 ACLs are enabled, a SID will be generated based on the conversion rules.

Windows SIDs (for example, “S-NNN-NNN-...”) are validated and directly converted into the corresponding SIDs. A UID/GID will be generated based on the conversion rules.

**Output mapping**

Output mapping occurs when the NFSv4 server sends an identifier to the NFSv4 client; for example, if the server returns the owner or owner-group of a file.

1. If configured, the output might be the numeric ID.
   This can be useful for NFSv4 clients that are not configured for ID mapping (for example, some Linux clients).
2. Mapping is attempted using the configured mapping services, (for example, NIS or Active Directory).
3. The output is a numeric ID or SID string if mapping fails and the configuration is allowed.
4. Otherwise, nobody is returned.

The `nfs` option `nfs4-idmap-out-numeric` configures the mapping on output:

- If `nfs` option `nfs4-idmap-out-numeric` is set to `map-first`, mapping will be attempted. On error, a numeric string is output if allowed. This is the default.
- If `nfs` option `nfs4-idmap-out-numeric` is set to `always`, output will always be a numeric string if allowed.
- If `nfs` option `nfs4-idmap-out-numeric` is set to `never`, mapping will be attempted. On error, nobody@nfs4-domain is the output.
  If the RPC connection uses GSS/Kerberos, a numeric string is never allowed and nobody@nfs4-domain is the output.

The following example configures the protection system NFS server to always attempt to output a numeric string on output. For Kerberos the name nobody is returned:

```
nfs option set nfs4-idmap-out-numeric always
```

**Credential mapping**

The NFSv4 server provides credentials for the NFSv4 client.

These credentials perform the following functions:

- Determine the access policy for the operation; for example, the ability to read a file.
- Determine the default owner and owner-group for new files and directories.
Credentials sent from the client may be john_doe@mycorp.com, or system credentials such as UID=1000, GID=2000. System credentials specify a UID/GID along with auxiliary group IDs. If NFSv4 ACLs are disabled, then the UID/GID and auxiliary group IDs are used for the credentials. If NFSv4 ACLs are enabled, then the configured mapping services are used to build an extended security descriptor for the credentials:

- SIDs for the owner, owner-group, and auxiliary group mapped and added to the Security Descriptor (SD).
- Credential privileges, if any, are added to the SD.

**NFSv4 and CIFS/SMB Interoperability**

The security descriptors used by NFSv4 and CIFS are similar from an ID mapping perspective, although there are differences.

You should be aware of the following to ensure for optimal interoperability:

- Active Directory should be configured for both CIFS and NFSv4, and the NFS ID mapper should be configured to use Active Directory for ID mapping.
- If you are using CIFS ACLs extensively, you can usually improve compatibility by also enabling NFSv4 ACLs.
  - Enabling NFSv4 ACLs allows NFSv4 credentials to be mapped to the appropriate SID when evaluating DACL access.
- The CIFS server receives credentials from the CIFS client, including default ACL and user privileges.
  - In contrast, the NFSv4 server receives a more limited set of credentials, and constructs credentials at runtime using its ID mapper. Because of this, the filesystem might see different credentials.

**CIFS/SMB Active Directory Integration**

The protection system NFSv4 server can be configured to use the Windows Active Directory configuration that is set with the protection system CIFS server.

The system is mapped to use Active Directory if possible. This functionality is disabled by default, but you can enable it using the following command:

```
nfs option set nfs4-idmap-active-directory enabled
```

**Default DACL for NFSv4**

NFSv4 sets a different default DACL (discretionary access control list) than the default DACL supplied by CIFS.

Only OWNER@, GROUP@ and EVERYONE@ are defined in the default NFSv4 DACL. You can use ACL inheritance to automatically add CIFS-significant ACEs by default if appropriate.

**System Default SIDs**

Files and directories created by NFSv3, and NFSv4 without ACLs, use the default system domain, sometimes referred to as the default UNIX domain:

- User SIDs in the system domain have format S-1-22-1-N, where N is the UID.
- Group SIDs in the system domain have format S-1-22-2-N, when N is the GID.
For example, a user with UID 1234 would have an owner SID of S-1-22-1-1234.

**Common identifiers in NFSv4 ACLs and SIDs**

The EVERYONE@ identifier and other special identifiers (such as BATCH@, for example) in NFSv4 ACLs use the equivalent CIFS SIDS and are compatible.

The OWNER@ and GROUP@ identifiers have no direct correspondence in CIFS; they appear as the current owner and current owner-group of the file or directory.

**NFS Referrals**

The referral feature allows an NFSv4 client to access an export (or file system) in one or multiple locations. Locations can be on the same NFS server or on different NFS servers, and use either the same or different path to reach the export.

Because referrals are an NFSv4 feature, they apply only to NFSv4 mounts.

Referrals can be made to any server that uses NFSv4 or later, including the following:

- A protection system running NFS with NFSv4 enabled
- Other servers that support NFSv4 including Linux servers, NAS appliances, and VNX systems.

A referral can use an NFS export point with or without a current underlying path in the DD file system.

NFS exports with referrals can be mounted through NFSv3, but NFSv3 clients will not be redirected since referrals are a NFSv4 feature. This characteristic is useful in scaleout systems to allow exports to be redirected at a file-management level.

**Referral Locations**

NFSv4 referrals always have one or more locations.

These locations consist of the following:

- A path on a remote NFS server to the referred filesystem.
- One or more server network addresses that allow the client to reach the remote NFS server.

Typically when multiple server addresses are associated with the same location, those addresses are found on the same NFS server.

**Referral location names**

You can name each referral location within an NFS export. You can use the name to access the referral as well as to modify or delete it.

A referral name can contain a maximum of 80 characters from the following character sets:

- a-z
- A-Z
- 0-9
- "_"
- "_"
- "_"
- "_"
Referrals and Scaleout Systems

NFSv4 referrals and locations can better enable access if you are scaling out your protection systems.

Because your system might or might not already contain a global namespace, the following two scenarios describe how you might use NFSv4 referrals:

- Your system does not contain a global namespace.
  - You can use NFSv4 referrals to build that global namespace. System administrators can build these global namespaces, or you can use smart system manager (SM) element building referrals as necessary.
- Your system already has a global namespace.
  - If your system has a global namespace with MTrees placed in specific nodes, NFS referrals can be created to redirect access to those MTrees to the nodes added to the scaled-out system. You can create these referrals or have them performed automatically within NFS if the necessary SM or file manager (FM) information is available.

NFSv4 and High Availability

With NFSv4, protocol exports (for example, /data/coll/<mtree>) are mirrored in a High Availability (HA) setup. However, configuration exports such as /ddvar are not mirrored.

The /ddvar filesystem is unique to each node of an HA pair. As a result, /ddvar exports and their associated client access lists are not mirrored to the standby node in an HA environment.

The information in /ddvar becomes stale when the active node fails over to the standby node. Any client permissions granted to /ddvar on the original active node must be recreated on the newly active node after a failover occurs.

You must also add any additional /ddvar exports and their clients (for example, /ddvar/core) that were created on the original active node to the newly active node after a failover occurs.

Finally, any desired /ddvar exports must be unmounted from the client and then remounted after a failover occurs.

NFSv4 Global Namespaces

The NFSv4 server provides a virtual directory tree known as a PseudoFS to connect NFS exports into a searchable set of paths.

The use of a PseudoFS distinguishes NFSv4 from NFSv3, which uses the MOUNTD auxiliary protocol.

In most configurations, the change from NFSv3 MOUNTD to NFSv4 global namespace is transparent and handled automatically by the NFSv4 client and server.
NFSv4 global namespaces and NFSv3 submounts

If you use NFSv3 export submounts, the global namespaces characteristic of NFSv4 might prevent submounts from being seen on the NFSv4 mount.

**Example 1** NFSv3 main exports and submount exports

If NFSv3 has a main export and a submount export, these exports might use the same NFSv3 clients yet have different levels of access:

<table>
<thead>
<tr>
<th>Export</th>
<th>Path</th>
<th>Client</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mt1</td>
<td>/data/coll/mt1</td>
<td>client1.example.com</td>
<td>ro</td>
</tr>
<tr>
<td>Mt1-sub</td>
<td>/data/coll/mt1/subdir</td>
<td>client1.example.com</td>
<td>rw</td>
</tr>
</tbody>
</table>

In the previous table, the following applies to NFSv3:

- If client1.example.com mounts /data/coll/mt1, the client gets read-only access.
- If client1.example.com mounts /data/coll/mt1/subdir, the client gets read-write access.

NFSv4 operates in the same manner in regard to highest-level export paths. For NFSv4, client1.example.com navigates the NFSv4 PseudoFS until it reaches the highest-level export path, /data/coll/mt1, where it gets read-only access.

However, because the export has been selected, the submount export (Mt1-sub) is not part of the PseudoFS for the client and read-write access is not given.

**Best practice**

If your system uses NFSv3 exports submounts to give the client read-write access based on the mount path, you must consider this before using NFSv4 with these submount exports.

With NFSv4, each client has an individual PseudoFS.

<table>
<thead>
<tr>
<th>Export</th>
<th>Path</th>
<th>Client</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mt1</td>
<td>/data/coll/mt1</td>
<td>client1.example.com</td>
<td>ro</td>
</tr>
<tr>
<td>Mt1-sub</td>
<td>/data/coll/mt1/subdir</td>
<td>client2.example.com</td>
<td>rw</td>
</tr>
</tbody>
</table>

NFSv4 Configuration

The default protection system configuration only enables NFSv3. To use NFSv4, you must first enable the NFSv4 server.
Enabling the NFSv4 Server

Procedure

1. Enter `nfs enable version 4` to enable NFSv4:

```
# nfs enable version 4
NFS server version(s) 3:4 enabled.
```

2. (Optional) If you want to disable NFSv3, enter `nfs disable version 3`.

```
# nfs disable version 3
NFS server version(s) 3 disabled.
NFS server version(s) 4 enabled.
```

**After you finish**

After the NFSv4 server is enabled, you might need to perform additional NFS configuration tasks specifically for your site. These tasks can include:

- Setting the NFSv4 domain
- Configuring NFSv4 ID mapping
- Configuring ACL (Access Control Lists)

Setting the default server to include NFSv4

**About this task**

The NFS command option `default-server-version` controls which NFS version is enabled when you enter the `nfs enable` command without specifying a version.

**Procedure**

1. Enter the `nfs option set default-server-version 3:4` command:

```
# nfs option set default-server-version 3:4
NFS option 'default-server-version' set to '3:4'.
```

Updating existing exports

You can update existing exports to change the NFS version used by your protection system.

**Procedure**

1. Enter the `nfs export modify all` command:

```
# nfs export modify all clients all options version=version number
```

To ensure all existing clients have either version 3, 4, or both, you can modify the NFS version to the appropriate string. The following example shows NFS modified to include versions 3 and 4:

```
# nfs export modify all clients all options version=3:4
```

For more information about the `nfs export` command, see the *DD OS Command Reference Guide* for more information.

Kerberos and NFSv4

Both NFSv4 and NFSv3 use the Kerberos authentication mechanism to secure user credentials.
Kerberos prevents user credentials from being spoofed in NFS packets and protects them from tampering en route to the protection system.

There are distinct types of Kerberos over NFS:

- **Kerberos 5 (sec=krb5)**
  Use Kerberos for user credentials.

- **Kerberos 5 with integrity (sec=krb5i)**
  Use Kerberos and check the integrity of the NFS payload using an encrypted checksum.

- **Kerberos 5 with security (sec=krb5p)**
  Use Kerberos 5 with integrity and encrypt the entire NFS payload.

**Note:** krb5i and krb5p can both cause performance degradation due to additional computational overhead on both the NFS client and the protection system.

You employ existing commands that are used for NFSv3 when configuring your system for Kerberos. See the nfsv3 chapter of the *DD OS Command Reference Guide* for more information.

### Configuring Kerberos with a Linux-Based KDC

**Before you begin**

You should ensure that all your systems can access the Key Distribution Center (KDC).

If the systems cannot reach the KDC, check the domain name system (DNS) settings.

**About this task**

The following steps allow you to create keytab files for the client and the protection system:

- In Steps 1-3, you create the keytab file for the protection system.
- In Steps 4-5, you create the keytab file for the client.

**Procedure**

1. Create the `nfs/<ddr_dns_name>@<realm>` service principal.
   ```
   kadmin.local: addprinc -randkey nfs/ddr12345.<domain-name>@<domain-name>
   ```

2. Export `nfs/<ddr_dns_name>@<realm>` to a keytab file.
   ```
   kadmin.local: ktadd –k /tmp/ddr.keytab nfs/ddr12345.corp.com@CORP.COM
   ```

3. Copy the keytab file to the protection system at the following location:
   ```
   /ddr/var/krb5.keytab
   ```

4. Create one of the following principals for the client and export that principal to the keytab file:
   ```
   nfs/<client_dns_name>@<REALM>
   root/<client_dns_name>@<REALM>
   ```

5. Copy the keytab file to the client at the following location:
   ```
   /etc/krb5.keytab
   ```

**Note:** It is recommended that you use an NTP server to keep the time synchronized on all entities.

### Configuring the protection System to Use Kerberos Authentication

**Procedure**

1. Configure the KDC and Kerberos realm on the protection system by using the `authentication command`:
   ```
   # authentication kerberos set realm <realm> kdc-type unix kdcs <kdc-server>
   ```

2. Import the keytab file:
   ```
   # authentication kerberos keytab import
   ```

3. (Optional) Configure the NIS server by entering the following commands:
   ```
   # authentication nis servers add <server>
   # authentication nis domain set <domain-name>
   # authentication nis enable
   # filesys restart
   ```

4. (Optional) Make the nfs4-domain the same as the Kerberos realm using the `nfs option command`:
   ```
   nfs option set nfs4-domain <kerberos-realm>
   ```

5. Add a client to an existing export by adding `sec=krb5` to the `nfs export add command`:
   ```
   nfs export add <export-name> clients * options version=4,sec=krb5
   ```
Configuring Clients

Procedure
1. Configure the DNS server and verify that forward and reverse lookups are working.
2. Configure the KDC and Kerberos realm by editing the /etc/krb5.conf configuration file.
   You might need to perform this step based on the client operating system you are using.
3. Configure NIS or another external name mapping service.
4. (Optional) Edit the /etc/idmapd.conf file to ensure it is the same as the Kerberos realm.
   You might need to perform this step based on the client operating system you are using.
5. Verify the keytab file /etc/krb5.keytab contains an entry for the nfs/ service principal or the root/ principal.

```
[root@fc22 ~]# klist -k
Keytab name: FILE:/etc/krb5.keytab
KVNO Principal
-----------
3 nfs/fc22.domain-name@domain-name
```
6. Mount the export using the sec=krb5 option.

```
[root@fc22 ~]# mount ddr12345.<domain-name>:/data/coll/mtree1 /mnt/nfs4 –o sec=krb5,vers=4
```

Enabling Active Directory

About this task
Configuring Active Directory authentication makes the protection system part of a Windows Active Directory realm. CIFS clients and NFS clients use Kerberos authentication.

Procedure
1. Join an active directory realm using the cifs set command:
   ```
   # cifs set authentication active-directory <realm>
   ```
   Kerberos is automatically set up on the system, and the required NFS/service principal is automatically created on the KDC.
2. Configure NIS using the authentication nis command:
   ```
   # authentication nis servers add <windows-ad-server>
   # authentication nis domain set <ad-realm>
   # authentication nis enable
   ```
3. Configure CIFS to use NSS for ID mapping by using cifs commands:
   ```
   # cifs disable
   # cifs option set idmap-type nss
   # cifs enable
   # filesys restart
   ```
4. Set the nfs4-domain to be the same as the Active Directory realm:
   ```
   # nfs option set nfs4-domain <ad-realm>
   ```
5. Enable Active Directory for NFSv4 id mapping by using the nfs command:
# nfs option set nfs4-idmap-active-directory enabled

## Configuring Active Directory

**Procedure**

1. Install the Active Directory Domain Services (AD DS) role on the Windows server.
2. Install the Identity Management for UNIX components.
   
   ```
   C:\Windows\system32>Dism.exe /online /enable-feature /featurename:adminui /all
   C:\Windows\system32>Dism.exe /online /enable-feature /featurename:nis /all
   ```
3. Verify the NIS domain is configured on the server.
   
   ```
   C:\Windows\system32>nisadmin
   The following are the settings on localhost
   Push Interval : 1 days
   Logging Mode  : Normal
   NIS Domains
   NIS Domain in AD  Master server  NIS Domain in UNIX
   ----------------  -------------  ----------------
   corp              win-ad-server  corp
   ```
4. Assign AD users and groups UNIX UIDs/GIDs for the NFSv4 server.
   
   a. Go to **Server Manager > Tools > Active Directory**.
   b. Open the **Properties** for an AD user or group.
   c. Under the **UNIX Attributes** tab, fill in the NIS domain, UID, and Primary GID fields.

## Configuring clients on Active Directory

**Procedure**

1. Create a new AD user on the AD server to represent the NFS client's service principal.
2. Create the nfs/ service principal for the NFS client.
   
   ```
   > ktpass -princ nfs/<client_dns_name>@<REALM> -mapuser nfsuser -pass ****
   -out nfsclient.keytab
   /crytp rc4-hmac-nt /ptype KRB5_NT_PRINCIPAL
   ```
3. (Optional) Copy the keytab file to `/etc/krb5.keytab` on the client.
   
   The need to perform this step depends on which client OS you are using.
CHAPTER 19

Metadata on Flash

This chapter includes:

- Overview of Metadata on Flash (MDoF) ................................................................. 230
- SSD cache licensing and capacity ............................................................................ 230
- SSD cache tier ......................................................................................................... 232
- SSD cache tier - system management ..................................................................... 232
- SSD alerts ............................................................................................................... 235
Overview of Metadata on Flash (MDoF)

MDoF creates caches for file system metadata using flash technologies. The SSD Cache is a low latency, high input/output operations per second (IOPS) cache to accelerate metadata and data access.

Note: The minimum software version required is DD OS 6.0.

Caching the file system metadata on SSDs improves I/O performance for both traditional and random workloads.

For traditional workloads, offloading random access to metadata from HDDs to SSDs allows the hard drives to accommodate streaming write and read requests.

For random workloads, SSD cache provides low latency metadata operations, which allows the HDDs to serve data requests instead of cache requests.

Read cache on SSD improves random read performance by caching frequently accessed data. Writing data to NVRAM combined with low latency metadata operations to drain the NVRAM faster improve random write latency. The absence of cache does not prevent file system operation, it only impacts file system performance.

When the cache tier is first created, a file system restart is only required if the cache tier is being added after the file system is running. For new systems that come with cache tier disks, no file system restart is required if the cache tier is created before enabling the file system for the first time. Additional cache can be added to a live system, without the need to disable and enable the file system.

One specific condition with regard to SSDs is when the number of spare blocks remaining gets close to zero, the SSD enters a read only condition. When a read only condition occurs, DD OS treats the drive as read-only cache and sends an alert.

MDoF is supported on the following systems:

- DD6300
- DD6800
- DD6900
- DD9300
- DD9400
- DD9500
- DD9800
- DD9900
- DD VE instances, including DD3300 systems, in capacity configurations of 16 TB and higher (SSD Cache Tier for DD VE)

SSD cache licensing and capacity

Depending on your system model, the SSD cache feature will either be enabled by default with no need for a license, or it will require an ELMS license to enable.

The following table describes the various SSD capacity and licensing requirements for the supported systems:
### Table 25 SSD capacity and licensing requirements

<table>
<thead>
<tr>
<th>Model</th>
<th>Memory</th>
<th>Number of SSDs</th>
<th>SSD capacity</th>
<th>License required</th>
<th>Enabled by default</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD6300</td>
<td>48 GB (Base)</td>
<td>1</td>
<td>800 GB</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>96 GB (Expanded)</td>
<td>2</td>
<td>1600 GB</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>DD6800</td>
<td>192 GB (Base)</td>
<td>2</td>
<td>1600 GB</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>192 GB (Expanded)</td>
<td>4</td>
<td>3200 GB</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>DD6900</td>
<td>288 GB</td>
<td>2</td>
<td>3840 GB</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>DD9300</td>
<td>192 GB (Base)</td>
<td>5</td>
<td>4000 GB</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>384 GB (Expanded)</td>
<td>8</td>
<td>6400 GB</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>DD9400</td>
<td>576 GB</td>
<td>5</td>
<td>19200 GB</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>DD9500</td>
<td>256 GB (Base)</td>
<td>8</td>
<td>6400 GB</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>512 GB (Expanded)</td>
<td>15</td>
<td>12000 GB</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>DD9800</td>
<td>256 GB (Base)</td>
<td>8</td>
<td>6400 GB</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>768 GB (Expanded)</td>
<td>15</td>
<td>12000 GB</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>DD9900</td>
<td>1152 GB</td>
<td>10</td>
<td>38400 GB</td>
<td>N</td>
<td>Y</td>
</tr>
</tbody>
</table>

**SSD Cache Tier for DD VE**

DD VE instances and DD3300 systems do not require a license for the SSD Cache Tier. The maximum supported SSD capacity is 1% of the Active Tier capacity.

The following table describes the various SSD capacity licenses and the SSD capacities for the given system:

### Table 26 DD VE and DD3300 SSD capacity

<table>
<thead>
<tr>
<th>Capacity configuration</th>
<th>Maximum SSD capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD VE 16 TB</td>
<td>160 GB</td>
</tr>
<tr>
<td>DD VE 32 TB</td>
<td>320 GB</td>
</tr>
<tr>
<td>DD VE 48 TB</td>
<td>480 GB</td>
</tr>
<tr>
<td>DD VE 64 TB</td>
<td>640 GB</td>
</tr>
<tr>
<td>DD VE 96 TB</td>
<td>960 GB</td>
</tr>
<tr>
<td>DD3300 8 TB</td>
<td>160 GB</td>
</tr>
<tr>
<td>DD3300 16 TB</td>
<td>160 GB</td>
</tr>
</tbody>
</table>
SSD cache tier

The SSD cache tier provides the SSD cache storage for the file system. The file system draws the required storage from the SSD cache tier without active intervention from the user.

SSD cache tier - system management

Be aware of the following considerations for SSD cache:

- When SSDs are deployed within a controller, those SSDs are treated as internal root drives. They display as enclosure 1 in the output of the `storage show all` command.
- Manage individual SSDs with the `disk` command the same way HDDs are managed.
- Run the `storage add` command to add an individual SSD or SSD enclosure to the SSD cache tier.
- The SSD cache tier space does not need to be managed. The file system draws the required storage from the SSD cache tier and shares it among its clients.
- The `filesys create` command creates an SSD volume if SSDs are available in the system.
  
  ![Note]
  
  If SSDs are added to the system later, the system should automatically create the SSD volume and notify the file system. SSD Cache Manager notifies its registered clients so they can create their cache objects.

- If the SSD volume contains only one active drive, the last drive to go offline will come back online if the active drive is removed from the system.

The next section describes how to manage the SSD cache tier from DD System Manager, and with the DD OS CLI.

Managing the SSD cache tier

Storage configuration features allow you to add and remove storage from the SSD cache tier.

Procedure

1. Select `Hardware > Storage > Overview`.
2. Expand the `Cache Tier` dialog.
3. Click `Configure`.
   
   ![Note]
   
   The licensed capacity bar shows the portion of licensed capacity (used and remaining) for the installed enclosures.

4. Select the checkbox for the Shelf to be added.
5. Click the `Add to Tier` button.
6. Click `OK` to add the storage.

   ![Note]
   
   To remove an added shelf, select it in the Tier Configuration list, click `Remove from Configuration`, and click `OK`.
CLI Equivalent
When the cache tier SSDs are installed in the head unit:

a. Add the SSDs to the cache tier.

```
# storage add disks 1.13,1.14 tier cache
Adding disk 1.13 to the cache tier...done
Updating system information...done
Disk 1.13 successfully added to the cache tier.
```

Checking storage requirements... done
Adding disk 1.14 to the cache tier...done
Updating system information...done
Disk 1.14 successfully added to the cache tier.

b. Verify the state of the newly added SSDs.

```
# disk show state
Enclosure  Disk
  1  2  3  4  5  6  7  8  9  10 11 12 13 14 15
--------- ----------------------------------------------
 1 . . . . . . . . s . s s s s v v
 2 U U U U U U U U U U U U U U U U U
 3 U U U U U U U U U U U U U U U U U
--------- ----------------------------------------------
Legend   State             Count
-------- ---------------   -----
.        In Use Disks      6
s        Spare Disks       6
v        Available Disks   2
U        Unknown Disks     30
-------- ---------------   -----
Total 44 disks
```

When the cache tier SSDs are installed in an external shelf:

a. Verify the system recognizes the SSD shelf. In the example below, the SSD shelf is enclosure 2.

```
# disk show state
Enclosure  Disk
Row(disk-id) 1  2  3  4  5  6  7  8  9  10 11 12 13 14 15
---------    ----------------------------------------------
 1 . . . . . . . .
 2 U U U U U U U U - - - - - -
 3 . . . . . . . . . . . . . v
 4 . . . . . . . . . . . . .
 5 v v v v v v v v v v v v v v v v v v
 6 v v v v v v v v v v v v v v v v v v
 7 v v v v v v v v v v v v v v v v v v
 8 v v v v v v v v v v v v v v v v v v
 9 v v v v v v v v v v v v v v v v v v
10 |--------|--------|--------|--------|
    | Pack 1 | Pack 2 | Pack 3 | Pack 4 |
E(49-60) | v v v | v v v | v v v | v v v |
D(37-48) | v v v | v v v | v v v | v v v |
C(25-36) | v v v | v v v | v v v | v v v |
B(13-24) | v v v | v v v | v v v | v v v |
A( 1-12) | v v v | v v v | v v v | v v v |
-------- ----------------------------------------------
11 v v v v v v v v v v v v v v v v v v
12 v v v v v v v v v v v v v v v v v v
13 v v v v v v v v v v v v v v v v v v
--------- ----------------------------------------------
```
Legend   State               Count
------   ------------------  -----  
.        In Use Disks        32  
v        Available Disks     182  
U        Unknown Disks       8  
-        Not Installed Disks 7  
------   -------------------  -----  
Total 222 disks

b. Identify the shelf ID of the SSD shelf. SSDs will display as SAS-SSD or SATA-SSD in the Type column.

# disk show hardware

Figure 10

c. Add the SSD shelf to the cache tier

# storage add enclosure 2 tier cache

Checking storage requirements...done
Adding enclosure 2 to the cache tier...Enclosure 2 successfully added to the cache tier.

Updating system information...done

Successfully added: 2  done

d. Verify the state of the newly added SSDs.

# disk show state

<table>
<thead>
<tr>
<th>Enclosure</th>
<th>Disk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>-----------</td>
<td>------</td>
</tr>
<tr>
<td>1</td>
<td>.</td>
</tr>
<tr>
<td>2</td>
<td>.</td>
</tr>
<tr>
<td>3</td>
<td>.</td>
</tr>
<tr>
<td>4</td>
<td>.</td>
</tr>
<tr>
<td>5</td>
<td>v</td>
</tr>
<tr>
<td>6</td>
<td>v</td>
</tr>
<tr>
<td>7</td>
<td>v</td>
</tr>
<tr>
<td>8</td>
<td>v</td>
</tr>
<tr>
<td>9</td>
<td>v</td>
</tr>
<tr>
<td>10</td>
<td>v</td>
</tr>
</tbody>
</table>

Legend   State               Count
------   ------------------  -----  
.        In Use Disks        32  
v        Available Disks     182  

To remove a controller-mounted SSD from the cache tier:

```bash
# storage remove disk 1.13
Removing disk 1.13...done
Updating system information...done
Disk 1.13 successfully removed.
```

To remove an SSD shelf from the system:

```bash
# storage remove enclosure 2
Removing enclosure 2...Enclosure 2 successfully removed.
Updating system information...done
Successfully removed: 2 done
```

### SSD alerts

There are three alerts specific to the SSD cache tier.

The SSD cache tier alerts are:

- **Licensing**
  If the file system is enabled and less physical cache capacity present than what the license permits is configured, an alert is generated with the current SSD capacity present, and the capacity license. This alert is classified as a warning alert. The absence of cache does not prevent file system operation, it only impacts file system performance. Additional cache can be added to a live system, without the need to disable and enable the file system.

- **Read only condition**
  When the number of spare blocks remaining gets close to zero, the SSD enters a read only condition. When a read only condition occurs, DD OS treats the drive as read-only cache.
  
  Alert **EVT-STORAGE-00001** displays when the SSD is in a read-only state and should be replaced.

- **SSD end of life**
  When an SSD reaches the end of its lifespan, the system generates a hardware failure alert identifying the location of the SSD within the SSD shelf. This alert is classified as a critical alert.
  
  Alert **EVT-STORAGE-00016** displays when the EOL counter reaches 98. The drive is failed proactively when the EOL counter reaches 99.
CHAPTER 20

SCSI Target

This chapter includes:

- SCSI Target overview ................................................................. 238
- Fibre Channel view ................................................................. 239
- Port monitoring ................................................................. 247
SCSI Target overview

SCSI (Small Computer System Interface) Target is a unified management daemon for all SCSI services and transports. SCSI Target supports DD VTL (Virtual Tape Library), DD Boost over FC (Fibre Channel), and vDisk/ProtectPoint Block Services, as well as anything that has a target LUN (logical unit number) on a DD system.

SCSI Target Services and Transports

The SCSI Target daemon starts when FC ports are present or DD VTL is licensed. It provides unified management for all SCSI Target services and transports.

- A **service** is anything that has a target LUN on a DD system that uses SCSI Target commands, such as DD VTL (tape drives and changers), DD Boost over FC (processor devices), or vDisk (Virtual Disk Device).
- A **transport** enables devices to become visible to initiators.
- An **initiator** is a backup client that connects to a system to read and write data using the FC protocol. A specific initiator can support DD Boost over FC, vDisk, or DD VTL, but not all three.
- **Devices** are visible on a SAN (storage area network) through physical ports. Host initiators communicate with the DD system through the SAN.
- **Access groups** manage access between devices and initiators.
- An **endpoint** is the logical target on a DD system to which an initiator connects. You can disable, enable, and rename endpoints. To delete endpoints, the associated transport hardware must no longer exist. Endpoints are automatically discovered and created when a new transport connection occurs. Endpoints have the following attributes: port topology, FCP2-RETRY status, WWPN, and WWNN.

- NPIV (N_port ID Virtualization) is an FC feature that lets multiple endpoints share a single physical port. NPIV eases hardware requirements and provides failover capabilities.
- In DD OS 6.0, users can specify the sequence of secondary system addresses for failover. For example, if the system specifies 0a, 0b, 1a, 1b and the user specifies 1b, 1a, 0a, 0b, the user-specified sequence is used for failover. The `scsitarget endpoint show detailed` command displays the user-specified sequence.

Only one initiator should be present per access group. Each access group is assigned a type (DD VTL, vDisk/ProtectPoint Block Services, or DD Boost over FC).

SCSI Target Architectures - Supported and Unsupported

SCSI Target supports the following architectures:

- **DD VTL plus DD Boost over FC from different initiators:** Two different initiators (on the same or different clients) may access a DD system using DD VTL and DD Boost over FC, through the same or different DD system target endpoints.
- **DD VTL plus DD Boost over FC from one initiator to two different DD systems:** A single initiator may access two different DD systems using any service.

SCSI Target does not support the following architecture:

- **DD VTL plus DD Boost over FC from one initiator to the same DD system:** A single initiator may not access the same DD system through different services.

Thin Protocol

The thin protocol is a lightweight daemon for VDisk and DD VTL that responds to SCSI commands when the primary protocol can’t. For Fibre Channel environments with multiple protocols, thin protocol:
- Prevents initiator hangs
- Prevents unnecessary initiator aborts
- Prevents initiator devices from disappearing
- Supports a standby mode
- Supports fast and early discoverable devices
- Enhances protocol HA behavior
- Doesn’t require fast registry access

For More Information about DD Boost and the scscitarget Command (CLI)

For more information about using DD Boost through the DD System Manager, see the related chapter in this book. For other types of information about DD Boost, see the *DD Boost for OpenStorage Administration Guide*.

This chapter focuses on using SCSI Target through the DD System Manager. After you have become familiar with basic tasks, the `scscitarget` command in the *DD OS Command Reference Guide* provides more advanced management tasks.

When there is heavy DD VTL traffic, avoid running the `scsitarget group use` command, which switches the in-use endpoint lists for one or more SCSI Target or vdisk devices in a group between primary and secondary endpoint lists.

### Fibre Channel view

The Fibre Channel view displays the current status of whether Fibre Channel and/or NPIV is enabled. It also displays two tabs: Resources and Access Groups. Resources include ports, endpoints, and initiators. An access group holds a collection of initiator WWPNs (worldwide port names) or aliases and the drives and changers they are allowed to access.

### Enable N_Port ID Virtualization on a Data Domain system

**Before you begin**

The following conditions must be met:

- The Data Domain system must be running a supported version of Data Domain OS.
- All ports must be connected to 4 Gb, 8 Gb, and 16 Gb Fibre Channel HBA and SLIC.
- The Data Domain system ID must be valid, that is, it must not be 0.

In addition, port topologies and port names are reviewed and may prevent NPIV from being enabled:

- NPIV is allowed if the topology for all ports is loop-preferred.
- NPIV is allowed if the topology for some of the ports is loop-preferred. However, NPIV must be disabled for ports that are loop-only, or you must reconfigure the topology to loop-preferred for proper functionality.
- NPIV is not allowed if none of the ports have a topology of loop-preferred.
- If port names are present in access groups, the port names are replaced with their associated endpoint names.

**Procedure**

1. Select **Hardware > Fibre Channel**.
2. Next to **NPIV: Disabled**, select **Enable**.
3. In the **Enable NPIV** dialog box, you are warned that all Fibre Channel ports must be disabled before NPIV can be enabled. If you are sure that you want to continue, select **Yes**.

### Disabling NPIV

Before you can disable NPIV, you must not have any ports with multiple endpoints.

**About this task**

ℹ️ **Note:** NPIV is required for HA configuration. It is enabled by default and cannot be disabled.

**Procedure**

1. Select **Hardware > Fibre Channel**.
2. Next to NPIV: **Enabled**, select **Disable**.
3. In the Disable NPIV dialog, review any messages about correcting the configuration, and when ready, select **OK**.

### Resources tab

The **Hardware > Fibre Channel > Resources** tab displays information about ports, endpoints, and initiators.

#### Table 27 Ports

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Address</td>
<td>System address for port</td>
</tr>
<tr>
<td>WWPN</td>
<td>Unique worldwide port name, which is a 64-bit identifier (a 60-bit value preceded by a 4-bit <em>Network Address Authority</em> identifier), of the Fibre Channel (FC) port.</td>
</tr>
<tr>
<td>WWNN</td>
<td>Unique worldwide node name, which is a 64-bit identifier (a 60-bit value preceded by a 4-bit <em>Network Address Authority</em> identifier), of the FC node</td>
</tr>
<tr>
<td>Enabled</td>
<td>Port operational status; either Enabled or Disabled.</td>
</tr>
<tr>
<td>NPIV</td>
<td>NPIV status; either Enabled or Disabled.</td>
</tr>
<tr>
<td>Link Status</td>
<td>Link status: either Online or Offline; that is, whether or not the port is up and capable of handling traffic.</td>
</tr>
<tr>
<td>Operation Status</td>
<td>Operation status: either Normal or Marginal.</td>
</tr>
<tr>
<td># of Endpoints</td>
<td>Number of endpoints associated with this port.</td>
</tr>
</tbody>
</table>

#### Table 28 Endpoints

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Name of endpoint.</td>
</tr>
<tr>
<td>WWPN</td>
<td>Unique worldwide port name, which is a 64-bit identifier (a 60-bit value preceded by a 4-bit <em>Network Address Authority</em> identifier), of the Fibre Channel (FC) port.</td>
</tr>
<tr>
<td>WWNN</td>
<td>Unique worldwide node name, which is a 64-bit identifier (a 60-bit value preceded by a 4-bit <em>Network Address Authority</em> identifier), of the FC node</td>
</tr>
</tbody>
</table>
Table 28 Endpoints (continued)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Address</td>
<td>System address of endpoint.</td>
</tr>
<tr>
<td>Enabled</td>
<td>Port operational state; either Enabled or Disabled.</td>
</tr>
<tr>
<td>Link Status</td>
<td>Either Online or Offline; that is, whether or not the port is up and capable of handling traffic.</td>
</tr>
</tbody>
</table>

Table 29 Initiators

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Name of initiator.</td>
</tr>
<tr>
<td>Service</td>
<td>Service support by the initiator, which is either DD VTL, DD Boost, or vDisk.</td>
</tr>
<tr>
<td>WWPN</td>
<td>Unique worldwide port name, which is a 64-bit identifier (a 60-bit value preceded by a 4-bit Network Address Authority identifier), of the Fibre Channel (FC) port.</td>
</tr>
<tr>
<td>WWNN</td>
<td>Unique worldwide node name, which is a 64-bit identifier (a 60-bit value preceded by a 4-bit Network Address Authority identifier), of the FC node.</td>
</tr>
<tr>
<td>Vendor Name</td>
<td>Initiator's model.</td>
</tr>
<tr>
<td>Online Endpoints</td>
<td>Endpoints seen by this initiator. Displays none or offline if the initiator is not available.</td>
</tr>
</tbody>
</table>

Configuring a port

Ports are discovered, and a single endpoint is automatically created for each port, at startup.

About this task

The properties of the base port depend on whether NPIV is enabled:

- In non-NPIV mode, ports use the same properties as the endpoint, that is, the WWPN for the base port and the endpoint are the same.
- In NPIV mode, the base port properties are derived from default values, that is, a new WWPN is generated for the base port and is preserved to allow consistent switching between NPIV modes. Also, NPIV mode provides the ability to support multiple endpoints per port.

Procedure

1. Select **Hardware > Fibre Channel > Resources**.
2. Under **Ports**, select an port, and then select **Modify** (pencil).
3. In the Configure Port dialog, select whether to automatically enable or disable NPIV for this port.
4. For Topology, select Loop Preferred, Loop Only, Point to Point, or Default.
5. For Speed, select 1, 2, 4, 8, or 16 Gbps, or auto.
6. Select **OK**.
Enabling a port

Ports must be enabled before they can be used.

Procedure

1. Select Hardware > Fibre Channel > Resources.
2. Select More Tasks > Ports > Enable. If all ports are already enabled, a message to that effect is displayed.
3. In the Enable Ports dialog, select one or more ports from the list, and select Next.
4. After the confirmation, select Next to complete the task.

Disabling a port

You can simply disable a port (or ports), or you can chose to failover all endpoints on the port (or ports) to another port.

Procedure

1. Select Hardware > Fibre Channel > Resources.
2. Select More Tasks > Ports > Disable.
3. In the Disable Ports dialog, select one or more ports from the list, and select Next.
4. In the confirmation dialog, you can continue with simply disabling the port, or you can chose to failover all endpoints on the ports to another port.

Adding an endpoint

An endpoint is a virtual object that is mapped to a underlying virtual port. In non-NPIV mode (not available on HA configuration), only a single endpoint is allowed per physical port, and the base port is used to configure that endpoint to the fabric. When NPIV is enabled, multiple endpoints are allowed per physical port, each using a virtual (NPIV) port, and endpoint failover/failback is enabled.

About this task

Note: Non-NPIV mode is not available on HA configurations. NPIV is enabled by default and cannot be disabled.

Note: In NPIV mode, endpoints:
  - have a primary system address.
  - may have zero or more secondary system addresses.
  - are all candidates for failover to an alternate system address on failure of a port; however, failover to a marginal port is not supported.
  - may be failed back to use their primary port when the port comes back up online.

Note: When using NPIV, it is recommended that you use only one protocol (that is, DD VTL Fibre Channel, DD Boost-over-Fibre Channel, or vDisk Fibre Channel) per endpoint. For failover configurations, secondary endpoints should also be configured to have the same protocol as the primary.

Procedure

1. Select Hardware > Fibre Channel > Resources.
2. Under Endpoints, select Add (+ sign).
3. In the Add Endpoint dialog, enter a Name for the endpoint (from 1 to 128 characters). The field cannot be empty or be the word “all,” and cannot contain the characters asterisk (*), question mark (?), front or back slashes (/, \), or right or left parentheses [(,)].

4. For Endpoint Status, select Enabled or Disabled.

5. If NPIV is enabled, for Primary system address, select from the drop-down list. The primary system address must be different from any secondary system address.

6. If NPIV is enabled, for Fails over to secondary system addresses, check the appropriate box next to the secondary system address.

7. Select OK.

Configuring an endpoint

After you have added an endpoint, you can modify it using the Configure Endpoint dialog.

About this task

**Note:** When using NPIV, it is recommended that you use only one protocol (that is, DD VTL Fibre Channel, DD Boost-over-Fibre Channel, or vDisk Fibre Channel) per endpoint. For failover configurations, secondary endpoints should also be configured to have the same protocol as the primary.

Procedure

1. Select Hardware > Fibre Channel > Resources.

2. Under Endpoints, select an endpoint, and then select **Modify** (pencil).

3. In the Configure Endpoint dialog, enter a Name for the endpoint (from 1 to 128 characters). The field cannot be empty or be the word “all,” and cannot contain the characters asterisk (*), question mark (?), front or back slashes (/, \), or right or left parentheses [(,)].

4. For Endpoint Status, select Enabled or Disabled.

5. For Primary system address, select from the drop-down list. The primary system address must be different from any secondary system address.

6. For Fails over to secondary system addresses, check the appropriate box next to the secondary system address.

7. Select OK.

Modifying an endpoint's system address

You can modify the active system address for a SCSI Target endpoint using the `scsitarget endpoint modify` command option. This is useful if the endpoint is associated with a system address that no longer exists, for example after a controller upgrade or when a controller HBA (host bus adapter) has been moved. When the system address for an endpoint is modified, all properties of the endpoint, including WWPN and WWNN (worldwide port and node names, respectively), if any, are preserved and are used with the new system address.

About this task

In the following example, endpoint ep-1 was assigned to system address 5a, but this system address is no longer valid. A new controller HBA was added at system address 10a. The SCSI Target subsystem automatically created a new endpoint, ep-new, for the newly discovered system address. Because only a single endpoint can be associated with a given system address, ep-new must be deleted, and then ep-1 must be assigned to system address 10a.

**Note:** It may take some time for the modified endpoint to come online, depending on the SAN environment, since the WWPN and WWNN have moved to a different system address. You may also need to update SAN zoning to reflect the new configuration.
Procedure
1. Show all endpoints to verify the endpoints to be changed:
   # scsitarget endpoint show list
2. Disable all endpoints:
   # scsitarget endpoint disable all
3. Delete the new, unnecessary endpoint, ep-new:
   # scsitarget endpoint del ep-new
4. Modify the endpoint you want to use, ep-1, by assigning it the new system address 10a:
   # scsitarget endpoint modify ep-1 system-address 10a
5. Enable all endpoints:
   # scsitarget endpoint enable all

Enabling an endpoint
Enabling an endpoint enables the port only if it is currently disabled, that is, you are in non-NPIV mode.

Procedure
1. Select Hardware > Fibre Channel > Resources.
2. Select More Tasks > Endpoints > Enable. If all endpoints are already enabled, a message to that effect is displayed.
3. In the Enable Endpoints dialog, select one or more endpoints from the list, and select Next.
4. After the confirmation, select Next to complete the task.

Disabling an endpoint
Disabling an endpoint does not disable the associated port, unless all endpoints using the port are disabled, that is, you are in non-NPIV mode.

Procedure
1. Select Hardware > Fibre Channel > Resources.
2. Select More Tasks > Endpoints > Disable.
3. In the Disable Endpoints dialog, select one or more endpoints from the list, and select Next.
   If an endpoint is in use, you are warned that disabling it might disrupt the system.
4. Select Next to complete the task.

Deleting an endpoint
You may want to delete an endpoint if the underlying hardware is no longer available. However, if the underlying hardware is still present, or becomes available, a new endpoint for the hardware is discovered automatically and configured based on default values.

Procedure
1. Select Hardware > Fibre Channel > Resources.
2. Select More Tasks > Endpoints > Delete.
3. In the Delete Endpoints dialog, select one or more endpoints from the list, and select Next.
   If an endpoint is in use, you are warned that deleting it might disrupt the system.
4. Select Next to complete the task.
Adding an initiator

Add initiators to provide backup clients to connect to the system to read and write data using the FC (Fibre Channel) protocol. A specific initiator can support DD Boost over FC, or DD VTL, but not both. A maximum of 1024 initiators can be configured for a DD system.

Procedure

1. Select Hardware > Fibre Channel > Resources.
2. Under Initiators, select Add (+ sign)
3. In the Add Initiator dialog, enter the port’s unique WWPN in the specified format.
4. Enter a Name for the initiator.
5. Select the Address Method: Auto is used for standard addressing, and VSA (Volume Set Addressing) is used primarily for addressing virtual buses, targets, and LUNs.
6. Select OK.

CLI Equivalent

```
# scsitarget group add My_Group initiator My_Initiator
```

Modifying or deleting an initiator

Before you can delete an initiator, it must be offline and not attached to any group. Otherwise, you will get an error message, and the initiator will not be deleted. You must delete all initiators in an access group before you can delete the access group. If an initiator remains visible, it may be automatically rediscovered.

Procedure

1. Select Hardware > Fibre Channel > Resources.
2. Under Initiators, select one of the initiators. If you want to delete it, select Delete (X). If you want to modify it, select Modify (pencil) to display the Modify Initiator dialog.
3. Change the initiator’s Name and/or Address Method [Auto is used for standard addressing, and VSA (Volume Set Addressing) is used primarily for addressing virtual buses, targets, and LUNs.]
4. Select OK.

Recommendation to Set Initiator Aliases - CLI only

It is strongly recommended that Initiator aliases be set to reduce confusion and human error during the configuration process.

```
# vtl initiator set alias NewAliasName wwpn 21:00:00:e0:8b:9d:0b:e8
```

<table>
<thead>
<tr>
<th>Initiator</th>
<th>Group</th>
<th>Status</th>
<th>WWNN</th>
<th>WWPN</th>
<th>Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>NewVTL</td>
<td>aussie1</td>
<td>Online</td>
<td>20:00:00:e0:8b:9d:0b:e8</td>
<td>21:00:00:e0:8b:9d:0b:e8</td>
<td>6a</td>
</tr>
<tr>
<td></td>
<td>Offline</td>
<td></td>
<td>20:00:00:e0:8b:9d:0b:e8</td>
<td>21:00:00:e0:8b:9d:0b:e8</td>
<td>6b</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Initiator</th>
<th>Symbolic Port Name</th>
<th>Address Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>NewVTL</td>
<td></td>
<td>auto</td>
</tr>
</tbody>
</table>
Setting a hard address (loop ID)
Some backup software requires that all private-loop targets have a hard address (loop ID) that does not conflict with another node. The range for a loop ID is from 0 to 125.

Procedure
1. Select Hardware > Fibre Channel > Resources.
2. Select More Tasks > Set Loop ID.
3. In the Set Loop ID dialog, enter the loop ID (from 0 to 125), and select OK.

Setting failover options
You can set options for automatic failover and failback when NPIV is enabled.

About this task
Here is the expected behavior for Fibre Channel port failover, by application:

- DD Boost-over-Fibre Channel operation is expected to continue without user intervention when the Fibre Channel endpoints failover.
- DD VTL Fibre Channel operation is expected to be interrupted when the DD VTL Fibre Channel endpoints failover. You may need to perform discovery (that is, operating system discovery and configuration of DD VTL devices) on the initiators using the affected Fibre Channel endpoint. You should expect to re-start active backup and restore operations.
- vDisk Fibre Channel operation is expected to continue without user intervention when the Fibre Channel endpoints failover.

Automatic failback is not guaranteed if all ports are disabled and then subsequently enabled (which could be triggered by the administrator), as the order in which ports get enabled is unspecified.

Procedure
1. Select Hardware > Fibre Channel > Resources.
2. Select More Tasks > Set Failover Options.
3. In the Set Failover Options dialog, enter the Failover and Failback Delay (in seconds) and whether to enable Automatic Failback, and select OK.

Access Groups tab
The Hardware > Fibre Channel > Access Groups tab provides information about DD Boost and DD VTL access groups. Selecting the link to View DD Boost Groups or View VTL Groups takes you to the DD Boost or DD VTL pages.

Table 30 Access Groups

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group Name</td>
<td>Name of access group.</td>
</tr>
<tr>
<td>Service</td>
<td>Service for this access group: either DD Boost or DD VTL.</td>
</tr>
<tr>
<td>Endpoints</td>
<td>Endpoints associated with this access group.</td>
</tr>
<tr>
<td>Initiators</td>
<td>Initiators associated with this access group.</td>
</tr>
<tr>
<td>Number of Devices</td>
<td>Number of devices associated with this access group.</td>
</tr>
</tbody>
</table>
Port monitoring

Port monitoring detects an FC port at system startup and raises an alert if the port is enabled and offline.

To clear the alert, disable an unused port using the `scsitarget port` commands.
CHAPTER 21

Working with DD Boost

This chapter includes:

- About DD Boost ................................................................. 250
- Managing DD Boost with DD System Manager ......................... 250
- About interface groups .......................................................... 264
- Destroying DD Boost ............................................................ 270
- Configuring DD Boost-over-Fibre Channel .............................. 271
- Using DD Boost on HA systems ............................................. 275
- About the DD Boost tabs .................................................... 275
About DD Boost

DD Boost provides advanced integration with backup and enterprise applications for increased performance and ease of use. DD Boost distributes parts of the deduplication process to the backup server or application clients, enabling client-side deduplication for faster, more efficient backup and recovery.

DD Boost is an optional product that requires a separate license to operate on the protection system. You can purchase a DD Boost software license key directly from Dell EMC.

**Note:** A special license, BLOCK-SERVICES-PROTECTPOINT, is available to enable clients using ProtectPoint block services to have DD Boost functionality without a DD Boost license. If DD Boost is enabled for ProtectPoint clients only—that is, if only the BLOCK-SERVICES-PROTECTPOINT license is installed—the license status indicates that DD Boost is enabled for ProtectPoint only.

There are two components to DD Boost: one component that runs on the backup server and another that runs on the protection system.

- In the context of the NetWorker backup application, Avamar backup application and other DDBoost partner backup applications, the component that runs on the backup server (DD Boost libraries) is integrated into the particular backup application.
- In the context of Veritas backup applications (NetBackup and Backup Exec) and the Oracle RMAN plug-in, you need to download an appropriate version of the DD Boost plugin that is installed on each media server. The DD Boost plugin includes the DD Boost libraries for integrating with the DD Boost server running on the protection system.

The backup application (for example, Avamar, NetWorker, NetBackup, or Backup Exec) sets policies that control when backups and duplications occur. Administrators manage backup, duplication, and restores from a single console and can use all of the features of DD Boost, including WAN-efficient replicator software. The application manages all files (collections of data) in the catalog, even those created by the protection system.

In the protection system, storage units that you create are exposed to backup applications that use the DD Boost protocol. For Veritas applications, storage units are viewed as disk pools. For Networker, storage units are viewed as logical storage units (LSUs). A storage unit is an MTree; therefore, it supports MTree quota settings. (Do not create an MTree in place of a storage unit.)

This chapter does not contain installation instructions; refer to the documentation for the product you want to install. For example, for information about setting up DD Boost with Veritas backup applications (NetBackup and Backup Exec), see the *DD Boost for OpenStorage Administration Guide*. For information on setting up DD Boost with any other application, see the application-specific documentation.

Additional information about configuring and managing DD Boost on the protection system can also be found in the *DD Boost for OpenStorage Administration Guide* (for NetBackup and Backup Exec) and the *DD Boost for Partner Integration Administration Guide* (for other backup applications).

Managing DD Boost with DD System Manager

Access the DD Boost view in DD System Manager.

**Before you begin**
NFSv3 must be enabled to use DD Boost.

**Procedure**
1. Select **Data Management > File System**. Verify that the file system is enabled and running by checking its state.
2. Select Protocols > DD Boost.

If you go to the DD Boost page without a license, the Status states that DD Boost is not licensed. Click Add License and enter a valid license in the Add License Key dialog box.

**Note:** A special license, BLOCK-SERVICES-PROTECTPOINT, is available to enable clients using ProtectPoint block services to have DD Boost functionality without a DD Boost license. If DD Boost is enabled for ProtectPoint clients only—that is, if only the BLOCK-SERVICES-PROTECTPOINT license is installed—the license status indicates that DD Boost is enabled for ProtectPoint only.

Use the DD Boost tabs—Settings, Active Connections, IP Network, Fibre Channel, and Storage Units—to manage DD Boost.

**Specifying DD Boost user names**

A DD Boost user is also a DD OS user. Specify a DD Boost user either by selecting an existing DD OS user name or by creating a new DD OS user name and making that name a DD Boost user.

**About this task**

Backup applications use the DD Boost user name and password to connect to the protection system. You must configure these credentials on each backup server that connects to this system. The system supports multiple DD Boost users. For complete information about setting up DD Boost with Veritas NetBackup and Backup Exec, see the *DD Boost for OpenStorage Administration Guide*. For information on setting up DD Boost with other applications, see the *DD Boost for Partner Integration Administration Guide* and the application-specific documentation.

**Procedure**

1. Select Protocols > DD Boost.
2. Select Add (+) above the Users with DD Boost Access list.
   
   The Add User dialog appears.
3. To select an existing user, select the user name in the drop-down list.
   If possible, select a user name with management role privileges set to none.
4. To create and select a new user, select Create a new Local User and do the following:
   a. Enter the new user name in the User field.
      The user must be configured in the backup application to connect to the protection system.
   b. Enter the password twice in the appropriate fields.
5. Click Add.

**Changing DD Boost user passwords**

Change a DD Boost user password.

**Procedure**

1. Select Protocols > DD Boost > Settings.
2. Select a user in the Users with DD Boost Access list.
3. Click the Edit button (pencil icon) above the DD Boost user list.
   
   The Change Password dialog appears.
4. Enter the password twice in the appropriate boxes.
5. Click Change.

Troubleshooting DD Boost user access issues

**DD Boost user is locked out**

The most common reason a user becomes locked out of the system is that the password expired. Passwords must be changed at intervals specified by the system administrator (90 days by default). Refer to KB article 520213 Data Domain: DDBoost user shows locked status for information on resolving and preventing this issue.

Removing a DD Boost user name

Remove a user from the DD Boost access list.

Procedure

1. Select Protocols > DD Boost > Settings.
2. Select the user in the Users with DD Boost Access list that needs to be removed.
3. Click Remove (X) above the DD Boost user list.
   - The Remove User dialog appears.
4. Click Remove.
   - After removal, the user remains in the DD OS access list.

Enabling DD Boost

Use the DD Boost Settings tab to enable DD Boost and to select or add a DD Boost user.

Procedure

1. Select Protocols > DD Boost.
2. Click Enable in the DD Boost Status area.
   - The Enable DD Boost dialog box is displayed.
3. Select an existing user name from the menu, or add a new user by supplying the name, password, and role.

Configuring Kerberos

You can configure Kerberos by using the DD Boost Settings tab.

Procedure

1. Select Protocols > DD Boost > Settings.
2. Click Configure in the Kerberos Mode status area.
   - The Authentication tab under Administration > Access is displayed.
   - The Active Directory/Kerberos Authentication dialog box is displayed.
   - Choose the type of Kerberos Key Distribution Center (KDC) you want to use:
- **Disabled**
  
  | Note: | If you select **Disabled**, NFS clients do not use Kerberos authentication. CIFS clients use Workgroup authentication. |

- **Windows/Active Directory**
  
  | Note: | Enter the Realm Name, Under Name, and Password for Active Directory authentication. |

- **Unix**
  
  a. Enter the Realm Name, the IP Address/Host Names of one to three KDC servers.
  
  b. Upload the keytab file from one of the KDC servers.

**Disabling DD Boost**

Disabling DD Boost drops all active connections to the backup server. When you disable or destroy DD Boost, the DD Boost FC service is also disabled.

**Before you begin**

Ensure there are no jobs running from your backup application before disabling.

**About this task**

| Note: | File replication started by DD Boost between two restore operations is not canceled. |

**Procedure**

1. Select **Protocols > DD Boost**.
2. Click **Disable** in the DD Boost Status area.
3. Click **OK** in the Disable DD Boost confirmation dialog box.

**Viewing DD Boost storage units**

Access the Storage Units tab to view and manage DD Boost storage units.

The DD Boost Storage Unit tab:

- Lists the storage units and provides the following information for each storage unit:

  **Table 31 Storage unit information**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Unit</td>
<td>The name of the storage unit.</td>
</tr>
<tr>
<td>User</td>
<td>The DD Boost user owning the storage unit.</td>
</tr>
<tr>
<td>Quota Hard Limit</td>
<td>The percentage of hard limit quota used.</td>
</tr>
<tr>
<td>Last 24 hr Pre-Comp</td>
<td>The amount of raw data from the backup application that has been written in the last 24 hours.</td>
</tr>
<tr>
<td>Last 24 hr Post-Comp</td>
<td>The amount of storage used after compression in the last 24 hours.</td>
</tr>
<tr>
<td>Last 24 hr Comp Ratio</td>
<td>The compression ratio for the last 24 hours.</td>
</tr>
<tr>
<td>Weekly Avg Post-Comp</td>
<td>The average amount of compressed storage used in the last five weeks.</td>
</tr>
<tr>
<td>Last Week Post-Comp</td>
<td>The average amount of compressed storage used in the last seven days.</td>
</tr>
</tbody>
</table>
Table 31 Storage unit information (continued)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekly Avg Comp Ratio</td>
<td>The average compression ratio for the last five weeks.</td>
</tr>
<tr>
<td>Last Week Comp Ratio</td>
<td>The average compression ratio for the last seven days.</td>
</tr>
</tbody>
</table>

- Allows you to create, modify, and delete storage units.
- Displays four related tabs for a storage unit selected from the list: Storage Unit, Space Usage, Daily Written, and Data Movement.
  
  **Note:** The Data Movement tab is available only if an optional Cloud Tier license is installed.
- Takes you to Replication > On-Demand > File Replication when you click the View DD Boost Replications link.
  
  **Note:** A DD Replicator license is required for DD Boost to display tabs other than the File Replication tab.

Creating a storage unit

You must create at least one storage unit on the protection system, and a DD Boost user must be assigned to that storage unit. Use the Storage Units tab to create a storage unit.

**About this task**

Each storage unit is a top-level subdirectory of the `/data/col1` directory; there is no hierarchy among storage units.

**Procedure**

1. Select Protocols > DD Boost > Storage Units.
2. Click Create (+).
   
   The Create Storage Unit dialog box is displayed.
3. Enter the storage unit name in the Name box.
   
   Each storage unit name must be unique. Storage unit names can be up to 50 characters. The following characters are acceptable:
   - upper- and lower-case alphabetical characters: A-Z, a-z
   - numbers: 0-9
   - embedded space
     
     **Note:** The storage-unit name must be enclosed in double quotes (""') if the name has an embedded space.
   - comma (,)
   - period (.), as long as it does not precede the name
   - exclamation mark (!)
   - number sign (#)
   - dollar sign ($)
   - per cent sign (%)
   - plus sign (+)
   - at sign (@)
   - equal sign (=)
4. To select an existing username that will have access to this storage unit, select the username in the dropdown list. If possible, select a username with management role privileges set to none.

5. To create and select a new username that will have access to this storage unit, select Create a new Local User and:
   a. Enter the new user name in the User box.
      The user must be configured in the backup application to connect to the protection system.
   b. Enter the password twice in the appropriate boxes.

6. To set storage space restrictions to prevent a storage unit from consuming excess space: enter either a soft or hard limit quota setting, or both a hard and soft limit. With a soft limit an alert is sent when the storage unit size exceeds the limit, but data can still be written to it. Data cannot be written to the storage unit when the hard limit is reached.

   **Note:** Quota limits are pre-compressed values. To set quota limits, select Set to Specific Value and enter the value. Select the unit of measurement: MiB, GiB, TiB, or PiB.

   **Note:** When setting both soft and hard limits, a quota’s soft limit cannot exceed the quota’s hard limit.

7. Click Create.

8. Repeat the above steps for each DD Boost-enabled system.

**Viewing storage unit information**

From the DD Boost Storage Units tab, you can select a storage unit and access the Storage Unit, Space Usage, Daily Written, and Data Movement tabs for the selected storage unit.

**Storage Unit tab**

The Storage Unit tab shows detailed information for a selected storage unit in its Summary and Quota panels. The Snapshot panel shows snapshot details, allows you to create new snapshots and schedules, and provides a link to the Data Management > Snapshots tab.

- The Summary panel shows summarized information for the selected storage unit.
Table 32 Summary panel

<table>
<thead>
<tr>
<th>Summary item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Files</td>
<td>The total number of file images on the storage unit. For compression details that you can download to a log file, click the Download Compression Details link. The generation can take up to several minutes. After it has completed, click Download.</td>
</tr>
<tr>
<td>Full Path</td>
<td>/data/coll/filename</td>
</tr>
<tr>
<td>Status</td>
<td>R: read; W: write; Q: quota defined</td>
</tr>
<tr>
<td>Pre-Comp Used</td>
<td>The amount of pre-compressed storage already used.</td>
</tr>
</tbody>
</table>

- The Quota panel shows quota information for the selected storage unit.

Table 33 Quota panel

<table>
<thead>
<tr>
<th>Quota item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quota Enforcement</td>
<td>Enabled or disable. Clicking Quota takes you to the Data Management &gt; Quota tab where you can configure quotas.</td>
</tr>
<tr>
<td>Pre-Comp Soft Limit</td>
<td>Current value of soft quota set for the storage unit.</td>
</tr>
<tr>
<td>Pre-Comp Hard Limit</td>
<td>Current value of hard quota set for the storage unit.</td>
</tr>
<tr>
<td>Quota Summary</td>
<td>Percentage of Hard Limit used.</td>
</tr>
</tbody>
</table>

To modify the pre-comp soft and hard limits shown in the tab:
1. Click the Quota link in the Quota panel.
2. In the Configure Quota dialog box, enter values for hard and soft quotas and select the unit of measurement: MiB, GiB, TiB, or PiB. Click OK.

- Snapshots
  The Snapshots panel shows information about the storage unit’s snapshots.

Table 34 Snapshots panel

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Snapshots</td>
<td>The total number of snapshots created for this MTree. A total of 750 snapshots can be created for each MTree.</td>
</tr>
<tr>
<td>Expired</td>
<td>The number of snapshots in this MTree that have been marked for deletion, but have not been removed with the clean operation as yet.</td>
</tr>
<tr>
<td>Unexpired</td>
<td>The number of snapshots in this MTree that are marked for keeping.</td>
</tr>
<tr>
<td>Oldest Snapshot</td>
<td>The date of the oldest snapshot for this MTree.</td>
</tr>
<tr>
<td>Newest Snapshot</td>
<td>The date of the newest snapshot for this MTree.</td>
</tr>
<tr>
<td>Next Scheduled</td>
<td>The date of the next scheduled snapshot.</td>
</tr>
<tr>
<td>Assigned Snapshot Schedules</td>
<td>The name of the snapshot schedule assigned to this MTree.</td>
</tr>
</tbody>
</table>

Using the Snapshots panel, you can:
- Assign a snapshot schedule to a selected storage unit: Click **Assign Schedules**. Select the schedule’s checkbox; click **OK** and **Close**.

- Create a new schedule: Click **Assign Snapshot Schedules > Create Snapshot Schedule**. Enter the new schedule’s name.

  **Note:** The snapshot name can be composed only of letters, numbers, _, -, %d (numeric day of the month: 01-31), %a (abbreviated weekday name), %m (numeric month of the year: 01-12), %b (abbreviated month name), %y (year, two digits), %Y (year, four digits), %H (hour: 00-23), and %M (minute: 00-59), following the pattern shown in the dialog box. Enter the new pattern and click **Validate Pattern & Update Sample**. Click **Next**.

  - Select when the schedule is to be executed: weekly, every day (or selected days), monthly on specific days that you select by clicking that date in the calendar, or on the last day of the month. Click **Next**.

  - Enter the times of the day when the schedule is to be executed: Either select **At Specific Times** or **In Intervals**. If you select a specific time, select the time from the list. Click **Add (+)** to add a time (24-hour format). For intervals, select **In Intervals** and set the start and end times and how often (Every), such as every eight hours. Click **Next**.

  - Enter the retention period for the snapshots in days, months, or years. Click **Next**.

  - Review the Summary of your configuration. Click **Back** to edit any of the values. Click **Finish** to create the schedule.

- Click the Snapshots link to go to the **Data Management > Snapshots** tab.

**Space Usage tab**

The Space Usage tab graph displays a visual representation of data usage for the storage unit over time.

- Click a point on a graph line to display a box with data at that point.
- Click **Print** (at the bottom on the graph) to open the standard Print dialog box.
- Click **Show in new window** to display the graph in a new browser window.

There are two types of graph data displayed: Logical Space Used (Pre-Compression) and Physical Capacity Used (Post-Compression).

**Daily Written tab**

The Daily Written view contains a graph that displays a visual representation of data that is written daily to the system over a period of time, selectable from 7 to 120 days. The data amounts are shown over time for pre- and post-compression amounts.

**Data Movement tab**

A graph in the same format as the Daily Written graph that shows the amount of disk space moved to Cloud Tier storage (if the Cloud Tier license is enabled).

**Modifying a storage unit**

Use the Modify Storage Unit dialog to rename a storage unit, select a different existing user, create and select a new user, and edit quota settings.

**About this task**

**Procedure**

1. Select **Protocols > DD Boost > Storage Units**.
2. In the Storage Unit list, select the storage unit to modify.
3. Click the pencil icon.
   The Modify Storage Unit dialog appears.

4. To rename the storage unit, edit the text in the **Name** field.
5. To select a different existing user, select the user name in the drop-down list.
   If possible, select a username with management role privileges set to **none**.

6. To create and select a new user, select **Create a new Local User** and do the following:
   a. Enter the new user name in the User box.
      The user must be configured in the backup application to connect to the protection system.
   b. Enter the password twice in the appropriate boxes.

7. Edit the Quota Settings as needed.
   To set storage space restrictions to prevent a storage unit from consuming excess space:
   enter either a soft or hard limit quota setting, or both a hard and soft limit. With a soft limit an alert is sent when the storage unit size exceeds the limit, but data can still be written to it. Data cannot be written to the storage unit when the hard limit is reached.

   **Note:** Quota limits are pre-compressed values. To set quota limits, select **Set to Specific Value** and enter the value. Select the unit of measurement: MiB, GiB, TiB, or PiB.

   **Note:** When setting both soft and hard limits, a quota’s soft limit cannot exceed the quota’s hard limit.

8. Click **Modify**.

**Renaming a storage unit**

Use the Modify Storage Unit dialog to rename a storage unit.

**About this task**

Renaming a storage unit changes the name of the storage unit while retaining its:

- Username ownership
- Stream limit configuration
- Capacity quota configuration and physical reported size
- AIR association on the local protection system

**Procedure**

1. Go to **Protocols > DD Boost > Storage Units**.
2. In the Storage Unit list, select the storage unit to rename.
3. Click the pencil icon.
   The Modify Storage Unit dialog appears.
4. Edit the text in the **Name** field.
5. Click **Modify**.
Deleting a storage unit

Use the Storage Units tab to delete a storage unit from your protection system. Deleting a storage unit removes the storage unit, as well as any images contained in the storage unit, from your system.

Procedure

1. Select Protocols > DD Boost > Storage Units.
2. Select the storage unit to be deleted from the list.
3. Click Delete (X).
4. Click OK.

Results

The storage unit is removed from your system. You must also manually remove the corresponding backup application catalog entries.

Undeleting a storage unit

Use the Storage Units tab to undelete a storage unit.

About this task

Undeleting a storage unit recovers a previously deleted storage unit, including its:

- Username ownership
- Stream limit configuration
- Capacity quota configuration and physical reported size
- AIR association on the local protection system

**Note:** Deleted storage units are available until the next `filesys clean` command is run.

Procedure

1. Select Protocols > DD Boost > Storage Units > More Tasks > Undelete Storage Unit....
2. In the Undelete Storage Units dialog box, select the storage unit(s) that you want to undelete.
3. Click OK.

Selecting DD Boost options

Use the Set DD Boost Options dialog to specify settings for distributed segment processing, virtual synthetics, low bandwidth optimization for file replication, file replication encryption, and file replication network preference (IPv4 or IPv6).

Procedure

1. To display the DD Boost option settings, select Protocols > DD Boost > Settings > Advanced Options.
2. To change the settings, select More Tasks > Set Options. The Set DD Boost Options dialog appears.
3. Select any option to be enabled.
4. Deselect any option to be disabled.
   - To deselect a File Replication Network Preference option, select the other option.
5. Set the DD Boost security options.
   a. Select the **Authentication Mode**:
      - None
      - Two-way
      - Two-way Password
   b. Select the **Encryption Strength**:
      - None
      - Medium
      - High

   The protection system compares the global authentication mode and encryption strength against the per-client authentication mode and encryption strength to calculate the effective authentication mode and authentication encryption strength. The system does not use the highest authentication mode from one entry, and the highest encryption settings from a different entry. The effective authentication mode and encryption strength come from the single entry that provides the highest authentication mode.

6. Click **OK**.

   **Note:** You can also manage distributed segment processing via the `ddboost option` commands, which are described in detail in the *DD OS Command Reference Guide*.

**Distributed segment processing**

Distributed segment processing increases backup throughput in almost all cases by eliminating duplicate data transmission between the media server and the protection system.

You can manage distributed segment processing via the `ddboost option` commands, which are described in detail in the *DD OS Command Reference Guide*.

**Virtual synthetics**

A virtual synthetic full backup is the combination of the last full (synthetic or full) backup and all subsequent incremental backups. Virtual synthetics are enabled by default.

**Low-bandwidth optimization**

If you use file replication over a low-bandwidth network (WAN), you can increase replication speed by using low bandwidth optimization. This feature provides additional compression during data transfer. Low bandwidth compression is available to protection systems with an installed Replication license.

Low-bandwidth optimization, which is disabled by default, is designed for use on networks with less than 6 Mbps aggregate bandwidth. Do not use this option if maximum file system write performance is required.

   **Note:** You can also manage low bandwidth optimization via the `ddboost file-replication` commands, which are described in detail in the *DD OS Command Reference Guide*. 
File replication encryption

You can encrypt the data replication stream by enabling the DD Boost file replication encryption option.

**Note:** If DD Boost file replication encryption is used on systems without the Data at Rest option, it must be set to on for both the source and destination systems.

**Managed file replication TCP port setting**

For DD Boost managed file replication, use the same global listen port on both the source and target protection systems. To set the listen port, use the `replication option command` as described in the *DD OS Command Reference Guide*.

File replication network preference

Use this option to set the preferred network type for DD Boost file replication to either IPv4 or IPv6.

**Managing certificates for DD Boost**

A host certificate allows DD Boost client programs to verify the identity of the system when establishing a connection. CA certificates identify certificate authorities that should be trusted by the system. The topics in this section describe how to manage host and CA certificates for DD Boost.

**Adding a host certificate for DD Boost**

Add a host certificate to your system. DD OS supports one host certificate for DD Boost.

**Procedure**

1. If you have not yet requested a host certificate, request one from a trusted CA.
2. When you have received a host certificate, copy or move it to the computer from which you run DD Service Manager.
3. Start DD System Manager on the system to which you want to add a host certificate.

**Note:** DD System Manager supports certificate management only on the management system (which is the system running DD System Manager).

4. Select Protocols > DD Boost > More Tasks > Manage Certificates....

**Note:** If you try to remotely manage certificates on a managed system, DD System Manager displays an information message at the top of the certificate management dialog. To manage certificates for a system, you must start DD System Manager on that system.

5. In the Host Certificate area, click Add.

6. To add a host certificate enclosed in a .p12 file, do the following:
   a. Select I want to upload the certificate as a .p12 file.
   b. Type the password in the Password box.
   c. Click Browse and select the host certificate file to upload to the system.
   d. Click Add.

7. To add a host certificate enclosed in a .pem file, do the following:
a. Select I want to upload the public key as a .pem file and use a generated private key.
b. Click Browse and select the host certificate file to upload to the system.
c. Click Add.

Adding CA certificates for DD Boost

Add a certificate for a trusted CA to your system. DD OS supports multiple certificates for trusted CAs.

**Procedure**

1. Obtain a certificate for the trusted CA.
2. Copy or move the trusted CA certificate to the computer from which you run DD Service Manager.
3. Start DD System Manager on the system to which you want to add the CA certificate.
   
   **Note:** DD System Manager supports certificate management only on the management system (which is the system running DD System Manager).

4. Select Protocols > DD Boost > More Tasks > Manage Certificates....

   **Note:** If you try to remotely manage certificates on a managed system, DD System Manager displays an information message at the top of the certificate management dialog. To manage certificates for a system, you must start DD System Manager on that system.

5. In the CA Certificates area, click Add.

   The Add CA Certificate for DD Boost dialog appears.

6. To add a CA certificate enclosed in a .pem file, do the following:

   a. Select I want to upload the certificate as a .pem file.
   
   b. Click Browse, select the host certificate file to upload to the system, and click Open.
   
   c. Click Add.

7. To add a CA certificate using copy and paste, do the following:

   a. Copy the certificate text to the clipboard using the controls in your operating system.
   
   b. Select I want to copy and paste the certificate text.
   
   c. Paste the certificate text in the box below the copy and paste selection.
   
   d. Click Add.

Managing DD Boost client access and encryption

Use the DD Boost Settings tab to configure which specific clients, or set of clients, can establish a DD Boost connection with the protection System and whether or not the client will use encryption. By default, the system is configured to allow all clients to have access, with no encryption.

**Note:** Enabling in-flight encryption will impact system performance.

**Note:** DD Boost offers global authentication and encryption options to defend your system against man-in-the-middle (MITM) attacks. You specify authentication and encryption settings using the GUI, or CLI commands on the protection system. For details, see the *DD Boost for*
Adding a DD Boost client

Create an allowed DD Boost client and specify whether the client will use encryption.

**Procedure**

1. Select Protocols > DD Boost > Settings.
2. In the Allowed Clients section, click Create (+).
   The Add Allowed Client dialog appears.
3. Enter the hostname of the client.
   This can be a fully-qualified domain name (e.g. host1.example.com) or a hostname with a wildcard (e.g. *.example.com).
4. Select the Encryption Strength.
   The options are None (no encryption), Medium (AES128-SHA1), or High (AES256-SHA1).
5. Select the Authentication Mode.
   The options are One Way, Two Way, Two Way Password, or Anonymous.
6. Click OK.

Modifying a DD Boost client

Change the name, encryption strength, and authentication mode of an allowed DD Boost client.

**Procedure**

1. Select Protocols > DD Boost > Settings.
2. In the Allowed Clients list, select the client to modify.
3. Click the Edit button, which displays a pencil icon.
   The Modify Allowed Client dialog appears.
4. To change the name of a client, edit the Client text.
5. To change the Encryption Strength, select the option.
   The options are None (no encryption), Medium (AES128-SHA1), or High (AES256-SHA1).
6. To change the Authentication Mode, select the option.
   The options are One Way, Two Way, or Anonymous.
7. Click OK.

Removing a DD Boost client

Delete an allowed DD Boost client.

**Procedure**

1. Select Protocols > DD Boost > Settings.
2. Select the client from the list.
3. Click Delete (X).
   The Delete Allowed Clients dialog appears.
4. Confirm and select the client name. Click OK.

### About interface groups

This feature lets you combine multiple Ethernet links into a group and register only one interface on the protection system with the backup application. The DD Boost Library negotiates with the system to obtain the best interface to send data. Load balancing provides higher physical throughput to the system.

Configuring an interface group creates a private network within the system, comprised of the IP addresses designated as a group. Clients are assigned to a single group, and the group interface uses load balancing to improve data transfer performance and increase reliability.

For example, in the Veritas NetBackup environment, media server clients use a single public network IP address to access the system. All communication with the system is initiated via this administered IP connection, which is configured on the NetBackup server.

If an interface group is configured, when the system receives data from the media server clients, the data transfer is load-balanced and distributed on all the interfaces in the group, providing higher input/output throughput, especially for customers who use multiple 1GigE connections.

The data transfer is load-balanced based on the number of connections outstanding on the interfaces. Only connections for backup and restore jobs are load-balanced. Check the Active Connections for more information on the number of outstanding connections on the interfaces in a group.

Should an interface in the group fail, all the in-flight jobs to that interface are automatically resumed on healthy operational links (unbeknownst to the backup applications). Any jobs that are started subsequent to the failure are also routed to a healthy interface in the group. If the group is disabled or an attempt to recover on an alternate interface fails, the administered IP is used for recovery. Failure in one group will not utilize interfaces from another group.

Consider the following information when managing interface groups.

- The IP address must be configured on the system, and its interface enabled. To check the interface configuration, select Hardware > Ethernet > Interfaces page, and check for free ports. See the net chapter of the DD OS Command Reference Guide for information about configuring an IP address for an interface.

- You can use the ifgroup commands to manage interface groups; these commands are described in detail in the DD OS Command Reference Guide.

- Interface groups provide full support for static IPv6 addresses, providing the same capabilities for IPv6 as for IPv4. Concurrent IPv4 and IPv6 client connections are allowed. A client connected with IPv6 sees IPv6 ifgroup interfaces only. A client connected with IPv4 sees IPv4 ifgroup interfaces only. Individual ifgroups include all IPv4 addresses or all IPv6 addresses. For details, see the DD Boost for Partner Integration Administration Guide or the DD Boost for OpenStorage Administration Guide.

- Configured interfaces are listed in Active Connections, on the lower portion of the Activities page.

**Note:** See Using DD Boost on HA systems on page 275 for important information about using interface groups with HA systems.

The topics that follow describe how to manage interface groups.

#### Interfaces

IFGROUP supports physical and virtual interfaces.

An IFGROUP interface is a member of a single IFGROUP `<group-name>` and may consist of:
- Physical interface such as eth0a
- Virtual interface, created for link failover or link aggregation, such as veth1
- Virtual alias interface such as eth0a:2 or veth1:2
- Virtual VLAN interface such as eth0a.1 or veth1.1
- Within an IFGROUP <group-name>, all interfaces must be on unique interfaces (Ethernet, virtual Ethernet) to ensure failover in the event of network error.

IFGROUP provides full support for static IPv6 addresses, providing the same capabilities for IPv6 as for IPv4. Concurrent IPv4 and IPv6 client connections are allowed. A client connected with IPv6 sees IPv6 IFGROUP interfaces only. A client connected with IPv4 sees IPv4 IFGROUP interfaces only. Individual IFGROUPs include all IPv4 addresses or all IPv6 addresses.

For more information, see the *DD Boost for Partner Integration Administration Guide* or the *DD Boost for OpenStorage Administration Guide*.

**Interface enforcement**

IFGROUP lets you enforce private network connectivity, ensuring that a failed job does not reconnect on the public network after network errors.

When interface enforcement is enabled, a failed job can only retry on an alternative private network IP address. Interface enforcement is only available for clients that use IFGROUP interfaces.

Interface enforcement is off (FALSE) by default. To enable interface enforcement, you must add the following setting to the system registry:

```
system.ENFORCE_IFGROUP_RW=TRUE
```

After you've made this entry in the registry, you must do a `filesys restart` for the setting to take effect.

For more information, see the *DD Boost for Partner Integration Administration Guide* or the *DD Boost for OpenStorage Administration Guide*.

**Clients**

IFGROUP supports various naming formats for clients. Client selection is based on a specified order of precedence.

An IFGROUP client is a member of a single ifgroup <group-name> and may consist of:

- A fully qualified domain name (FQDN) such as ddboost.exampledomain.com
- A partial host, allowing search on the first $n$ characters of the hostname. For example, when $n=3$, valid formats are rtp_.*example.com and dur_.*example.com. Five different values of $n$ (1-5) are supported.
- Wild cards such as *.exampledomain.com or “*”
- A short name for the client, such as ddboost
- Client public IP range, such as 128.5.20.0/24

Prior to write or read processing, the client requests an IFGROUP IP address from the server. To select the client IFGROUP association, the client information is evaluated according to the following order of precedence.

1. IP address of the connected protection system. If there is already an active connection between the client and the system, and the connection exists on the interface in the IFGROUP, then the IFGROUP interfaces are made available for the client.
2. Connected client IP range. An IP mask check is done against the client source IP; if the client's source IP address matches the mask in the IFGROUP clients list, then the IFGROUP interfaces are made available for the client.
   - For IPv4, you can select five different range masks, based on network.
   - For IPv6, fixed masks /64, /112, and /128 are available.

   This host-range check is useful for separate VLANs with many clients where there isn't a unique partial hostname (domain).

3. Client Name: abc-11.d1.com
4. Client Domain Name: *.d1.com
5. All Clients: *

For more information, see the *DD Boost for Partner Integration Administration Guide*.

**Creating interface groups**

Use the IP Network tab to create interface groups and to add interfaces and clients to the groups.

**About this task**

Multiple interface groups improve the efficiency of DD Boost by allowing you to:
- Configure DD Boost to use specific interfaces configured into groups.
- Assign clients to one of those interface groups.
- Monitor which interfaces are active with DD Boost clients.

Create interface groups first, and then add clients (as new media servers become available) to an interface group.

**Procedure**

1. Select **Protocols > DD Boost > IP Network**.
2. In the Interface Groups section, click Add (+).
3. Enter the interface group name.
4. Select one or more interfaces. A maximum of 32 interfaces can be configured.
   
   ![Note: Depending upon aliasing configurations, some interfaces may not be selectable if they are sharing a physical interface with another interface in the same group. This is because each interface within the group must be on a different physical interface to ensure fail-over recovery.]

5. Click OK.
6. In the Configured Clients section, click Add (+).
7. Enter a fully qualified client name or *.mydomain.com.
   
   ![Note: The * client is initially available to the default group. The * client may only be a member of one ifgroup.]

8. Select a previously configured interface group, and click OK.
Enabling and disabling interface groups

Use the IP Network tab to enable and disable interface groups.

Procedure
2. In the Interface Groups section, select the interface group in the list. 
   (Note: If the interface group does not have both clients and interfaces assigned, you cannot enable the group.
3. Click Edit (pencil).
4. Click Enabled to enable the interface group; clear the checkbox to disable.
5. Click OK.

Modifying an interface group's name and interfaces

Use the IP Network tab to change an interface group's name and the interfaces associated with the group.

Procedure
2. In the Interface Groups section, select the interface group in the list.
3. Click Edit (pencil).
4. Retype the name to modify the name.
   The group name must be one to 24 characters long and contain only letters, numbers, underscores, and dashes. It cannot be the same as any other group name and cannot be “default”, “yes”, “no”, or “all.”
5. Select or deselect client interfaces in the Interfaces list. 
   (Note: If you remove all interfaces from the group, it will be automatically disabled.
6. Click OK.

Deleting an interface group

Use the IP Network tab to delete an interface group. Deleting an interface group deletes all interfaces and clients associated with the group.

Procedure
2. In the Interface Groups section, select the interface group in the list. The default group cannot be deleted.
3. Click Delete (X).
4. Confirm the deletion.
Adding a client to an interface group

Use the IP Network tab to add clients to interface groups.

Procedure

2. In the Configured Clients section, click Add (+).
3. Enter a name for the client.
   Client names must be unique and may consist of:
   - FQDN
   - *.domain
   - Client public IP range:
     - For IPv4, xx.xx.xx.0/24 provides a 24-bit mask against the connecting IP. The /24 represents what bits are masked when the client's source IP address is evaluated for access to the IFGROUP.
     - For IPv6, xxxx::0/112 provides a 112-bit mask against the connecting IP. The /112 represents what bits are masked when the client's source IP address is evaluated for access to the IFGROUP.
   Client names have a maximum length of 128 characters.
4. Select a previously configured interface group, and click OK.

Modifying a client's name or interface group

Use the IP Network tab to change a client's name or interface group.

Procedure

2. In the Configured Clients section, select the client.
3. Click Edit (pencil).
4. Type a new client name.
   Client names must be unique and may consist of:
   - FQDN
   - *.domain
   - Client public IP range:
     - For IPv4, xx.xx.xx.0/24 provides a 24-bit mask against the connecting IP. The /24 represents what bits are masked when the client's source IP address is evaluated for access to the IFGROUP.
     - For IPv6, xxxx::0/112 provides a 112-bit mask against the connecting IP. The /112 represents what bits are masked when the client's source IP address is evaluated for access to the IFGROUP.
   Client names have a maximum length of 128 characters.
5. Select a new interface group from the menu.
   Note: The old interface group is disabled if it has no clients.
6. Click OK.

Deleting a client from the interface group

Use the IP Network tab to delete a client from an interface group.

Procedure
2. In the Configured Clients section, select the client.
3. Click Delete (X).

   Note: If the interface group to which the client belongs has no other clients, the interface group is disabled.

4. Confirm the deletion.

Using interface groups for Managed File Replication (MFR)

Interface groups can be used to control the interfaces used for DD Boost MFR, to direct the replication connection over a specific network, and to use multiple network interfaces with high bandwidth and reliability for failover conditions. All protection system IP types are supported—IPv4 or IPv6, Alias IP/VLAN IP, and LACP/failover aggregation.

   Note: Interface groups used for replication are different from the interface groups previously explained and are supported for DD Boost Managed File Replication (MFR) only. For detailed information about using interface groups for MFR, see the DD Boost for Partner Integration Administration Guide or the DD Boost for OpenStorage Administration Guide.

Without the use of interface groups, configuration for replication requires several steps:
1. Adding an entry in the /etc/hosts file on the source system for the target system and hard coding one of the private LAN network interfaces as the destination IP address.
2. Adding a route on the source system to the target system specifying a physical or virtual port on the source system to the remote destination IP address.
3. Configuring LACP through the network on all switches between the systems for load balancing and failover.
4. Requiring different applications to use different names for the target system to avoid naming conflicts in the /etc/hosts file.

Using interface groups for replication simplifies this configuration through the use of the DD OS System Manager or DD OS CLI commands. Using interface groups to configure the replication path lets you:

- Redirect a hostname-resolved IP address away from the public network, using another private system IP address.
- Identify an interface group based on configured selection criteria, providing a single interface group where all the interfaces are reachable from the target system.
- Select a private network interface from a list of interfaces belonging to a group, ensuring that the interface is healthy.
- Provide load balancing across multiple system interfaces within the same private network.
- Provide a failover interface for recovery for the interfaces of the interface group.
- Provide host failover if configured on the source system.
- Use Network Address Translation (NAT)

The selection order for determining an interface group match for file replication is:
1. Local MTree (storage-unit) path and a specific remote system hostname
2. Local MTree (storage-unit) path with any remote system hostname
3. Any MTree (storage-unit) path with a specific system hostname

The same MTree can appear in multiple interface groups only if it has a different system hostname. The same system hostname can appear in multiple interface groups only if it has a different MTree path. The remote hostname is expected to be an FQDN, such as dd9900-1.example.com.

The interface group selection is performed locally on both the source system and the target system, independent of each other. For a WAN replication network, only the remote interface group needs to be configured since the source IP address corresponds to the gateway for the remote IP address.

### Adding a replication path to an interface group

Use the IP Network tab to add replication paths to interface groups.

**Procedure**

2. In the Configured Replication Paths section, click Add (+).
3. Enter values for MTree and/or Remote Host.
4. Select a previously configured interface group, and click OK.

### Modifying a replication path for an interface group

Use the IP Network tab to modify replication paths for interface groups.

**Procedure**

2. In the Configured Replication Paths section, select the replication path.
3. Click Edit (pencil).
4. Modify any or all values for MTree, Remote Host, or Interface Group.
5. Click OK.

### Deleting a replication path for an interface group

Use the IP Network tab to delete replication paths for interface groups.

**Procedure**

2. In the Configured Replication Paths section, select the replication path.
3. Click Delete (X).
4. In the Delete Replication Path(s) dialog, click OK.

### Destroying DD Boost

Use this option to permanently remove all of the data (images) contained in the storage units. When you disable or destroy DD Boost, the DD Boost FC service is also disabled. Only an administrative user can destroy DD Boost.

**Procedure**

1. Manually remove (expire) the corresponding backup application catalog entries.
Note: If multiple backup applications are using the same protection system, then remove all entries from each of those applications’ catalogs.

2. Select Protocols > DD Boost > More Tasks > Destroy DD Boost....
3. Enter your administrative credentials when prompted.
4. Click OK.

Configuring DD Boost-over-Fibre Channel

In earlier versions of DD OS, all communication between the DD Boost Library and any protection system was performed using IP networking. DD OS now offers Fibre Channel as an alternative transport mechanism for communication between the DD Boost Library and the system.

Note: Windows, Linux, HP-UX (64-bit Itanium architecture), AIX, and Solaris client environments are supported.

Enabling DD Boost users

Before you can configure the DD Boost-over-FC service on a protection system, you must add one or more DD Boost users and enable DD Boost.

Before you begin

- Log in to DD System Manager. For instructions, see “Logging In and Out of DD System Manager.”
  
  CLI equivalent
  
  login as: sysadmin
  Data Domain OS 5.7.x.x-12345
  Using keyboard-interactive authentication.
  Password:

  # scsitarget enable
  Please wait ...
  SCSI Target subsystem is enabled.

  Note: If you are using DD System Manager, the SCSI target daemon is automatically enabled when you enable the DD Boost-over-FC service (later in this procedure).

- Verify that the DD Boost license is installed. In DD System Manager, select Protocols > DD Boost > Settings. If the Status indicates that DD Boost is not licensed, click Add License and enter a valid license in the Add License Key dialog box.
  
  CLI equivalents
  
  # elicense show
  # elicense update license-file

Procedure

1. Select Protocols > DD Boost > Settings.
2. In the Users with DD Boost Access section, specify one or more DD Boost user names.
   
   A DD Boost user is also a DD OS user. When specifying a DD Boost user name, you can select an existing DD OS user name, or you can create a new DD OS user name and make that name a DD Boost user. This release supports multiple DD Boost users. For detailed instructions, see “Specifying DD Boost User Names.”

   CLI equivalents
   
   # user add username [password password]
# ddboost set user-name exampleuser

3. Click **Enable** to enable DD Boost.

**CLI equivalent**

```bash
# ddboost enable
Starting DDBOOST, please wait............... 
DDBOOST is enabled.
```

**Results**

You are now ready to configure the DD Boost-over-FC service.

## Configuring DD Boost

After you have added user(s) and enabled DD Boost, you need to enable the Fibre Channel option and specify the DD Boost Fibre Channel server name. Depending on your application, you may also need to create one or more storage units and install the DD Boost API/plug-in on media servers that will access the protection system.

**Procedure**

1. Select **Protocols > DD Boost > Fibre Channel.**
2. Click **Enable** to enable Fibre Channel transport.

**CLI equivalent**

```bash
# ddboost option set fc enabled
Please wait... 
DD Boost option "FC" set to enabled.
```

3. To change the DD Boost Fibre Channel server name from the default (hostname), click **Edit**, enter a new server name, and click **OK**.

**CLI equivalent**

```bash
# ddboost fc dfc-server-name set DFC-ddbeta2
DDBoost dfc-server-name is set to "DFC-ddbeta2" for DDBoost FC. 
Configure clients to use "DFC-DFC-ddbeta2" for DDBoost FC.
```

4. Select **Protocols > DD Boost > Storage Units** to create a storage unit (if not already created by the application).

You must create at least one storage unit on the system, and a DD Boost user must be assigned to that storage unit. For detailed instructions, see “Creating a Storage Unit.”

**CLI equivalent**

```bash
# ddboost storage-unit create storage_unit_name-su
```

5. Install the DD Boost API/plug-in (if necessary, based on the application).

The DD Boost OpenStorage plug-in software must be installed on NetBackup media servers that need to access the system. This plug-in includes the required DD Boost Library that integrates with the system. For detailed installation and configuration instructions, see the *DD Boost for Partner Integration Administration Guide* or the *DD Boost for OpenStorage Administration Guide.*
Results
You are now ready to verify connectivity and create access groups.

Verifying connectivity and creating access groups

Go to Hardware > Fibre Channel > Resources to manage initiators and endpoints for access points. Go to Protocols > DD Boost > Fibre Channel to create and manage DD Boost-over-FC access groups.

About this task

Note: Avoid making access group changes on a protection system during active backup or restore jobs. A change may cause an active job to fail. The impact of changes during active jobs depends on a combination of backup software and host configurations.

Procedure

1. Select Hardware > Fibre Channel > Resources > Initiators to verify that initiators are present.

   It is recommended that you assign aliases to initiators to reduce confusion during the configuration process.

   CLI equivalent

   ```bash
   # scsitarget initiator show list
   Initiator      System Address                 Group   Service
   ----------     -----------------------   ----------   -------
   initiator-1    21:00:00:24:ff:31:b7:16          n/a       n/a
   initiator-2    21:00:00:24:ff:31:b8:32          n/a       n/a
   initiator-3    25:00:00:21:88:00:73:ee          n/a       n/a
   initiator-4    50:06:01:6d:3c:e0:68:14          n/a       n/a
   initiator-5    50:06:01:6a:46:e0:55:9a          n/a       n/a
   initiator-6    21:00:00:24:ff:31:b7:17          n/a       n/a
   initiator-7    21:00:00:24:ff:31:b8:33          n/a       n/a
   initiator-8    25:10:00:21:88:00:73:ee          n/a       n/a
   initiator-9    50:06:01:6c:3c:e0:68:14          n/a       n/a
   initiator-10   50:06:01:6b:46:e0:55:9a          n/a       n/a
   tsm6_p23       21:00:00:24:ff:31:ce:f8   SetUp_Test       VTL
   ----------     -----------------------   ----------   -------
   ```

2. To assign an alias to an initiator, select one of the initiators and click the pencil (edit) icon. In the Name field of the Modify Initiator dialog, enter the alias and click OK.

   CLI equivalents

   ```bash
   # scsitarget initiator rename initiator-1 initiator-renamed
   Initiator 'initiator-1' successfully renamed.
   # scsitarget initiator show list
   Initiator      System Address                 Group   Service
   ----------     -----------------------   ----------   -------
   initiator-renamed 21:00:00:24:ff:31:b7:16          n/a       n/a
   ----------     -----------------------   ----------   -------
   ```

3. On the Resources tab, verify that endpoints are present and enabled.

   CLI equivalent

   ```bash
   # scsitarget endpoint show list
   endpoint-fc-0   5a               FibreChannel   Yes       Online
   endpoint-fc-1   5b               FibreChannel   Yes       Online
   ```
4. Go to **Protocols > DD Boost > Fibre Channel**.

5. In the DD Boost Access Groups area, click the + icon to add an access group.

6. Enter a unique name for the access group. Duplicate names are not supported.

   **CLI equivalent**
   
   ```
   # ddboost fc group create test-dfc-group
   DDBoost FC Group "test-dfc-group" successfully created.
   ```

7. Select one or more initiators. Optionally, replace the initiator name by entering a new one. Click **Next**.

   **CLI equivalent**
   
   ```
   #ddboost fc group add test-dfc-group initiator initiator-5
   Initiator(s) "initiator-5" added to group "test-dfc-group".
   ```

   An initiator is a port on an HBA attached to a backup client that connects to the system for the purpose of reading and writing data using the Fibre Channel protocol. The WWPN is the unique World-Wide Port Name of the Fibre Channel port in the media server.

8. Specify the number of DD Boost devices to be used by the group. This number determines which devices the initiator can discover and, therefore, the number of I/O paths to the system. The default is one, the minimum is one, and the maximum is 64.

   **CLI equivalent**
   
   ```
   # ddboost fc group modify Test device-set count 5
   Added 3 devices.
   ```

   See the [DD Boost for OpenStorage Administration Guide](#) for the recommended value for different clients.

9. Indicate which endpoints to include in the group: all, none, or select from the list of endpoints. Click **Next**.

   **CLI equivalents**
   
   ```
   # scsitarget group add Test device ddboost-dev8 primary-endpoint all secondary-endpoint all
   Device 'ddboost-dev8' successfully added to group.
   ```

   ```
   # scsitarget group add Test device ddboost-dev8 primary-endpoint endpoint-fc-1 secondary-endpoint fc-port-0
   Device 'ddboost-dev8' is already in group 'Test'.
   ```

   When presenting LUNs via attached FC ports on HBAs, ports can be designated as primary, secondary or none. A primary port for a set of LUNs is the port that is currently advertising those LUNs to a fabric. A secondary port is a port that will broadcast a set of LUNs in the event of primary path failure (this requires manual intervention). A setting of none is used in the case where you do not wish to advertise selected LUNs. The presentation of LUNs is dependent upon the SAN topology.

10. Review the Summary and make any modifications. Click **Finish** to create the access group, which is displayed in the DD Boost Access Groups list.

    **CLI equivalent**
    
    ```
    # scsitarget group show detailed
    ```

    **Note:** To change settings for an existing access group, select it from the list and click the pencil icon (Modify).
Deleting access groups

Use the Fibre Channel tab to delete access groups.

Procedure

1. Select Protocols > DD Boost > Fibre Channel.
2. Select the group to be deleted from the DD Boost Access Groups list.

   Note: You cannot delete a group that has initiators assigned to it. Edit the group to remove the initiators first.

3. Click Delete (X).

Using DD Boost on HA systems

HA provides seamless failover of any application using DD Boost—that is, any backup or restore operation continues with no manual intervention required. All other DD Boost user scenarios are supported on HA systems as well, including managed file replication (MFR), distributed segment processing (DSP), filecopy, and dynamic interface groups (DIG).

Note these special considerations for using DD Boost on HA systems:

- On HA-enabled protection systems, failovers of the DD server occur in less than 10 minutes. However, recovery of DD Boost applications may take longer than this, because Boost application recovery cannot begin until the DD server failover is complete. In addition, Boost application recovery cannot start until the application invokes the Boost library.
- DD Boost on HA systems requires that the Boost applications be using Boost HA libraries; applications using non-HA Boost libraries do not see seamless failover.
- MFR will fail over seamlessly when both the source and destination systems are HA-enabled. MFR is also supported on partial HA configurations (that is, when either the source or destination system is enabled, but not both) when the failure occurs on the HA-enabled system. For more information, see the DD Boost for OpenStorage Administration Guide or the DD Boost for Partner Integration Administration Guide.
- Dynamic interface groups should not include IP addresses associated with the direct interconnection between the active and standby nodes.
- DD Boost clients must be configured to use floating IP addresses.

About the DD Boost tabs

Learn to use the DD Boost tabs in DD System Manager.

Settings

Use the Settings tab to enable or disable DD Boost, select clients and users, and specify advanced options.

The Settings tab shows the DD Boost status (Enabled or Disabled). Use the Status button to switch between Enabled or Disabled.

Under Allowed Clients, select the clients that are to have access to the system. Use the Add, Modify, and Delete buttons to manage the list of clients.

Under Users with DD Boost Access, select the users that are to have DD Boost access. Use the Add, Change Password, and Remove buttons to manage the list of users.
Expand **Advanced Options** to see which advanced options are enabled. Go to **More Tasks > Set Options** to reset these options.

## Active Connections

Use the Active Connections tab to see information about clients, interfaces, and outbound files.

**Table 35** Connected client information

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Client</strong></td>
<td>The name of the connected client.</td>
</tr>
<tr>
<td><strong>Idle</strong></td>
<td>Whether the client is idle (Yes) or not (No).</td>
</tr>
<tr>
<td><strong>Plug-In Version</strong></td>
<td>The DD Boost plug-in version installed, such as 7.0.0.1.</td>
</tr>
<tr>
<td><strong>OS Version</strong></td>
<td>The operating system version installed, such as Linux 3.0.101-108.57-default x86_64</td>
</tr>
<tr>
<td><strong>Application Version</strong></td>
<td>The backup application version installed, such as NetWorker 19.1.</td>
</tr>
<tr>
<td><strong>Encrypted</strong></td>
<td>Whether the connection is encrypted (Yes) or not (No).</td>
</tr>
<tr>
<td><strong>DSP</strong></td>
<td>Whether or not the connection is using Distributed Segment Processing (DSP) or not.</td>
</tr>
<tr>
<td><strong>Transport</strong></td>
<td>Type of transport being used, such as IPv4, IPv6 or DFC (Fibre Channel).</td>
</tr>
</tbody>
</table>

**Table 36** Configured interface connection information

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interface</strong></td>
<td>The IP address of the interface.</td>
</tr>
<tr>
<td><strong>Interface Group</strong></td>
<td>One of the following:</td>
</tr>
<tr>
<td></td>
<td>• The name of the interface group.</td>
</tr>
<tr>
<td></td>
<td>• None, if not a member of one.</td>
</tr>
<tr>
<td><strong>Backup</strong></td>
<td>The number of active backup connections.</td>
</tr>
<tr>
<td><strong>Restore</strong></td>
<td>The number of active restore connections.</td>
</tr>
<tr>
<td><strong>Replication</strong></td>
<td>The number of active replication connections.</td>
</tr>
<tr>
<td><strong>Synthetic</strong></td>
<td>The number of synthetic backups.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>The total number of connections for the interface.</td>
</tr>
</tbody>
</table>

**Table 37** Outbound file replication information

<table>
<thead>
<tr>
<th>Outbound files item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>File Name</strong></td>
<td>The name of the outgoing image file.</td>
</tr>
<tr>
<td><strong>Target Host</strong></td>
<td>The name of the host receiving the file.</td>
</tr>
<tr>
<td><strong>Logical Bytes to Transfer</strong></td>
<td>The number of logical bytes to be transferred.</td>
</tr>
<tr>
<td><strong>Logical Bytes Transferred</strong></td>
<td>The number of logical bytes already transferred.</td>
</tr>
</tbody>
</table>
Table 37 Outbound file replication information (continued)

<table>
<thead>
<tr>
<th>Outbound files item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Bandwidth Optimization</td>
<td>The number of low-bandwidth bytes already transferred.</td>
</tr>
</tbody>
</table>

**IP Network**

The IP Network tab lists configured interface groups. Details include whether or not a group is enabled and any configured client interfaces. Administrators can use the Interface Group menu to view which clients are associated with an interface group.

**Fibre Channel**

The Fibre Channel tab lists configured DD Boost access groups. Use the Fibre Channel tab to create and delete access groups and to configure initiators, devices, and endpoints for DD Boost access groups.

**Storage Units**

Use the Storage Units tab to view, create, modify, and delete storage units.

Table 38 Storage Units tab

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Units</td>
<td></td>
</tr>
<tr>
<td>View DD Boost Replications</td>
<td>View DD Boost replication contexts.</td>
</tr>
<tr>
<td>Storage Unit</td>
<td>The name of the storage unit.</td>
</tr>
<tr>
<td>User</td>
<td>Username associated with the storage unit.</td>
</tr>
<tr>
<td>Quota Hard Limit</td>
<td>The hard quota set for the storage unit.</td>
</tr>
<tr>
<td>Last 24hr Pre-Comp</td>
<td>The amount of data written to the storage unit in the last 24 hours, before compression.</td>
</tr>
<tr>
<td>Last 24hr Post-Comp</td>
<td>The amount of data written to the storage unit in the last 24 hours, after compression.</td>
</tr>
<tr>
<td>Last 24hr Comp Ratio</td>
<td>Compression ratio of the data written to the storage unit in the last 24 hours.</td>
</tr>
<tr>
<td>Weekly Avg Post-Comp</td>
<td>Average amount of data written to the storage unit each week, after compression.</td>
</tr>
<tr>
<td>Last Week Post-Comp</td>
<td>Amount of data written to the storage unit in the last week, after compression.</td>
</tr>
<tr>
<td>Weekly Avg Comp Ratio</td>
<td>Average compression ratio of data written to the storage unit each week.</td>
</tr>
<tr>
<td>Last Week Comp Ratio</td>
<td>Compression ratio of the data written to the storage unit in the last week.</td>
</tr>
</tbody>
</table>

Select a storage unit to see detailed information about it. Detailed information is available on three tabs:
- **Storage Unit tab**

  **Table 39 Storage unit details: Storage Unit tab**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Files</td>
<td>The total number of file images on the storage unit.</td>
</tr>
<tr>
<td>Full Path</td>
<td>The full path of the storage unit.</td>
</tr>
<tr>
<td>Status</td>
<td>The current status of the storage unit (combinations are supported). Status can be:</td>
</tr>
<tr>
<td></td>
<td>D—Deleted</td>
</tr>
<tr>
<td></td>
<td>RO—Read-only</td>
</tr>
<tr>
<td></td>
<td>RW—Read/write</td>
</tr>
<tr>
<td></td>
<td>RD—Replication destination</td>
</tr>
<tr>
<td></td>
<td>RLE—DD Retention lock enabled</td>
</tr>
<tr>
<td></td>
<td>RLD—DD Retention lock disabled</td>
</tr>
<tr>
<td>Pre-Comp Used</td>
<td>The amount of pre-compressed storage already used.</td>
</tr>
<tr>
<td>Used (Post-Comp)</td>
<td>The total size after compression of the files in the storage unit.</td>
</tr>
<tr>
<td>Compression</td>
<td>The compression ratio achieved on the files.</td>
</tr>
<tr>
<td>Schedules</td>
<td>The number of physical capacity measurement schedules assigned to the storage unit.</td>
</tr>
<tr>
<td>Submitted Measurements</td>
<td>The number of times the physical capacity of the storage unit has been measured.</td>
</tr>
<tr>
<td>Quota Enforcement</td>
<td>Click Quota to go to the Data Management Quota page, which lists hard and soft quota values/percentage used by MTrees.</td>
</tr>
<tr>
<td>Pre-Comp Soft Limit</td>
<td>Current value of soft quota set for the storage unit.</td>
</tr>
<tr>
<td>Pre-Comp Hard Limit</td>
<td>Current value of hard quota set for the storage unit.</td>
</tr>
<tr>
<td>Quota Summary</td>
<td>Percentage of Hard Limit used.</td>
</tr>
<tr>
<td>Total Snapshots</td>
<td>Total number of snapshots of the storage unit.</td>
</tr>
<tr>
<td>Expired</td>
<td>Number of expired snapshots of the storage unit.</td>
</tr>
<tr>
<td>Unexpired</td>
<td>Number of unexpired snapshots of the storage unit.</td>
</tr>
<tr>
<td>Oldest Snapshot</td>
<td>The oldest snapshot of the storage unit.</td>
</tr>
<tr>
<td>Newest Snapshot</td>
<td>The newest snapshot of the storage unit.</td>
</tr>
<tr>
<td>Next Scheduled</td>
<td>The next scheduled snapshot of the storage unit.</td>
</tr>
<tr>
<td>Assigned Snapshot Schedules</td>
<td>The snapshot schedules assigned to the storage unit.</td>
</tr>
</tbody>
</table>

- **Space Usage tab:** Displays a graph showing pre-compression bytes used, post-compression bytes used, and compression factor.

- **Daily Written tab:** Displays a graph showing pre-compression bytes written, post-compression bytes written, and total compression factor.
CHAPTER 22

DD Virtual Tape Library

This chapter includes:

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- Working with a selected drive ....................................................................... 304
- Working with tapes ......................................................................................... 305
- Working with the vault ................................................................................... 306
- Working with the cloud-based vault ............................................................. 307
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- Working with a selected pool ........................................................................ 326
DD Virtual Tape Library overview

DD Virtual Tape Library (DD VTL) is a disk-based backup system that emulates the use of physical tapes. It enables backup applications to connect to and manage DD system storage using functionality almost identical to a physical tape library.

Virtual tape drives are accessible to backup software in the same way as physical tape drives. After you create these drives in a DD VTL, they appear to the backup software as SCSI tape drives. The DD VTL itself, appears to the backup software as a SCSI robotic device accessed through standard driver interfaces. However, the backup software (not the DD system that is configured as a DD VTL) manages the movement of the media changer and backup images.

The following terms have special meaning when used with DD VTL:

- **Library**: A library emulates a physical tape library with drives, changer, CAPs (cartridge access ports), and slots (cartridge slots).
- **Tape**: A tape is represented as a file. Tapes can be imported from the vault to a library. Tapes can be exported from a library to the vault. Tapes can be moved within a library across drives, slots, and CAPs.
- **Pool**: A pool is a collection of tapes that maps to a directory on the file system. Pools are used to replicate tapes to a destination. By default, pools are created as MTree pools unless you specify them as directory pools when they are created. You can convert directory-based pools to MTree-based pools to take advantage of the greater functionality of MTrees.
- **Vault**: The vault holds tapes not being used by any library. Tapes reside in either a library or the vault.

DD VTL has been tested with, and is supported by, specific backup software and hardware configurations. For more information, see the appropriate *Backup Compatibility Guide* on the Online Support Site.

DD VTL supports simultaneous use of the tape library and file system (NFS/CIFS/DD Boost) interfaces.

When DR (disaster recovery) is needed, pools and tapes can be replicated to a remote DD system using the DD Replicator.

To protect data on tapes from modification, tapes can be locked using DD Retention Lock Governance software.

**Note**: At present, 16 Gb/s is supported for fabric and point-to-point topologies. Other topologies will present issues.

The KB article *Data Domain: VTL Best Practices Guide*, available at [https://support.emc.com/kb/180591](https://support.emc.com/kb/180591), provides additional information about best practices for DD VTL.

The KB article *Data Domain: Create a Virtual Tape Library via CLI*, available at [https://support.emc.com/kb/181043](https://support.emc.com/kb/181043), provides more information.

Planning a DD VTL

The DD VTL (Virtual Tape Library) feature has very specific requirements, such as proper licensing, interface cards, user permissions, etc. These requirements are listed here, complete with details and recommendations.

- An appropriate DD VTL license.
  - DD VTL is a licensed feature, and you must use NDMP (Network Data Management Protocol) over IP (Internet Protocol) or DD VTL directly over FC (Fibre Channel).
- An additional license is required for IBM i systems – the I/OS license.
- Adding a DD VTL license through the DD System Manager automatically disables and enables the DD VTL feature.
- An installed FC interface card or DD VTL configured to use NDMP.
  - If the DD VTL communication between a backup server and a DD system is through an FC interface, the DD system must have an FC interface card installed. Notice that whenever an FC interface card is removed from (or changed within) a DD system, any DD VTL configuration associated with that card must be updated.
  - If the DD VTL communication between a backup server and a DD system is through NDMP, no FC interface card is required. However, you must configure the TapeServer access group. Also, when using NDMP, all initiator and port functionality does not apply.
  - The net filter must be configured to allow the NDMP client to send information to the DD system. Run the `net filter add operation allow clients <client-IP-address>` command to allow access for the NDMP client.
    - For added security, run the `net filter add operation allow clients <client-IP-address> interfaces <DD-interface-IP-address>` command.
    - Add the `seq-id 1` option to the command to enforce this rule before any other net filter rules.
- A backup software minimum record (block) size.
  - If possible, set backup software to use a minimum record (block) size of 64 KiB or larger. Larger sizes usually give faster performance and better data compression.
  - Depending on your backup application, if you change the size after the initial configuration, data written with the original size might become unreadable.
- Appropriate user access to the system.
  - For basic tape operations and monitoring, only a user login is required.
  - To enable and configure DD VTL services and perform other configuration tasks, a sysadmin login is required.

### DD VTL limits

Before setting up or using a DD VTL, review these limits on size, slots, etc.

- **I/O Size** – The maximum supported I/O size for any DD system using DD VTL is 1 MB.
- **Libraries** – DD VTL supports a maximum of 64 libraries per DD system (that is, 64 DD VTL instances on each DD system).
- **Initiators** – DD VTL supports a maximum of 1024 initiators or WWPNs (world-wide port names) per DD system.
- **Tape Drives** – Information about tape drives is presented in the next section.
- **Data Streams** – Information about data streams is presented in the following table.

<table>
<thead>
<tr>
<th>Model</th>
<th>RAM / NVRAM</th>
<th>Backup write streams</th>
<th>Backup read streams</th>
<th>Repl(^a) source streams</th>
<th>Repl(^a) dest streams</th>
<th>Mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD4200</td>
<td>128 GB / 4 GB</td>
<td>270</td>
<td>75</td>
<td>150</td>
<td>270</td>
<td><code>w&lt;=270; r&lt;=75; ReplSrc&lt;=150; ReplDest&lt;=270; ReplDest +w&lt;=270; Total&lt;=270</code></td>
</tr>
<tr>
<td>Model</td>
<td>RAM / NVRAM</td>
<td>Backup write streams</td>
<td>Backup read streams</td>
<td>Replication source streams</td>
<td>Replication dest streams</td>
<td>Mixed</td>
</tr>
<tr>
<td>-------------</td>
<td>---------------------</td>
<td>----------------------</td>
<td>---------------------</td>
<td>---------------------------</td>
<td>--------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>DD4500</td>
<td>192 GB / 4 GB</td>
<td>270</td>
<td>75</td>
<td>150</td>
<td>270</td>
<td>w&lt;=270; r&lt;=75; ReplSrc&lt;=150; ReplDest&lt;=270; ReplDest +w&lt;=270; Total&lt;=270</td>
</tr>
<tr>
<td>DD6300</td>
<td>48 or 96 GB / 8 GB</td>
<td>270</td>
<td>75</td>
<td>150</td>
<td>270</td>
<td>w&lt;=270; r&lt;=75; ReplSrc&lt;=150; ReplDest&lt;=270; ReplDest +w&lt;=270; Total&lt;=270</td>
</tr>
<tr>
<td>DD6800</td>
<td>192 GB / 8 GB</td>
<td>400</td>
<td>110</td>
<td>220</td>
<td>400</td>
<td>w&lt;=400; r&lt;=110; ReplSrc&lt;=220; ReplDest&lt;=400; ReplDest +w&lt;=400; Total&lt;=400</td>
</tr>
<tr>
<td>DD6900</td>
<td>288 GB / 16 GB</td>
<td>400</td>
<td>110</td>
<td>220</td>
<td>400</td>
<td>w&lt;=400; r&lt;=110; ReplSrc&lt;=220; ReplDest&lt;=400; ReplDest +w&lt;=400; Total&lt;=400</td>
</tr>
<tr>
<td>DD7200</td>
<td>128 or 256 GB / 4 GB</td>
<td>540</td>
<td>150</td>
<td>270</td>
<td>540</td>
<td>w&lt;=540; r&lt;=150; ReplSrc&lt;=270; ReplDest&lt;=540; ReplDest +w&lt;=540; Total&lt;=540</td>
</tr>
<tr>
<td>DD9300</td>
<td>192 or 384 GB / 8 GB</td>
<td>800</td>
<td>220</td>
<td>440</td>
<td>800</td>
<td>w&lt;=800; r&lt;=220; ReplSrc&lt;=440; ReplDest&lt;=800; ReplDest +w&lt;=800; Total&lt;=800</td>
</tr>
<tr>
<td>DD9400</td>
<td>576 GB / 16 GB</td>
<td>800</td>
<td>220</td>
<td>440</td>
<td>800</td>
<td>w&lt;=800; r&lt;=220; ReplSrc&lt;=440; ReplDest&lt;=800; ReplDest +w&lt;=800; Total&lt;=800</td>
</tr>
<tr>
<td>DD9500</td>
<td>256 or 512 GB / 8 GB</td>
<td>1885</td>
<td>300</td>
<td>540</td>
<td>1080</td>
<td>w&lt;=1885; r&lt;=300; ReplSrc&lt;=540; ReplDest&lt;=1080; ReplDest +w&lt;=1080; Total&lt;=1885</td>
</tr>
<tr>
<td>DD9800</td>
<td>256 or 768 GB / 8 GB</td>
<td>1885</td>
<td>300</td>
<td>540</td>
<td>1080</td>
<td>w&lt;=1885; r&lt;=300; ReplSrc&lt;=540; ReplDest&lt;=1080; ReplDest +w&lt;=1080; Total&lt;=1885</td>
</tr>
<tr>
<td>DD9900</td>
<td>1152 GB / 16 GB</td>
<td>1885</td>
<td>300</td>
<td>540</td>
<td>1080</td>
<td>w&lt;=1885; r&lt;=300; ReplSrc&lt;=540; ReplDest&lt;=1080; ReplDest +w&lt;=1080; Total&lt;=1885</td>
</tr>
<tr>
<td>DD VE 8 TB</td>
<td>8 GB / 512 MB</td>
<td>20</td>
<td>16</td>
<td>20</td>
<td>20</td>
<td>w&lt;= 20; r&lt;= 16; ReplSrc&lt;=20; ReplDest&lt;=20; ReplDest +w&lt;=20; Total&lt;=20</td>
</tr>
<tr>
<td>DD VE 16 TB</td>
<td>16 GB / 512 MB or 24 GB / 1 GB</td>
<td>45</td>
<td>30</td>
<td>45</td>
<td>45</td>
<td>w&lt;= 45; r&lt;= 30; ReplSrc&lt;=45; ReplDest&lt;=45; ReplDest +w&lt;=45; Total&lt;=45</td>
</tr>
<tr>
<td>DD VE 32 TB</td>
<td>24 GB / 1 GB</td>
<td>90</td>
<td>50</td>
<td>90</td>
<td>90</td>
<td>w&lt;= 90; r&lt;= 50; ReplSrc&lt;=90; ReplDest&lt;=90; Total&lt;=90</td>
</tr>
</tbody>
</table>
### Table 40 Data streams sent to a protection system (continued)

<table>
<thead>
<tr>
<th>Model</th>
<th>RAM / NVRAM</th>
<th>Backup write streams</th>
<th>Backup read streams</th>
<th>Repl&lt;sup&gt;a&lt;/sup&gt; source streams</th>
<th>Repl&lt;sup&gt;a&lt;/sup&gt; dest streams</th>
<th>Mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD VE 48 TB</td>
<td>36 GB / 1 GB</td>
<td>90</td>
<td>50</td>
<td>90</td>
<td>90</td>
<td>+w&lt;=90; w+r+ReplSrc &gt;=90; Total&lt;=90</td>
</tr>
<tr>
<td>DD VE 64 TB</td>
<td>48 GB / 1 GB</td>
<td>90</td>
<td>50</td>
<td>90</td>
<td>90</td>
<td>w&lt;= 90 ; r&lt;= 50 ReplSrc&lt;=90; ReplDest&lt;=90; ReplDest +w&lt;=90; w+r+ReplSrc &lt;=90; Total&lt;=90</td>
</tr>
<tr>
<td>DD VE 96 TB</td>
<td>64 GB / 2 GB</td>
<td>180</td>
<td>50</td>
<td>90</td>
<td>180</td>
<td>w&lt;= 180 ; r&lt;= 50 ReplSrc&lt;=90; ReplDest&lt;=180; ReplDest +w&lt;=180; w+r+ReplSrc &lt;=180; Total&lt;=180</td>
</tr>
<tr>
<td>DD3300 4 TB</td>
<td>12 GB (virtual memory) / 512 MB</td>
<td>20</td>
<td>16</td>
<td>30</td>
<td>20</td>
<td>w&lt;= 20 ; r&lt;= 16 ReplSrc&lt;=30; ReplDest&lt;=20; ReplDest +w&lt;=20; w+r+ReplSrc &lt;=30; Total&lt;=30</td>
</tr>
<tr>
<td>DD3300 8 TB</td>
<td>32 GB (virtual memory) / 1.536 GB</td>
<td>90</td>
<td>50</td>
<td>90</td>
<td>90</td>
<td>w&lt;= 90 ; r&lt;= 50 ReplSrc&lt;=90; ReplDest&lt;=90; ReplDest +w&lt;=90; w+r+ReplSrc &lt;=90; Total&lt;=90</td>
</tr>
<tr>
<td>DD3300 16 TB</td>
<td>32 GB (virtual memory) / 1.536 GB</td>
<td>90</td>
<td>50</td>
<td>90</td>
<td>90</td>
<td>w&lt;= 90 ; r&lt;= 50 ReplSrc&lt;=90; ReplDest&lt;=90; ReplDest +w&lt;=90; w+r+ReplSrc &lt;=90; Total&lt;=90</td>
</tr>
<tr>
<td>DD3300 32 TB</td>
<td>46 GB (virtual memory) / 1.536 GB</td>
<td>90</td>
<td>50</td>
<td>90</td>
<td>90</td>
<td>w&lt;= 90 ; r&lt;= 50 ReplSrc&lt;=90; ReplDest&lt;=90; ReplDest +w&lt;=90; w+r+ReplSrc &lt;=90; Total&lt;=140</td>
</tr>
</tbody>
</table>

Note: Some device drivers (for example, IBM AIX atape device drivers) limit library configurations to specific drive/slot limits, which may be less than what the DD system supports. Backup applications, and drives used by those applications, may be affected by this limitation.

- Slots – DD VTL supports a maximum of:
  - 32,000 slots per library
  - 64,000 slots per DD system

The DD system automatically adds slots to keep the number of slots equal to, or greater than, the number of drives.
- 100 CAPs per library
- 1000 CAPs per DD system

**Number of drives supported by a DD VTL**

The maximum number of drives supported by a DD VTL depends on the number of CPU cores and the amount of memory installed (both RAM and NVRAM, if applicable) on a DD system.

*Note:* There are no references to model numbers in this table because there are many combinations of CPU cores and memories for each model, and the number of supported drives depends *only* on the CPU cores and memories – not on the particular model, itself.

**Table 41 Number of drives supported by a DD VTL**

<table>
<thead>
<tr>
<th>Number of CPU cores</th>
<th>RAM (in GB)</th>
<th>NVRAM (in GB)</th>
<th>Maximum number of supported drives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fewer than 32</td>
<td>4 or less</td>
<td>NA</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>More than 4, up to 38</td>
<td>NA</td>
<td>128</td>
</tr>
<tr>
<td></td>
<td>More than 38, up to 128</td>
<td>NA</td>
<td>256</td>
</tr>
<tr>
<td></td>
<td>More than 128</td>
<td>NA</td>
<td>540</td>
</tr>
<tr>
<td>32 to 39</td>
<td>Up to 128</td>
<td>Less than 4</td>
<td>270</td>
</tr>
<tr>
<td></td>
<td>Up to 128</td>
<td>4 or more</td>
<td>540</td>
</tr>
<tr>
<td></td>
<td>More than 128</td>
<td>NA</td>
<td>540</td>
</tr>
<tr>
<td>40 to 59</td>
<td>NA</td>
<td>NA</td>
<td>540</td>
</tr>
<tr>
<td>60 or more</td>
<td>NA</td>
<td>NA</td>
<td>1080</td>
</tr>
</tbody>
</table>

**Tape barcodes**

When you create a tape, you must assign a unique *barcode* (never duplicate barcodes as this can cause unpredictable behavior). Each barcode consists of eight characters: the first six are numbers or uppercase letters (0-9, A-Z), and the last two are the tape code for the supported tape type, as shown in the following table.

*Note:* Although a DD VTL barcode consists of eight characters, either six or eight characters may be transmitted to a backup application, depending on the changer type.

**Table 42 Tape Codes by Tape Type**

<table>
<thead>
<tr>
<th>Tape Type</th>
<th>Default Capacity (unless noted)</th>
<th>Tape Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTO-1</td>
<td>100 GiB</td>
<td>L1</td>
</tr>
<tr>
<td>LTO-1</td>
<td>50 GiB (non-default)</td>
<td>LA^a</td>
</tr>
<tr>
<td>LTO-1</td>
<td>30 GiB (non-default)</td>
<td>LB</td>
</tr>
<tr>
<td>LTO-1</td>
<td>10 GiB (non-default)</td>
<td>LC</td>
</tr>
<tr>
<td>LTO-2</td>
<td>200 GiB</td>
<td>L2</td>
</tr>
</tbody>
</table>
Table 42 Tape Codes by Tape Type (continued)

<table>
<thead>
<tr>
<th>Tape Type</th>
<th>Default Capacity (unless noted)</th>
<th>Tape Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTO-3</td>
<td>400 GiB</td>
<td>L3</td>
</tr>
<tr>
<td>LTO-4</td>
<td>800 GiB</td>
<td>L4</td>
</tr>
<tr>
<td>LTO-5 (default)</td>
<td>1.5 TiB</td>
<td>L5</td>
</tr>
</tbody>
</table>

a. For TSM, use the L2 tape code if the LA code is ignored.

For multiple tape libraries, barcodes are automatically incremented, if the sixth character (just before the "L") is a number. If an overflow occurs (9 to 0), numbering moves one position to the left. If the next character to increment is a letter, incrementation stops. Here are a few sample barcodes and how each will be incremented:

- 000000L1 creates tapes of 100 GiB capacity and can accept a count of up to 100,000 tapes (from 000000 to 999999).
- AA0000LA creates tapes of 50 GiB capacity and can accept a count of up to 10,000 tapes (from 0000 to 9999).
- AAA000LB creates tapes of 30 GiB capacity and can accept a count of up to 100 tapes (from 00 to 99).
- AAAAAALC creates one tape of 10 GiB capacity. Only one tape can be created with this name.
- AAA350L1 creates tapes of 100 GiB capacity and can accept a count of up to 650 tapes (from 350 to 999).
- 000AAALA creates one tape of 50 GiB capacity. Only one tape can be created with this name.
- 5M7Q3KLB creates one tape of 30 GiB capacity. Only one tape can be created with this name.

**LTO tape drive compatibility**

You may have different generations of LTO (Linear Tape-Open) technology in your setup; the compatibility between these generations is presented in tabular form.

In this table:

- **RW** = read and write compatible
- **R** = read-only compatible
- **—** = not compatible

<table>
<thead>
<tr>
<th>tape format</th>
<th>LTO-5 drive</th>
<th>LTO-4 drive</th>
<th>LTO-3 drive</th>
<th>LTO-2 drive</th>
<th>LTO-1 drive</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTO-5 tape</td>
<td>RW</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>LTO-4 tape</td>
<td>RW</td>
<td>RW</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>LTO-3 tape</td>
<td>R</td>
<td>RW</td>
<td>RW</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>LTO-2 tape</td>
<td>—</td>
<td>R</td>
<td>RW</td>
<td>RW</td>
<td>—</td>
</tr>
<tr>
<td>LTO-1 tape</td>
<td>—</td>
<td>—</td>
<td>R</td>
<td>RW</td>
<td>RW</td>
</tr>
</tbody>
</table>
Setting up a DD VTL

To set up a simple DD VTL, use the Configuration Wizard, which is described in the Getting Started chapter.

Then, continue with the following topics to enable the DD VTL, create libraries, and create and import tapes.

Note: If the deployment environment includes an AS400 system as a DD VTL client, refer to Configuring DD VTL default options on page 289 to configure the serial number prefix for VTL changers and drives before configuring the DD VTL relationship between the protection system and the AS400 client system.

HA systems and DD VTL

HA systems are compatible with DD VTL; however, if a DD VTL job is in progress during a failover, the job will need to be restarted manually after the failover is complete.

The DD Operating System Backup Compatibility Guide provides additional details about the HBA, switch, firmware, and driver requirements for using DD VTL in an HA environment.

DD VTL tape out to cloud

DD VTL supports storing the VTL vault on Cloud Tier storage. To use this functionality, the protection system must be a supported Cloud Tier configuration, and have a Cloud Tier license in addition to the VTL license.

Configure and license the Cloud Tier storage before configuring DD VTL to use cloud storage for the vault. Cloud Tier on page 385 provides additional information about the requirements for Cloud Tier, and how to configure Cloud Tier.

The FC and network interface requirements for VTL are the same for both cloud-based and local vault storage. DD VTL does not require special configuration to use cloud storage for the vault. When configuring the DD VTL, select the cloud storage as the vault location. However, when working with a cloud-based vault, there are some data management options that are unique to the cloud-based vault. Working with the cloud-based vault on page 307 provides more information.

Managing a DD VTL

You can manage a DD VTL using the DD System Manager or the CLI. After you login, you can check the status of your DD VTL process, check your license information, and review and configure options.

Logging In

To use a graphical user interface (GUI) to manage your DD Virtual Tape Library (DD VTL), log in to the DD System Manager.

CLI Equivalent

You can also log in at the CLI:

```
login as: sysadmin
Data Domain OS
Using keyboard-interactive authentication.
Password:
```
Enabling SCSI Target Daemon (CLI only)

If you do log in from the CLI, you must enable the scsitarget daemon (the Fibre Channel service). This daemon is enabled during the DD VTL or DD Boost-FC enable selections in DD System Manager. In the CLI, these processes need to be enabled separately.

```
# scsitarget enable
Please wait ...
SCSI Target subsystem is enabled.
```

Accessing DD VTL

From the menu at the left of the DD System Manager, select Protocols > VTL.

Status

In the Virtual Tape Libraries > VTL Service area, you can see the status of your DD VTL process is displayed at the top, for example, Enabled: Running. The first part of the status will be Enabled (on) or Disabled (off). The second part will be one of the following process states.

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Running</td>
<td>DD VTL process is enabled and active (shown in green).</td>
</tr>
<tr>
<td>Starting</td>
<td>DD VTL process is starting.</td>
</tr>
<tr>
<td>Stopping</td>
<td>DD VTL process is being shut down.</td>
</tr>
<tr>
<td>Stopped</td>
<td>DD VTL process is disabled (shown in red).</td>
</tr>
<tr>
<td>Timing out</td>
<td>DD VTL process crashed and is attempting an automatic restart.</td>
</tr>
<tr>
<td>Stuck</td>
<td>After several failed automatic restarts, the DD VTL process is unable to</td>
</tr>
<tr>
<td></td>
<td>shut down normally, so an attempt is being made to kill it.</td>
</tr>
</tbody>
</table>

DD VTL License

The VTL License line tells you whether your DD VTL license has been applied. If it says Unlicensed, select Add License. Enter your license key in the Add License Key dialog. Select Next and OK.

**Note:** All license information should have been populated as part of the factory configuration process; however, if DD VTL was purchased later, the DD VTL license key may not have been available at that time.

CLI Equivalent

You can also verify that the DD VTL license has been installed at the CLI:

```
# elicense show
## License Key                      Feature
--    -------------------        -----------
1     DEFA-EFCD-FCDE-CDEF        Replication
2     EFCD-FCDE-CDEF-DEFA        VTL
--    -------------------        -----------
```

If the license is not present, each unit comes with documentation – a quick install card – which will show the licenses that have been purchased. Enter the following command to populate the license key.

```
# elicense update <license-file>
```
I/OS License (for IBM i users)

For customers of IBM i, the I/OS License line tells you whether your I/OS license has been applied. If it says Unlicensed, select Add License. You must enter a valid I/OS license in either of these formats: xxxx-xxxx-xxxx-xxxx or xxxx-xxxx-xxxx-xxxx-xxxx. Your I/OS license must be installed before creating a library and drives to be used on an IBM i system. Select Next and OK.

Enabling DD VTL

Enabling DD VTL broadcasts the WWN of the protection system HBA to customer fabric and enables all libraries and library drives. If a forwarding plan is required in the form of change control processes, this process should be enabled to facilitate zoning.

Procedure

1. Make sure that you have a DD VTL license and that the file system is enabled.
2. Select Virtual Tape Libraries > VTL Service.
3. To the right of the Status area, select Enable.
4. In the Enable Service dialog box, select OK.
5. After DD VTL has been enabled, note that Status will change to Enabled: Running in green. Also note that the configured DD VTL options are displayed in the Option Defaults area.

CLI Equivalent

```
# vtl enable
Starting VTL, please wait ...
VTL is enabled.
```

Disabling DD VTL

Disabling DD VTL closes all libraries and shuts down the DD VTL process.

Procedure

2. To the right of the Status area, select Disable.
3. In the Disable Service dialog, select OK.
4. After DD VTL has been disabled, notice that the Status has changed to Disabled: Stopped in red.

CLI Equivalent

```
# vtl disable
```

DD VTL option defaults

The Option Default area of the VTL Service page displays the current settings for default DD VTL options (auto-eject, auto-offline, and barcode-length) that you can configure.

In the Virtual Tape Libraries > VTL Service area, the current default options for your DD VTL are displayed. Select Configure to change any of these values.
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property</td>
<td>Lists the configured options:</td>
</tr>
<tr>
<td></td>
<td>• auto-eject</td>
</tr>
<tr>
<td></td>
<td>• auto-offline</td>
</tr>
<tr>
<td></td>
<td>• barcode-length</td>
</tr>
<tr>
<td>Value</td>
<td>Provides the value for each configured option:</td>
</tr>
<tr>
<td></td>
<td>• auto-eject: default (disabled), enabled, or</td>
</tr>
<tr>
<td></td>
<td>disabled</td>
</tr>
<tr>
<td></td>
<td>• auto-offline: default (disabled), enabled, or</td>
</tr>
<tr>
<td></td>
<td>disabled</td>
</tr>
<tr>
<td></td>
<td>• barcode-length: default (8), 6, or 8</td>
</tr>
</tbody>
</table>

### Configuring DD VTL default options

You can configure DD VTL default options when you add a license, create a library, or any time thereafter.

**About this task**

*Note: DD VTLs are assigned global options, by default, and those options are updated whenever global options change, unless you change them manually using this method.*

**Procedure**

1. Select **Virtual Tape Libraries > VTL Service**.
2. In the Option Defaults area, select **Configure**. In the Configure Default Options dialog box, change any of the default options, and then click **OK**.

### Table 46 DD VTL default options

<table>
<thead>
<tr>
<th>Option</th>
<th>Values</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>auto-eject</td>
<td>default (disabled), enable, or</td>
<td>Enabling auto-eject causes any tape put into a CAP (cartridge access port) to automatically move to the virtual vault, unless:</td>
</tr>
<tr>
<td></td>
<td>disable</td>
<td>• the tape came from the vault, in which case the tape stays in the CAP.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• an ALLOW_MEDIUM_REMOVAL command with a 0 value (false) has been issued to the library to prevent the removal of the medium from</td>
</tr>
<tr>
<td></td>
<td></td>
<td>the CAP to the outside world.</td>
</tr>
</tbody>
</table>
Table 46 DD VTL default options (continued)

<table>
<thead>
<tr>
<th>Option</th>
<th>Values</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>auto-offline</td>
<td>default (disabled), enable, or disable</td>
<td>Enabling auto-offline takes a drive offline automatically before a tape move operation is performed.</td>
</tr>
<tr>
<td>barcode-length</td>
<td>default (8), 6 or 8 [automatically set to 6 for L180, RESTORER-L180, and DDVTL changer models]</td>
<td>Although a DD VTL barcode consists of 8 characters, either 6 or 8 characters may be transmitted to a backup application, depending on the changer type.</td>
</tr>
</tbody>
</table>

Note: To disable all of these service options, select Reset to Factory, and the values will be immediately reset to factory defaults.

After you finish

If the DD VTL environment contains an AS400 as a DD VTL client, configure the DD VTL option for serial-number-prefix manually before adding the AS400 to the DD VTL environment. This is required to avoid duplicate serial numbers when there are multiple protection systems using DD VTL. The serial-number-prefix value must:

- Be a unique six digit value such that no other DD VTL on any system in the environment has the same prefix number
- Not end with a zero

Configure this value only once during the deployment of the system and the configuration of DD VTL. It will persist with any future DD OS upgrades on the system. Setting this value does not require a DD VTL service restart. Any DD VTL library created after setting this value will use the new prefix for the serial number.

CLI equivalent

```
# vtl option set serial-number-prefix value
# vtl option show serial-number-prefix
```

Working with libraries

A library emulates a physical tape library with drives, changer, CAPs (cartridge access ports), and slots (cartridge slots). Selecting Virtual Tape Libraries > VTL Service > Libraries displays detailed information for all configured libraries.

Table 47 Library information

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>The name of a configured library.</td>
</tr>
<tr>
<td>Drives</td>
<td>The number of drives configured in the library.</td>
</tr>
<tr>
<td>Slots</td>
<td>The number of slots configured in the library.</td>
</tr>
<tr>
<td>CAPs</td>
<td>The number of CAPs (cartridge access ports) configured in the library.</td>
</tr>
</tbody>
</table>

From the More Tasks menu, you can create and delete libraries, as well as search for tapes.
Creating libraries

DD VTL supports a maximum of 64 libraries per system, that is, 64 concurrently active virtual tape library instances on each DD system.

Before you begin

If the deployment environment includes an AS400 system as a DD VTL client, refer to Configuring DD VTL default options on page 289 to configure the serial number prefix for VTL changers and drives before creating the DD VTL library and configuring the DD VTL relationship between the protection system and the AS400 client system.

Procedure

2. Select More Tasks > Library > Create
3. In the Create Library dialog, enter the following information:

<table>
<thead>
<tr>
<th>Field</th>
<th>User input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Library Name</td>
<td>Enter a name of from 1 to 32 alphanumeric characters.</td>
</tr>
<tr>
<td>Number of Drives</td>
<td>Enter the number of drives from 1 to 98. The number of drives to be created will correspond to the number of data streams that will write to a library.</td>
</tr>
<tr>
<td>Drive Model</td>
<td>Select the desired model from the drop-down list:</td>
</tr>
<tr>
<td></td>
<td>• IBM-LTO-1</td>
</tr>
<tr>
<td></td>
<td>• IBM-LTO-2</td>
</tr>
<tr>
<td></td>
<td>• IBM-LTO-3</td>
</tr>
<tr>
<td></td>
<td>• IBM-LTO-4</td>
</tr>
<tr>
<td></td>
<td>• IBM-LTO-5 (default)</td>
</tr>
<tr>
<td></td>
<td>• HP-LTO-3</td>
</tr>
<tr>
<td></td>
<td>• HP-LTO-4</td>
</tr>
<tr>
<td>Number of Slots</td>
<td>Enter the number of slots in the library. Here are some things to consider:</td>
</tr>
<tr>
<td></td>
<td>• The number of slots must be equal to or greater than the number of drives.</td>
</tr>
<tr>
<td></td>
<td>• You can have up to 32,000 slots per individual library</td>
</tr>
<tr>
<td></td>
<td>• You can have up to 64,000 slots per system.</td>
</tr>
</tbody>
</table>
Table 48 Create Library dialog (continued)

<table>
<thead>
<tr>
<th>Field</th>
<th>User input</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Try to have enough slots so tapes remain in the DD VTL and never need to be exported to a vault – to avoid reconfiguring the DD VTL and to ease management overhead.</td>
</tr>
<tr>
<td></td>
<td>• Consider any applications that are licensed by the number of slots.</td>
</tr>
<tr>
<td>Number of CAPs</td>
<td>(Optional) Enter the number of cartridge access ports (CAPs).</td>
</tr>
<tr>
<td></td>
<td>• You can have up to 100 CAPs per library.</td>
</tr>
<tr>
<td></td>
<td>• You can have up to 1000 CAPs per system.</td>
</tr>
<tr>
<td></td>
<td>Check your particular backup software application documentation on the Online Support Site for guidance.</td>
</tr>
<tr>
<td>Changer Model Name</td>
<td>Select the desired model from the drop-down list:</td>
</tr>
<tr>
<td></td>
<td>• L180 (default)</td>
</tr>
<tr>
<td></td>
<td>• RESTORER-L180</td>
</tr>
<tr>
<td></td>
<td>• TS3500</td>
</tr>
<tr>
<td></td>
<td>• I2000</td>
</tr>
<tr>
<td></td>
<td>• I6000</td>
</tr>
<tr>
<td></td>
<td>• DDVTL</td>
</tr>
<tr>
<td></td>
<td>Check your particular backup software application documentation on the Online Support Site for guidance. Also refer to the DD VTL support matrix to see the compatibility of emulated libraries to supported software.</td>
</tr>
<tr>
<td>Options</td>
<td>auto-eject default (disabled), enable, disable</td>
</tr>
<tr>
<td></td>
<td>auto-offline default (disabled), enable, disable</td>
</tr>
<tr>
<td></td>
<td>barcode-length default (8), 6, 8 [automatically set to 6 for L180, RESTORER-L180, and DD VTL changer models]</td>
</tr>
</tbody>
</table>

4. Select OK.

After the Create Library status dialog shows Completed, select OK.

The new library appears under the Libraries icon in the VTL Service tree, and the options you have configured appear as icons under the library. Selecting the library displays details about the library in the Information Panel.

Note that access to VTLs and drives is managed with Access Groups.

CLI Equivalent

```
# vtl add NewVTL model L180 slots 50 caps 5
```

This adds the VTL library, NewVTL. Use 'vtl show config NewVTL' to view it.
Deleting libraries

When a tape is in a drive within a library, and that library is deleted, the tape is moved to the vault. However, the tape's pool does not change.

Procedure
2. Select More Tasks > Library > Delete.
3. In the Delete Libraries dialog, select or confirm the checkbox of the items to delete:
   - The name of each library, or
   - Library Names, to delete all libraries
4. Select Next.
5. Verify the libraries to delete, and select Submit in the confirmation dialogs.
6. After the Delete Libraries Status dialog shows Completed, select Close. The selected libraries are deleted from the DD VTL.

CLI Equivalent

```
# vtl del OldVTL
```

Searching for tapes

You can use a variety of criteria – location, pool, and/or barcode – to search for a tape.

Procedure
1. Select Virtual Tape Libraries or Pools.
2. Select the area to search (library, vault, pool).
4. In the Search Tapes dialog, enter information about the tape(s) you want to find.

<table>
<thead>
<tr>
<th>Field</th>
<th>User input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Specify a location, or leave the default (All).</td>
</tr>
<tr>
<td>Pool</td>
<td>Select the name of the pool in which to search for the tape. If no pools have been created, use the Default pool.</td>
</tr>
<tr>
<td>Barcode</td>
<td>Specify a unique barcode. or leave the default (*) to return a group of tapes. Barcode allows the wildcards ? and *, where ? matches any single character and * matches 0 or more characters.</td>
</tr>
<tr>
<td>Count</td>
<td>Enter the maximum number of tapes you want to be returned to you. If you leave this blank, the barcode default (*) is used.</td>
</tr>
</tbody>
</table>

5. Select Search.
Working with a selected library

Selecting Virtual Tape Libraries > VTL Service > Libraries > library displays detailed information for a selected library.

Table 50 Devices

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device</td>
<td>The elements in the library, such as drives, slots, and CAPs (cartridge access ports).</td>
</tr>
<tr>
<td>Loaded</td>
<td>The number of devices with media loaded.</td>
</tr>
<tr>
<td>Empty</td>
<td>The number of devices with no media loaded.</td>
</tr>
<tr>
<td>Total</td>
<td>The total number of loaded and empty devices.</td>
</tr>
</tbody>
</table>

Table 51 Options

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>auto-eject</td>
<td>enabled or disabled</td>
</tr>
<tr>
<td>auto-offline</td>
<td>enabled or disabled</td>
</tr>
<tr>
<td>barcode-length</td>
<td>6 or 8</td>
</tr>
</tbody>
</table>

Table 52 Tapes

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pool</td>
<td>The name of the pool where the tapes are located.</td>
</tr>
<tr>
<td>Tape Count</td>
<td>The number of tapes in that pool.</td>
</tr>
<tr>
<td>Capacity</td>
<td>The total configured data capacity of the tapes in that pool, in GiB (Gibibytes, the base-2 equivalent of GB, Gigabytes).</td>
</tr>
<tr>
<td>Used</td>
<td>The amount of space used on the virtual tapes in that pool.</td>
</tr>
<tr>
<td>Average Compression</td>
<td>The average amount of compression achieved on the data on the tapes in that pool.</td>
</tr>
</tbody>
</table>

From the More Tasks menu, you can delete, rename, or set options for a library; create, delete, import, export, or move tapes; and add or delete slots and CAPs.

Creating tapes

You can create tapes in either a library or a pool. If initiated from a pool, the system first creates the tapes, then imports them to the library.

Procedure

1. Select Virtual Tape Libraries > VTL Service > Libraries > library or Vault or Pools > Pools > pool.
2. Select More Tasks > Tapes > Create.
3. In the Create Tapes dialog, enter the following information about the tape:
Table 53 Create Tapes dialog

<table>
<thead>
<tr>
<th>Field</th>
<th>User input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Library (if initiated from a library)</td>
<td>If a drop-down menu is enabled, select the library or leave the default selection.</td>
</tr>
<tr>
<td>Pool Name</td>
<td>Select the name of the pool in which the tape will reside, from the drop-down list. If no pools have been created, use the Default pool.</td>
</tr>
<tr>
<td>Number of Tapes</td>
<td>For a library, select from 1 to 20. For a pool, select from 1 to 100,000, or leave the default (20). [Although the number of supported tapes is unlimited, you can create no more than 100,000 tapes at a time.]</td>
</tr>
<tr>
<td>Starting Barcode</td>
<td>Enter the initial barcode number (using the format A99000LA).</td>
</tr>
<tr>
<td>Tape Capacity</td>
<td>(optional) Specify the number of GiBs from 1 to 4000 for each tape (this setting overrides the barcode capacity setting). For efficient use of disk space, use 100 GiB or fewer.</td>
</tr>
</tbody>
</table>

4. Select OK and Close.

CLI Equivalent

```
# vtl tape add A00000L1 capacity 100 count 5 pool VTL_Pool
... added 5 tape(s)...
```

**Note:** You must auto-increment tape volume names in base10 format.

Deleting tapes

You can delete tapes from either a library or a pool. If initiated from a library, the system first exports the tapes, then deletes them. The tapes must be in the vault, not in a library. On a Replication destination DD system, deleting a tape is not permitted.

**Procedure**

1. Select **Virtual Tape Libraries > VTL Service > Libraries > library or Vault or Pools > Pools > pool.**
2. Select **More Tasks > Tapes > Delete.**
3. In the Delete Tapes dialog, enter search information about the tapes to delete, and select **Search:**

Table 54 Delete Tapes dialog

<table>
<thead>
<tr>
<th>Field</th>
<th>User input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>If there is a drop-down list, select a library, or leave the default <strong>Vault</strong> selection.</td>
</tr>
<tr>
<td>Pool</td>
<td>Select the name of the pool in which to search for the tape. If no pools have been created, use the Default pool.</td>
</tr>
<tr>
<td>Barcode</td>
<td>Specify a unique barcode, or leave the default (*) to search for a group of tapes. Barcode allows the wildcards ? and *, where ? matches any single character and * matches 0 or more characters.</td>
</tr>
<tr>
<td>Count</td>
<td>Enter the maximum number of tapes you want to be returned to you. If you leave this blank, the barcode default (*) is used.</td>
</tr>
</tbody>
</table>
### Table 54 Delete Tapes dialog (continued)

<table>
<thead>
<tr>
<th>Field</th>
<th>User input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tapes Per Page</td>
<td>Select the maximum number of tapes to display per page – possible values are 15, 30, and 45.</td>
</tr>
<tr>
<td>Select all pages</td>
<td>Select the Select All Pages checkbox to select all tapes returned by the search query.</td>
</tr>
<tr>
<td>Items Selected</td>
<td>Shows the number of tapes selected across multiple pages – updated automatically for each tape selection.</td>
</tr>
</tbody>
</table>

4. Select the checkbox of the tape that should be deleted or the checkbox on the heading column to delete all tapes, and select Next.

5. Select Submit in the confirmation window, and select Close.

- **Note:** After a tape is removed, the physical disk space used for the tape is not reclaimed until after a file system cleaning operation.

### CLI Equivalent

```bash
# vtl tape del barcode [count count] [pool pool]
```

For example:

```bash
# vtl tape del A00000L1
```

- **Note:** You can act on ranges; however, if there is a missing tape in the range, the action will stop.

## Importing tapes

**Importing a tape** means that an existing tape will be moved from the vault to a library slot, drive, or cartridge access port (CAP).

### About this task

The number of tapes you can import at one time is limited by the number of empty slots in the library, that is, you cannot import more tapes than the number of currently empty slots.

To view the available slots for a library, select the library from the stack menu. The information panel for the library shows the count in the Empty column.

- If a tape is in a drive, and the tape origin is known to be a slot, a slot is reserved.
- If a tape is in a drive, and the tape origin is unknown (slot or CAP), a slot is reserved.
- If a tape is in a drive, and the tape origin is known to be a CAP, a slot is not reserved. (The tape returns to the CAP when removed from the drive.)
- To move a tape to a drive, see the section on moving tapes, which follows.

### Procedure

1. You can import tapes using either step a. or step b.

    a. Select **Virtual Tape Libraries > VTL Service > Libraries > library**. Then, select **More Tasks > Tapes > Import**. In the Import Tapes dialog, enter search information about the tapes to import, and select **Search**:
Table 55 Import Tapes dialog

<table>
<thead>
<tr>
<th>Field</th>
<th>User input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>If there is a drop-down list, select the location of the tape, or leave the default of Vault.</td>
</tr>
<tr>
<td>Pool</td>
<td>Select the name of the pool in which to search for the tape. If no pools have been created, use the Default pool.</td>
</tr>
<tr>
<td>Barcode</td>
<td>Specify a unique barcode or leave the default (*) to return a group of tapes. Barcode allows the wildcards ? and *, where ? matches any single character and * matches 0 or more characters.</td>
</tr>
<tr>
<td>Count</td>
<td>Enter the maximum number of tapes you want to be returned to you. If you leave this blank, the barcode default (*) is used.</td>
</tr>
<tr>
<td>Select</td>
<td>Select the destination device where the tape will be imported. Possible values are Drive, CAP, and Slot.</td>
</tr>
<tr>
<td>Destination</td>
<td></td>
</tr>
<tr>
<td>Device</td>
<td></td>
</tr>
<tr>
<td>Tapes Per Page</td>
<td>Select the maximum number of tapes to display per page. Possible values are 15, 30, and 45.</td>
</tr>
<tr>
<td>Items Selected</td>
<td>Shows the number of tapes selected across multiple pages – updated automatically for each tape selection.</td>
</tr>
</tbody>
</table>

Based on the previous conditions, a default set of tapes is searched to select the tapes to import. If pool, barcode, or count is changed, select Search to update the set of tapes available from which to choose.

b. Select Virtual Tape Libraries > VTL Service > Libraries > library > Changer > Drives > drive > Tapes. Select tapes to import by selecting the checkbox next to:

- An individual tape, or
- The Barcode column to select all tapes on the current page, or
- The Select all pages checkbox to select all tapes returned by the search query.

Only tapes showing Vault in the Location can be imported.

Select Import from Vault. This button is disabled by default and enabled only if all of the selected tapes are from the Vault.

2. From the Import Tapes: library view, verify the summary information and the tape list, and select OK.

3. Select Close in the status window.

CLI Equivalent

```
# vtl tape show pool VTL_Pool
Processing tapes....
Barcode Pool Location State Size Used (%)           Comp ModTime
------------ -------- -------- ----- --------------- ---- -------------------
A00000L3 VTL_Pool vault RW 100 GiB 0.0 GiB (0.00%) 0x   2010/07/16 09:50:41
A00001L3 VTL_Pool vault RW 100 GiB 0.0 GiB (0.00%) 0x   2010/07/16 09:50:41
A00002L3 VTL_Pool vault RW 100 GiB 0.0 GiB (0.00%) 0x   2010/07/16 09:50:41
A00003L3 VTL_Pool vault RW 100 GiB 0.0 GiB (0.00%) 0x   2010/07/16 09:50:41
A00004L3 VTL_Pool vault RW 100 GiB 0.0 GiB (0.00%) 0x   2010/07/16 09:50:41

VTL Tape Summary
---------------------
Total number of tapes:  5
Total pools:            1
```
Total size of tapes: 500 GiB  
Total space used by tapes: 0.0 GiB  
Average Compression: 0.0x

# vtl import NewVTL barcode A00000L3 count 5 pool VTL_Pool
... imported 5 tape(s)...

# vtl tape show pool VTL_Pool  
Processing tapes....

VTL Tape Summary  
----------------
Total number of tapes: 5  
Total pools: 1  
Total size of tapes: 500 GiB  
Total space used by tapes: 0.0 GiB  
Average Compression: 0.0x

Exporting tapes

Exporting a tape removes that tape from a slot, drive, or cartridge-access port (CAP) and sends it to the vault.

Procedure

1. You can export tapes using either step a. or step b.

   a. Select Virtual Tape Libraries > VTL Service > Libraries > library. Then, select More Tasks > Tapes > Export. In the Export Tapes dialog, enter search information about the tapes to export, and select Search:

   Table 56 Export Tapes dialog

<table>
<thead>
<tr>
<th>Field</th>
<th>User input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>If there is a drop-down list, select the name of the library where the tape is located, or leave the selected library.</td>
</tr>
<tr>
<td>Pool</td>
<td>Select the name of the pool in which to search for the tape. If no pools have been created, use the Default pool.</td>
</tr>
<tr>
<td>Barcode</td>
<td>Specify a unique barcode, or leave the default (*) to return a group of tapes. Barcode allows the wildcards ? and *, where ? matches any single character and * matches 0 or more characters.</td>
</tr>
<tr>
<td>Count</td>
<td>Enter the maximum number of tapes you want to be returned to you. If you leave this blank, the barcode default (*) is used.</td>
</tr>
<tr>
<td>Tapes Per Page</td>
<td>Select the maximum number of tapes to display per page. Possible values are 15, 30, and 45.</td>
</tr>
<tr>
<td>Select all pages</td>
<td>Select the Select All Pages checkbox to select all tapes returned by the search query.</td>
</tr>
<tr>
<td>Items Selected</td>
<td>Shows the number of tapes selected across multiple pages – updated automatically for each tape selection.</td>
</tr>
</tbody>
</table>

   b. Select Virtual Tape Libraries > VTL Service > Libraries > library > Changer > Drives > drive > Tapes. Select tapes to export by selecting the checkbox next to:

   - An individual tape, or
   - The Barcode column to select all tapes on the current page, or
   - The Select all pages checkbox to select all tapes returned by the search query.
Only tapes with a library name in the Location column can be exported. Select Export from Library. This button is disabled by default and enabled only if all of the selected tapes have a library name in the Location column.

2. From the Export Tapes: library view, verify the summary information and the tape list, and select OK.
3. Select Close in the status window.

CLI Equivalent

```
# vtl export NewVTL cap address 1 count 4
... exported 4 tape(s)...
```

**Moving tapes between devices within a library**

Tapes can be moved between physical devices within a library to mimic backup software procedures for physical tape libraries (which move a tape in a library from a slot to a drive, a slot to a CAP, a CAP to a drive, and the reverse). In a physical tape library, backup software never moves a tape outside the library. Therefore, the destination library cannot change and is shown only for clarification.

**Procedure**

   
   Note that when started from a library, the Tapes panel allows tapes to be moved only between devices.

2. Select More Tasks > Tapes > Move.
   
   Note that when started from a library, the Tapes panel allows tapes to be moved only between devices.

3. In the Move Tape dialog, enter search information about the tapes to move, and select Search:

   **Table 57 Move Tape dialog**

<table>
<thead>
<tr>
<th>Field</th>
<th>User input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Location cannot be changed.</td>
</tr>
<tr>
<td>Pool</td>
<td>Select a pool.</td>
</tr>
<tr>
<td>Barcode</td>
<td>Specify a unique barcode. or leave the default (*) to return a group of tapes.</td>
</tr>
<tr>
<td></td>
<td>Barcode allows the wildcards ? and *, where ? matches any single character and * matches 0 or more characters.</td>
</tr>
<tr>
<td>Count</td>
<td>Enter the maximum number of tapes you want to be returned to you. If you leave this blank, the barcode default (*) is used.</td>
</tr>
<tr>
<td>Tapes Per Page</td>
<td>Select the maximum number of tapes to display per page. Possible values are 15, 30, and 45.</td>
</tr>
<tr>
<td>Items Selected</td>
<td>Shows the number of tapes selected across multiple pages – updated automatically for each tape selection.</td>
</tr>
</tbody>
</table>

4. From the search results list, select the tape or tapes to move.
5. Do one of the following:
a. Select the device from the Device list (for example, a slot, drive, or CAP), and enter a starting address using sequential numbers for the second and subsequent tapes. For each tape to be moved, if the specified address is occupied, the next available address is used.

b. Leave the address blank if the tape in a drive originally came from a slot and is to be returned to that slot; or if the tape is to be moved to the next available slot.

6. Select Next.
7. In the Move Tape dialog, verify the summary information and the tape listing, and select Submit.
8. Select Close in the status window.

Adding slots
You can add slots from a configured library to change the number of storage elements.

About this task

1 | Note: Some backup applications do not automatically recognize that slots have been added to a DD VTL. See your application documentation for information on how to configure the application to recognize this type of change.

Procedure

2. Select More Tasks > Slots > Add.
3. In the Add Slots dialog, enter the Number of Slots to add. The total number of slots in a library, or in all libraries on a system, cannot exceed 32,000 for a library and 64,000 for a system.
4. Select OK and Close when the status shows Completed.

Deleting slots
You can delete slots from a configured library to change the number of storage elements.

About this task

1 | Note: Some backup applications do not automatically recognize that slots have been deleted from a DD VTL. See your application documentation for information on how to configure the application to recognize this type of change.

Procedure

1. If the slot that you want to delete contains cartridges, move those cartridges to the vault. The system will delete only empty, uncommitted slots.
3. Select More Tasks > Slots > Delete.
4. In the Delete Slots dialog, enter the Number of Slots to delete.
5. Select OK and Close when the status shows Completed.
Adding CAPs

You can add CAPs (cartridge access ports) from a configured library to change the number of storage elements.

About this task

**Note:** CAPs are used by a limited number of backup applications. See your application documentation to ensure that CAPs are supported.

Procedure

1. Select **Virtual Tape Libraries > VTL Service > Libraries > library.**
2. Select **More Tasks > CAPs > Add.**
3. In the Add CAPs dialog, enter the Number of CAPs to add. You can add from 1 to 100 CAPs per library and from 1 to 1,000 CAPs per system.
4. Select **OK and Close** when the status shows **Completed.**

Deleting CAPs

You can delete CAPs (cartridge access ports) from a configured library to change the number of storage elements.

About this task

**Note:** Some backup applications do not automatically recognize that CAPs have been deleted from a DD VTL. See your application documentation for information on how to configure the application to recognize this type of change.

Procedure

1. If the CAP that you want to delete contains cartridges, move those cartridges to the vault, or this will be done automatically.
2. Select **Virtual Tape Libraries > VTL Service > Libraries > library.**
3. Select **More Tasks > CAPs > Delete.**
4. In the Delete CAPs dialog, enter the Number of CAPs to delete. You can delete a maximum of 100 CAPs per library or 1000 CAPs per system.
5. Select **OK and Close** when the status shows **Completed.**

Viewing changer information

There can be only one changer per DD VTL. The changer model you select depends on your specific configuration.

Procedure

1. Select **Virtual Tape Libraries > VTL Service > Libraries.**
2. Select a specific library.
3. If not expanded, select the plus sign (+) on the left to open the library, and select a Changer element to display the Changer information panel, which provides the following information.
Table 58 Changer information panel

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vendor</td>
<td>The name of the vendor who manufactured the changer</td>
</tr>
<tr>
<td>Product</td>
<td>The model name</td>
</tr>
<tr>
<td>Revision</td>
<td>The revision level</td>
</tr>
<tr>
<td>Serial Number</td>
<td>The changer serial number</td>
</tr>
</tbody>
</table>

**Working with drives**

Selecting Virtual Tape Libraries > VTL Service > Libraries > library > Drives displays detailed information for all drives for a selected library.

**About this task**

Table 59 Drives information panel

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive</td>
<td>The list of drives by name, where name is “Drive #” and # is a number between 1 and n representing the address or location of the drive in the list of drives.</td>
</tr>
<tr>
<td>Vendor</td>
<td>The manufacturer or vendor of the drive, for example, IBM.</td>
</tr>
<tr>
<td>Product</td>
<td>The product name of the drive, for example, ULTRIUM-TD5.</td>
</tr>
<tr>
<td>Revision</td>
<td>The revision number of the drive product.</td>
</tr>
<tr>
<td>Serial</td>
<td>The serial number of the drive product.</td>
</tr>
<tr>
<td>Number</td>
<td></td>
</tr>
<tr>
<td>Status</td>
<td>Whether the drive is Empty, Open, Locked, or Loaded. A tape must be present for the drive to be locked or loaded.</td>
</tr>
<tr>
<td>Tape</td>
<td>The barcode of the tape in the drive (if any).</td>
</tr>
<tr>
<td>Pool</td>
<td>The pool of the tape in the drive (if any).</td>
</tr>
</tbody>
</table>

**Tape and library drivers** – To work with drives, you must use the tape and library drivers supplied by your backup software vendor that support the IBM LTO-1, IBM LTO-2, IBM LTO-3, IBM LTO-4, IBM LTO-5 (default), HP-LTO-3, or HP-LTO-4 drives and the StorageTek L180 (default), RESTORER-L180, IBM TS3500, i2000, i6000, or DDVTL libraries. For more information, see the Application Compatibility Matrices and Integration Guides for your vendors. When configuring drives, also keep in mind the limits on backup data streams, which are determined by the platform in use.

**LTO drive capacities** – Because the DD system treats LTO drives as virtual drives, you can set a maximum capacity to 4 TiB (4000 GiB) for each drive type. The default capacities for each LTO drive type are as follows:

- LTO-1 drive: 100 GiB
- LTO-2 drive: 200 GiB
- LTO-3 drive: 400 GiB
- LTO-4 drive: 800 GiB
- LTO-5 drive: 1.5 TiB

**Migrating LTO-1 tapes** – You can migrate tapes from existing LTO-1 type VTLs to VTLs that include other supported LTO-type tapes and drives. The migration options are different for each
backup application, so follow the instructions in the LTO tape migration guide specific to your application. To find the appropriate guide, go to the Online Support Site, and in the search text box, type LTO Tape Migration for VTLs.

**Tape full: Early warning** – You will receive a warning when the remaining tape space is almost completely full, that is, greater than 99.9, but less than 100 percent. The application can continue writing until the end of the tape to reach 100 percent capacity. The last write, however, is not recoverable.

From the More Tasks menu, you can create or delete a drive.

**Creating drives**

See the *Number of drives supported by a DD VTL* section to determine the maximum number of drives supported for your particular DD VTL.

**Procedure**

1. Select *Virtual Tape Libraries > VTL Service > Libraries > library > Changer > Drives*.
2. Select *More Tasks > Drives > Create*.
3. In the Create Drive dialog, enter the following information:

   **Table 60 Create Drive dialog**

<table>
<thead>
<tr>
<th>Field</th>
<th>User input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Select a library name, or leave the name selected.</td>
</tr>
<tr>
<td>Number of Drives</td>
<td>See the table in the <em>Number of Drives Supported by a DD VTL</em> section, earlier in this chapter.</td>
</tr>
<tr>
<td>Model Name</td>
<td>Select the model from the drop-down list. If another drive already exists, this option is inactive, and the existing drive type must be used. You cannot mix drive types in the same library.</td>
</tr>
<tr>
<td></td>
<td>- IBM-LTO-1</td>
</tr>
<tr>
<td></td>
<td>- IBM-LTO-2</td>
</tr>
<tr>
<td></td>
<td>- IBM-LTO-3</td>
</tr>
<tr>
<td></td>
<td>- IBM-LTO-4</td>
</tr>
<tr>
<td></td>
<td>- IBM-LTO-5 (default)</td>
</tr>
<tr>
<td></td>
<td>- HP-LTO-3</td>
</tr>
<tr>
<td></td>
<td>- HP-LTO-4</td>
</tr>
</tbody>
</table>

4. Select *OK*, and when the status shows *Completed*, select *OK*.

The added drive appears in the Drives list.

**Deleting drives**

A drive must be empty before it can be deleted.

**Procedure**

1. If there is a tape in the drive that you want to delete, remove the tape.
2. Select *Virtual Tape Libraries > VTL Service > Libraries > library > Changer > Drives*.
3. Select *More Tasks > Drives > Delete*. 
4. In the Delete Drives dialog, select the checkboxes of the drives to delete, or select the Drive checkbox to delete all drives.

5. Select Next, and after verifying that the correct drive(s) has been selected for deletion, select Submit.

6. When the Delete Drive Status dialog shows Completed, select Close.

The drive will have been removed from the Drives list.

Working with a selected drive

Selecting Virtual Tape Libraries > VTL Service > Libraries > library > Drives > drive displays detailed information for a selected drive.

Table 61 Drive Tab

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive</td>
<td>The list of drives by name, where name is “Drive #” and # is a number between 1 and n representing the address or location of the drive in the list of drives.</td>
</tr>
<tr>
<td>Vendor</td>
<td>The manufacturer or vendor of the drive, for example, IBM.</td>
</tr>
<tr>
<td>Product</td>
<td>The product name of the drive, for example, ULTRIUM-TD5.</td>
</tr>
<tr>
<td>Revision</td>
<td>The revision number of the drive product.</td>
</tr>
<tr>
<td>Serial Number</td>
<td>The serial number of the drive product.</td>
</tr>
<tr>
<td>Status</td>
<td>Whether the drive is Empty, Open, Locked, or Loaded. A tape must be present for the drive to be locked or loaded.</td>
</tr>
<tr>
<td>Tape</td>
<td>The barcode of the tape in the drive (if any).</td>
</tr>
<tr>
<td>Pool</td>
<td>The pool of the tape in the drive (if any).</td>
</tr>
</tbody>
</table>

Table 62 Statistics Tab

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endpoint</td>
<td>The specific name of the endpoint.</td>
</tr>
<tr>
<td>Ops/s</td>
<td>The operations per second.</td>
</tr>
<tr>
<td>Read KiB/s</td>
<td>The speed of reads in KiB per second.</td>
</tr>
<tr>
<td>Write KiB/s</td>
<td>The speed of writes in KiB per second.</td>
</tr>
</tbody>
</table>

From the More Tasks menu, you can delete the drive or perform a refresh.
Working with tapes

A tape is represented as a file. Tapes can be imported from the vault to a library. Tapes can be exported from a library to the vault. Tapes can be moved within a library across drives, slots (cartridge slots), and CAPs (cartridge access ports).

About this task

When tapes are created, they are placed into the vault. After they have been added to the vault, they can be imported, exported, moved, searched, or removed.

Selecting Virtual Tape Libraries > VTL Service > Libraries > library > Tapes displays detailed information for all tapes for a selected library.

Table 63 Tape description

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barcode</td>
<td>The unique barcode for the tape.</td>
</tr>
<tr>
<td>Pool</td>
<td>The name of the pool that holds the tape. The Default pool holds all tapes unassigned to a user-created pool.</td>
</tr>
<tr>
<td>Location</td>
<td>The location of the tape - whether in a library (and which drive, CAP, or slot number) or in the virtual vault.</td>
</tr>
<tr>
<td>State</td>
<td>The state of the tape:</td>
</tr>
<tr>
<td></td>
<td>- RW – Read-writable</td>
</tr>
<tr>
<td></td>
<td>- RL – Retention-locked</td>
</tr>
<tr>
<td></td>
<td>- RO – Readable only</td>
</tr>
<tr>
<td></td>
<td>- WP – Write-protected</td>
</tr>
<tr>
<td></td>
<td>- RD – Replication destination</td>
</tr>
<tr>
<td>Capacity</td>
<td>The total capacity of the tape.</td>
</tr>
<tr>
<td>Used</td>
<td>The amount of space used on the tape.</td>
</tr>
<tr>
<td>Compression</td>
<td>The amount of compression performed on the data on a tape.</td>
</tr>
<tr>
<td>Last Modified</td>
<td>The date of the last change to the tape’s information. Modification times used by the system for age-based policies might differ from the last modified time displayed in the tape information sections of the DD System Manager.</td>
</tr>
<tr>
<td>Locked Until</td>
<td>If a DD Retention Lock deadline has been set, the time set is shown. If no retention lock exists, this value is Not specified.</td>
</tr>
</tbody>
</table>

From the information panel, you can import a tape from the vault, export a tape to the library, set a tape’s state, create a tape, or delete a tape.

From the More Tasks menu, you can move a tape.
Changing a tape's write or retention lock state

Before changing a tape's write or retention lock state, the tape must have been created and imported. DD VTL tapes follow the standard DD Retention Lock policy. After the retention period for a tape has expired, it cannot be written to or changed (however, it can be deleted).

Procedure

2. Select the tape to modify from the list, and select Set State (above the list).
3. In the Set Tape State dialog, select Read-Writeable, Write-Protected, or Retention-Lock.
4. If the state is Retention-Lock, either
   • enter the tape’s expiration date in a specified number of days, weeks, months, years, or
   • select the calendar icon, and select a date from the calendar. The Retention-Lock expires at noon on the selected date.
5. Select Next, and select Submit to change the state.

Working with the vault

The vault holds tapes not being used by any library. Tapes reside in either a library or the vault.

Selecting Virtual Tape Libraries > VTL Service > Vault displays detailed information for the Default pool and any other existing pools in the vault.

Systems with Cloud Tier and DD VTL provide the option of storing the vault on cloud storage.

Table 64 Pool Summary

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pool Count</td>
<td>The number of VTL pools.</td>
</tr>
<tr>
<td>Tape Count</td>
<td>The number of tapes in the pools.</td>
</tr>
<tr>
<td>Size</td>
<td>The total amount of space in the pools.</td>
</tr>
<tr>
<td>Logical Used</td>
<td>The amount of space used in the pools.</td>
</tr>
<tr>
<td>Compression</td>
<td>The average amount of compression in the pools.</td>
</tr>
</tbody>
</table>

The Protection Distribution pane displays the following information.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage type</td>
<td>Vault or Cloud.</td>
</tr>
<tr>
<td>Cloud provider</td>
<td>For systems with tapes in Cloud Tier, there is a column for each cloud provider.</td>
</tr>
<tr>
<td>Logical Used</td>
<td>The amount of space used in the pools.</td>
</tr>
<tr>
<td>Pool Count</td>
<td>The number of VTL pools.</td>
</tr>
<tr>
<td>Tape Count</td>
<td>The number of tapes in the pools.</td>
</tr>
</tbody>
</table>

Note: This table only appears if Cloud Tier is enabled on the protection system.
From the More Tasks menu, you can create, delete, and search for tapes in the vault.

Working with the cloud-based vault

DD VTL supports several parameters that are unique to configurations where the vault is stored on Cloud Tier storage.

The following operations are available for working with cloud-based vault storage.

- Configure the data movement policy and cloud unit information for the specified VTL pool. Run the vtl pool modify <pool-name> data-movement-policy {user-managed | age-threshold <days> | none} to-tier {cloud} cloud-unit <cloud-unit-name> command.
  The available data movement policies are:
  - User-managed: The administrator can set this policy on a pool, to manually select tapes from the pool for migration to the cloud tier. The tapes migrate to the cloud tier on the first data movement operation after the tapes are selected.
  - Age-threshold: The administrator can set this policy on a pool, to allow the DD VTL to automatically select tapes from the pool for migration to the cloud tier based on the age of the tape. The tapes are selected for migration within six hours after they meet the age threshold, and are migrated on the first data movement operation after the tapes are selected.
- Select a specified tape for migration to the cloud tier. Run the vtl tape select-for-move barcode <barcode> [count <count>] pool <pool> to-tier {cloud} command.
- Deselect a specified tape for migration to the cloud tier. Run the vtl tape deselect-for-move barcode <barcode> [count <count>] pool <pool> to-tier {cloud} command.
- Recall a tape from the cloud tier. Run the vtl tape recall start barcode <barcode> [count <count>] pool <pool> command.
  After the recall, the tape resides in a local DD VTL vault and must be imported to the library for access.

Note: Run the vtl tape show command at any time to check the current location of a tape. The tape location updates within one hour of the tape moving to or from the cloud tier.

Prepare the VTL pool for data movement

Set the data movement policy on the VTL pool to manage migration of VTL data from the local vault to Cloud Tier.

About this task

Data movement for VTL occurs at the tape volume level. Individual tape volumes or collections of tape volumes can be moved to the cloud tier but only from the vault location. Tapes in other elements of a VTL cannot be moved.

Note: The default VTL pool and vault, /data/col1/backup directories or legacy library configurations cannot be used for Tape out to Cloud.

Procedure

1. Select Protocols > DD VTL.
2. Expand the list of pools, and select a pool on which to enable migration to Cloud Tier.
3. In the Cloud Data Movement pane, click Create under Cloud Data Movement Policy.
4. In the Policy drop-down list, select a data movement policy:
• Age of tapes in days
• Manual selection

5. Set the data movement policy details.
• For Age of tapes in days, select an age threshold after which tapes are migrated to Cloud Tier, and specify a destination cloud unit.
• For Manual selection, specify a destination cloud unit.

6. Click Create.

Note: After creating the data movement policy, the Edit and Clear buttons can be used to modify or delete the data movement policy.

CLI equivalent

Procedure

1. Set the data movement policy to user-managed or age-threshold

Note: VTL pool and cloud unit names are case sensitive and commands will fail if the case is not correct.

• To set the data movement policy to user-managed, run the following command:
  `vtl pool modify cloud-vtl-pool data-movement-policy user-managed to-tier cloud cloud-unit ecs-unit1`
  ** Any tapes that are already selected will be migrated on the next data-movement run. VTL data-movement policy is set to "user-managed" for VTL pool "cloud-vtl-pool".

• To set the data movement policy to age-threshold, run the following command:
  ** Note: The minimum is 14 days, and the maximum is 182,250 days.
  `vtl pool modify cloud-vtl-pool data-movement-policy age-threshold 14 to-tier cloud cloud-unit ecs-unit1`
  ** Any tapes that are already selected will be migrated on the next data-movement run. VTL data-movement policy "age-threshold" is set to 14 days for the VTL pool "cloud-vtl-pool".

2. Verify the data movement policy for the VTL pool.

Run the following command:
`vtl pool show all`

<table>
<thead>
<tr>
<th>VTL Pools</th>
<th>Status</th>
<th>Tapes</th>
<th>Size (GiB)</th>
<th>Used (GiB)</th>
<th>Comp</th>
<th>Cloud Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pool</td>
<td>-------</td>
<td>-------</td>
<td>------------</td>
<td>------------</td>
<td>------</td>
<td>------------</td>
</tr>
<tr>
<td>Cloud Policy</td>
<td>------</td>
<td>----</td>
<td>----------</td>
<td>----------</td>
<td>----</td>
<td>----------</td>
</tr>
<tr>
<td>----------</td>
<td>-------</td>
<td>-------</td>
<td>------------</td>
<td>------------</td>
<td>------</td>
<td>------------</td>
</tr>
<tr>
<td>cloud-vtl-pool</td>
<td>RW</td>
<td>50</td>
<td>250</td>
<td>41</td>
<td>45x</td>
<td>ecs-unit1</td>
</tr>
<tr>
<td>user-managed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Default</td>
<td>RW</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0x</td>
<td>-</td>
</tr>
<tr>
<td>none</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>-------</td>
<td>-------</td>
<td>------------</td>
<td>------------</td>
<td>------</td>
<td>------------</td>
</tr>
</tbody>
</table>

8080 tapes in 5 pools

RO : Read Only
RD : Replication Destination
BCM : Backwards-Compatibility

3. Verify the policy for the VTL pool MTree is app-managed.

Run the following command:
`data-movement policy show all`
### Remove tapes from the backup application inventory

Use the backup application verify the tape volumes that will move to the cloud are marked and inventoried according to the backup application requirements.

### Select tape volumes for data movement

Manually select tapes for migration to Cloud Tier (immediately or at the next scheduled data migration), or manually remove tapes from the migration schedule.

#### Before you begin

Verify the backup application is aware of status changes for volumes moved to cloud storage. Complete the necessary steps for the backup application to refresh its inventory to reflect the latest volume status.

If the tape is not in the vault, it cannot be migrated to Cloud Tier.

#### About this task

**Procedure**

1. Select Protocols > DD VTL.
2. Expand the list of pools, and select the pool which is configured to migrate tapes to Cloud Tier.
3. In the pool pane, click the Tape tab.
4. Select tapes for migration to Cloud Tier.
5. Click **Select for Cloud Move** to migrate the tape at the next scheduled migration, or **Move to Cloud Now** to immediately migrate the tape.

   ![Note:](image) **Note:** If the data movement policy is based on tape ages, the **Select for Cloud Move** is not available, as the protection system automatically selects tapes for migration.

6. Click **Yes** at the confirmation dialog.

#### Unselect tape volumes for data movement

**About this task**

Tapes selected for migration to Cloud Tier can be removed from the migration schedule.

**Procedure**

1. Select Protocols > DD VTL.
2. Expand the list of pools, and select the pool which is configured to migrate tapes to Cloud Tier.
3. In the pool pane, click the Tape tab.
4. Select tapes for migration to Cloud Tier.
5. Click **Unselect Cloud Move** to remove the tape from the migration schedule.
6. Click **Yes** at the confirmation dialog.
CLI equivalent

Procedure

1. Identify the slot location of the tape volume to move.
   Run the following command:
   
   ```
   vtl tape show cloud-vtl
   ```

<table>
<thead>
<tr>
<th>Barcode</th>
<th>Pool</th>
<th>Location</th>
<th>State</th>
<th>Size</th>
<th>Used (%)</th>
<th>Comp</th>
</tr>
</thead>
<tbody>
<tr>
<td>T00001L3</td>
<td>cloud-vtl-pool</td>
<td>cloud-vtl slot 1</td>
<td>RW</td>
<td>5 GiB</td>
<td>5.0 GiB  (99.07%)</td>
<td>205x</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T00002L3</td>
<td>cloud-vtl-pool</td>
<td>cloud-vtl slot 2</td>
<td>RW</td>
<td>5 GiB</td>
<td>5.0 GiB  (99.07%)</td>
<td>36x</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T00003L3</td>
<td>cloud-vtl-pool</td>
<td>cloud-vtl slot 3</td>
<td>RW</td>
<td>5 GiB</td>
<td>5.0 GiB  (99.07%)</td>
<td>73x</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Specify the numeric slot value to export the tape from the DD VTL.
   Run the following command:
   
   ```
   vtl export cloud-vtl-pool slot 1 count 1
   ```

3. Verify the tape is in the vault.
   Run the following command:
   
   ```
   vtl tape show vault
   ```

4. Select the tape for data movement.
   Run the following command:
   
   ```
   vtl tape select-for-move barcode T00001L3 count 1 pool cloud-vtl-pool to-tier cloud
   ```

   Note: If the data movement policy is age-threshold, data movement occurs automatically after 15-20 minutes.

5. View the list of tapes scheduled to move to cloud storage during the next data movement operation. The tapes selected for movement display an (S) in the location column.
   Run the following command:
   
   ```
   vtl tape show vault
   ```

<table>
<thead>
<tr>
<th>Barcode</th>
<th>Pool</th>
<th>Location</th>
<th>State</th>
<th>Size</th>
<th>Used (%)</th>
<th>Comp</th>
</tr>
</thead>
<tbody>
<tr>
<td>T00003L3</td>
<td>cloud-vtl-pool</td>
<td>vault (S)</td>
<td>RW</td>
<td>5 GiB</td>
<td>5.0 GiB  (99.07%)</td>
<td>63x</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T00006L3</td>
<td>cloud-vtl-pool</td>
<td>ecs-unit1</td>
<td>n/a</td>
<td>5 GiB</td>
<td>5.0 GiB  (99.07%)</td>
<td>62x</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* RD : Replication Destination
(S) Tape selected for migration to cloud. Selected tapes will move to cloud on the next data-movement run.
(R) Recall operation is in progress for the tape.

VTL Tape Summary

<table>
<thead>
<tr>
<th>Total number of tapes:</th>
<th>4024</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total pools:</td>
<td>3</td>
</tr>
<tr>
<td>Total size of tapes:</td>
<td>40175 GiB</td>
</tr>
<tr>
<td>Total space used by tapes:</td>
<td>39.6 GiB</td>
</tr>
<tr>
<td>Average Compression:</td>
<td>9.7x</td>
</tr>
</tbody>
</table>
6. If the data movement policy is user-managed, initiate the data movement operation.
   Run the following command:
   `data-movement start`

7. Observe the status of the data movement operation.
   Run the following command:
   `data-movement watch`

8. Verify the tape volumes successfully move to cloud storage.
   Run the following command:
   `vtl tape show all cloud-unit ecs-unit1`

   ```
   Processing tapes.....
   Barcode Pool Location State Size Used (%) Comp Modification Time
   -------- -------------- --------- ----- ----- ---------------- ---- -------------------
   T00001L3 cloud-vtl-pool ecs-unit1 n/a 5 GiB 5.0 GiB (99.07%) 89x 2017/05/05 10:41:41
   T00006L3 cloud-vtl-pool ecs-unit1 n/a 5 GiB 5.0 GiB (99.07%) 62x 2017/05/05 10:45:49
   -------- -------------- --------- ----- ----- ---------------- ---- -------------------
   (S) Tape selected for migration to cloud. Selected tapes will move to cloud on the next data-movement run.
   (R) Recall operation is in progress for the tape.
   ```

   **VTL Tape Summary**
   --------------------------------
   Total number of tapes: 4
   Total pools: 2
   Total size of tapes: 16 GiB
   Total space used by tapes: 14.9 GiB
   Average Compression: 59.5x

**Restore data held in the cloud**

When a client requests data for restore from the backup application server, the backup application should generate an alert or message requesting the required volumes from the cloud unit. The volume must be recalled from the cloud and checked into the DD VTL library before the backup application must be notified of the presence of the volumes.

**Note:** Verify the backup application is aware of status changes for volumes moved to cloud storage. Complete the necessary steps for the backup application to refresh its inventory to reflect the latest volume status.

**Manually recall a tape volume from cloud storage**

Recall a tape from Cloud Tier to the local VTL vault.

**Procedure**

1. Select Protocols > DD VTL.
2. Expand the list of pools, and select the pool which is configured to migrate tapes to Cloud Tier.
3. In the pool pane, click the Tape tab.
4. Select one or more tapes that are located in a cloud unit.
5. Click Recall Cloud Tapes to recall tapes from Cloud Tier.

**Results**

After the next scheduled data migration, the tapes are recalled from the cloud unit to the vault. From the vault, the tapes can be returned to a library.
**CLI equivalent**

**Procedure**

1. Identify the volume required to restore data.
2. Recall the tape volume from the vault.
   - Run the following command:
     ```
     vtl tape recall start barcode T00001L3 count 1 pool cloud-vtl-pool
     ```
3. Verify the recall operation started.
   - Run the following command:
     ```
     data-movement status
     ```
4. Verify the recall operation completed successfully.
   - Run the following command:
     ```
     vtl tape show all barcode T00001L3
     ```

---

**Processing tapes....**

<table>
<thead>
<tr>
<th>Barcode</th>
<th>Pool</th>
<th>Location</th>
<th>State</th>
<th>Size</th>
<th>Used (%)</th>
<th>Comp</th>
</tr>
</thead>
<tbody>
<tr>
<td>T00001L3</td>
<td>cloud-vtl-pool</td>
<td>cloud-vtl slot 1</td>
<td>RW</td>
<td>5 GiB</td>
<td>5.0 GiB (99.07%)</td>
<td>239x</td>
</tr>
<tr>
<td>Modification Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2017/05/05 10:41:41</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(S) Tape selected for migration to cloud. Selected tapes will move to cloud on the next data-movement run.
(R) Recall operation is in progress for the tape.

**VTL Tape Summary**

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of tapes:</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total pools:</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total size of tapes:</td>
<td>5 GiB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total space used by tapes:</td>
<td>5.0 GiB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Compression:</td>
<td>239.1x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Validate the file location.
   - Run the following command:
     ```
     filesys report generate file-location path /data/col1/cloud-vtl-pool
     ```

---

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>File Name</td>
<td>Location(Unit Name)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/data/col1/cloud-vtl-pool/.vtl_pool</td>
<td></td>
<td>Active</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/data/col1/cloud-vtl-pool/.vtc/T00001L3</td>
<td></td>
<td>Active</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. Import the recalled tape to the DD VTL.
   - Run the following command:
     ```
     vtl import cloud-vtl barcode T00001L3 count 1 pool cloud-vtl-pool element slot
     ```

7. Check the volume into the backup application inventory.
8. Restore data through the backup application.
9. When restore is completed check the tape volume out of the backup application inventory.
10. Export the tape volume from the DD VTL to the vault.
11. Move the tape back to the cloud unit.

Working with access groups

Access groups hold a collection of initiator WWPNs (worldwide port names) or aliases and the drives and changers they are allowed to access. A DD VTL default group named TapeServer lets you add devices that will support NDMP (Network Data Management Protocol)-based backup applications.

Access group configuration allows initiators (in general backup applications) to read and write data to devices in the same access group.

Access groups let clients access only selected LUNs (media changers or virtual tape drives) on a system. A client set up for an access group can access only devices in its access group.

Avoid making access group changes on a DD system during active backup or restore jobs. A change may cause an active job to fail. The impact of changes during active jobs depends on a combination of backup software and host configurations.

Selecting Access Groups > Groups displays the following information for all access groups.

Table 66 Access group information

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group Name</td>
<td>Name of group.</td>
</tr>
<tr>
<td>Initiators</td>
<td>Number of initiators in group.</td>
</tr>
<tr>
<td>Devices</td>
<td>Number of devices in group.</td>
</tr>
</tbody>
</table>

If you select View All Access Groups, you are taken to the Fibre Channel view.
From the More Tasks menu, you can create or delete a group.

Creating an access group

Access groups manage access between devices and initiators. Do not use the default TapeServer access group unless you are using NDMP.

Procedure

2. Select More Tasks > Group > Create
3. In the Create Access Group dialog, enter a name, from 1 to 128 characters, and select Next.
4. Add devices, and select Next.
5. Review the summary, and select Finish or Back, as appropriate.

CLI Equivalent

```bash
# vtl group create My_Group
```
Adding an access group device

Access group configuration allows initiators (in general backup applications) to read and write data to devices in the same access group.

Procedure

1. Select **Access Groups > Groups**. You can also select a specific **group**.
2. Select **More Tasks > Group > Create** or **Group > Configure**.
3. In the Create or Modify Access Group dialog, enter or modify the **Group Name** if desired. (This field is required.)
4. To configure initiators to the access group, check the box next to the initiator. You can add initiators to the group later.
5. Select **Next**.
6. In the Devices display, select **Add (+)** to display the Add Devices dialog.
   a. Verify that the correct library is selected in the **Library Name** drop-down list, or select another library.
   b. In the **Device** area, select the checkboxes of the devices (changer and drives) to be included in the group.
   c. Optionally, specify a starting LUN in the **LUN Start Address** text box.

   This is the LUN that the DD system returns to the initiator. Each device is uniquely identified by the library and the device name. (For example, it is possible to have drive 1 in Library 1 and drive 1 in Library 2). Therefore, a LUN is associated with a device, which is identified by its library and device name.

   When presenting LUNs via attached FC ports on FC HBA/SLIC, ports can be designated as primary, secondary, or none. A Primary port for a set of LUNs is the port that is currently advertising those LUNs to a fabric. A secondary port is a port that will broadcast a set of LUNs in the event of primary path failure (this requires manual intervention). A setting of none is used in the case where you do not wish to advertise selected LUNs. The presentation of LUNs depends on the SAN topology in question.

   The initiators in the access group interact with the LUN devices that are added to the group.

   The maximum LUN accepted when creating an access group is 16383.

   A LUN can be used only once for an individual group. The same LUN can be used with multiple groups.

   Some initiators (clients) have specific rules for target LUN numbering; for example, requiring LUN 0 or requiring contiguous LUNs. If these rules are not followed, an initiator may not be able to access some or all of the LUNs assigned to a DD VTL target port.

   Check your initiator documentation for special rules, and if necessary, alter the device LUNs on the DD VTL target port to follow the rules. For example, if an initiator requires LUN 0 to be assigned on the DD VTL target port, check the LUNs for devices assigned to ports, and if there is no device assigned to LUN 0, change the LUN of a device so it is assigned to LUN 0.

   d. In the **Primary and Secondary Endpoints** area, select an option to determine from which ports the selected device will be seen. The following conditions apply for designated ports:
      - all – The checked device is seen from all ports.
      - none – The checked device is not seen from any port.
• select – The checked device is to be seen from selected ports. Select the checkboxes of the appropriate ports.
If only primary ports are selected, the checked device is visible only from primary ports.
If only secondary ports are selected, the checked device is visible only from secondary ports. Secondary ports can be used if the primary ports become unavailable.
The switchover to a secondary port is not an automatic operation. You must manually switch the DD VTL device to the secondary ports if the primary ports become unavailable.
The port list is a list of physical port numbers. A port number denotes the PCI slot and a letter denotes the port on a PCI card. Examples are 1a, 1b, or 2a, 2b.
A drive appears with the same LUN on all the ports that you have configured.
e. Select OK.
You are returned to the Devices dialog box where the new group is listed. To add more devices, repeat these five substeps.

7. Select Next.
8. Select Close when the Completed status message is displayed.

CLI Equivalent

# vtl group add VTL_Group vtl NewVTL changer lun 0 primary-port all secondary-port all
# vtl group add VTL_Group vtl NewVTL drive 1 lun 1 primary-port all secondary-port all
# vtl group add SetUp_Test vtl SetUp_Test drive 3 lun 3 primary-port endpoint-fc-0 secondary-port endpoint-fc-1

# vtl group show SetUp_Test
Group: SetUp_Test

Initiators:
Initiator Alias   Initiator WWPN
---------------   -----------------------
tsm6_p23          21:00:00:24:ff:31:ce:f8
---------------   -----------------------

Devices:
Device Name          LUN   Primary Ports   Secondary Ports    In-use Ports
------------------   ---   -------------   ---------------   -------------
SetUp_Test changer     0             all               all             all
SetUp_Test drive 1     1             all               all             all
SetUp_Test drive 2     2   5a                5b              5a
SetUp_Test drive 3     3   endpoint-fc-0     endpoint-fc-1   endpoint-fc-0
------------------   ---   -------------   ---------------   -------------

Modifying or deleting an access group device
You may need to modify or delete a device from an access group.

Procedure

2. Select More Tasks > Group > Configure.
3. In the Modify Access Group dialog, enter or modify the Group Name. (This field is required.)
4. To configure initiators to the access group, check the box next to the initiator. You can add initiators to the group later.
5. Select **Next**.

6. Select a device, and select the edit (pencil) icon to display the Modify Devices dialog. Then, follow steps a-e. If you simply want to delete the device, select the delete (X) icon, and skip to step e.

   a. Verify that the correct library is selected in the Library drop-down list, or select another library.

   b. In the Devices to Modify area, select the checkboxes of the devices (Changer and drives) to be modified.

   c. Optionally, modify the starting LUN (logical unit number) in the LUN Start Address box.

      This is the LUN that the DD system returns to the initiator. Each device is uniquely identified by the library and the device name. (For example, it is possible to have drive 1 in Library 1 and drive 1 in Library 2). Therefore, a LUN is associated with a device, which is identified by its library and device name.

      The initiators in the access group interact with the LUN devices that are added to the group.

      The maximum LUN accepted when creating an access group is 16383.

      A LUN can be used only once for an individual group. The same LUN can be used with multiple groups.

      Some initiators (clients) have specific rules for target LUN numbering; for example, requiring LUN 0 or requiring contiguous LUNs. If these rules are not followed, an initiator may not be able to access some or all of the LUNs assigned to a DD VTL target port.

      Check your initiator documentation for special rules, and if necessary, alter the device LUNs on the DD VTL target port to follow the rules. For example, if an initiator requires LUN 0 to be assigned on the DD VTL target port, check the LUNs for devices assigned to ports, and if there is no device assigned to LUN 0, change the LUN of a device so it is assigned to LUN 0.

   d. In the Primary and Secondary Ports area, change the option that determines the ports from which the selected device is seen. The following conditions apply for designated ports:

      - **all** – The checked device is seen from all ports.
      - **none** – The checked device is not seen from any port.
      - **select** – The checked device is seen from selected ports. Select the checkboxes of the ports from which it will be seen.
        
        If only primary ports are selected, the checked device is visible only from primary ports.

        If only secondary ports are selected, the checked device is visible only from secondary ports. Secondary ports can be used if primary ports become unavailable.

      The switchover to a secondary port is not an automatic operation. You must manually switch the DD VTL device to the secondary ports if the primary ports become unavailable.

      The port list is a list of physical port numbers. A port number denotes the PCI slot, and a letter denotes the port on a PCI card. Examples are 1a, 1b, or 2a, 2b.

      A drive appears with the same LUN on all ports that you have configured.

   e. Select **OK**.
Deleting an access group

Before you can delete an access group, you must remove all of its initiators and LUNs.

Procedure

1. Remove all of the initiators and LUNs from the group.
4. In the Delete Group dialog, select the checkbox of the group to be removed, and select Next.
5. In the groups confirmation dialog, verify the deletion, and select Submit.
6. Select Close when the Delete Groups Status displays Completed.

CLI Equivalent

```
# scsitarget group destroy My_Group
```

Working with a selected access group

Selecting Access Groups > Groups > group displays the following information for a selected access group.

Table 67 LUNs tab

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LUN</td>
<td>Device address – maximum number is 16383. A LUN can be used only once within a group, but can be used again within another group. DD VTL devices added to a group must use contiguous LUNs.</td>
</tr>
<tr>
<td>Library</td>
<td>Name of library associated with LUN.</td>
</tr>
<tr>
<td>Device</td>
<td>Changers and drives.</td>
</tr>
<tr>
<td>In-Use Endpoints</td>
<td>Set of endpoints currently being used: primary or secondary.</td>
</tr>
<tr>
<td>Primary Endpoints</td>
<td>Initial (or default) endpoint used by backup application. In the event of a failure on this endpoint, the secondary endpoints may be used, if available.</td>
</tr>
<tr>
<td>Secondary Endpoints</td>
<td>Set of fail-over endpoints to use if primary endpoint fails.</td>
</tr>
</tbody>
</table>

Table 68 Initiators tab

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Name of initiator, which is either the WWPN or the alias assigned to the initiator.</td>
</tr>
<tr>
<td>WWPN</td>
<td>Unique worldwide port name, which is a 64-bit identifier (a 60-bit value preceded by a 4-bit Network Address Authority identifier), of the Fibre Channel port.</td>
</tr>
</tbody>
</table>
From the More Tasks menu, with a group selected, you can configure that group, or set endpoints in use.

Selecting endpoints for a device

Since endpoints connect a device to an initiator, use this process to set up the endpoints before you connect the device.

Procedure

2. Select More Tasks > Endpoints > Set In-Use.
3. In the Set in-Use Endpoints dialog, select only specific devices, or select Devices to select all devices in the list.
4. Indicate whether the endpoints are primary or secondary.
5. Select OK.

Configuring the NDMP device TapeServer group

The DD VTL TapeServer group holds tape drives that interface with NDMP (Network Data Management Protocol)-based backup applications and that send control information and data streams over IP (Internet Protocol) instead of Fibre Channel (FC). A device used by the NDMP TapeServer must be in the DD VTL group TapeServer and is available only to the NDMP TapeServer.

Procedure

1. Add tape drives to a new or existing library (in this example, named “dd9900-16”).
2. Create slots and CAPs for the library.
3. Add the created devices in a library (in this example, “dd9900-16”) to the TapeServer access group.
4. Enable the NDMP daemon by entering at the command line:
   ```bash
   # ndmpd enable
   Starting NDMP daemon, please wait..................
   NDMP daemon is enabled.
   
   5. Ensure that the NDMP daemon sees the devices in the TapeServer group:
   
   ```
   
   # ndmpd show devicenames
   NDMP Device Virtual Name Vendor Product Serial Number
   ----------------- ----------------- ------ ----------- -----------------
   /dev/dd_ch_c0t010 dd9900-16 changer STK L180 6290820000
   /dev/dd_st_c0t1l0 dd9900-16 drive 1 IBM ULTRIUM-TD3 6290820001
   /dev/dd_st_c0t2l0 dd9900-16 drive 2 IBM ULTRIUM-TD3 6290820002
   /dev/dd_st_c0t3l0 dd9900-16 drive 3 IBM ULTRIUM-TD3 6290820003
   /dev/dd_st_c0t4l0 dd9900-16 drive 4 IBM ULTRIUM-TD3 6290820004
   
   6. Add an NDMP user (ndmp in this example) with the following command:
   
   ```bash
   # ndmpd user add ndmp
   Enter password:
   Verify password:
   
   7. Verify that user ndmp is added correctly:
   
   ```
   
   # ndmpd user show
   ndmp
   
   8. Display the NDMP configuration:
   
   ```bash
   # ndmpd option show all
   Name Value
   ----------------- ------
   ```
9. Change the default user password authentication to use MD5 encryption for enhanced security, and verify the change (notice the authentication value changed from text to md5):

```
# ndmpd option set authentication md5
# ndmpd option show all
```

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>authentication</td>
<td>md5</td>
</tr>
<tr>
<td>debug</td>
<td>disabled</td>
</tr>
<tr>
<td>port</td>
<td>10000</td>
</tr>
<tr>
<td>preferred-ip</td>
<td>---------</td>
</tr>
</tbody>
</table>

Results

NDMP is now configured, and the TapeServer access group shows the device configuration. See the `ndmpd` chapter of the *DD OS Command Reference Guide* for the complete command set and options.

Working with resources

Selecting Resources > Resources displays information about initiators and endpoints. An initiator is a backup client that connects to a system to read and write data using the Fibre Channel (FC) protocol. A specific initiator can support DD Boost over FC or DD VTL, but not both. An endpoint is the logical target on a DD system to which the initiator connects.

**Table 69 Initiators tab**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Name of initiator, which is either the WWPN or the alias assigned to the initiator.</td>
</tr>
<tr>
<td>WWPN</td>
<td>Unique worldwide port name, which is a 64-bit identifier (a 60-bit value preceded by a 4-bit Network Address Authority identifier), of the Fibre Channel (FC) port.</td>
</tr>
<tr>
<td>WWNN</td>
<td>Unique worldwide node name, which is a 64-bit identifier (a 60-bit value preceded by a 4-bit Network Address Authority identifier), of the FC node.</td>
</tr>
</tbody>
</table>

**Table 70 Endpoints tab**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Specific name of endpoint.</td>
</tr>
<tr>
<td>WWPN</td>
<td>Unique worldwide port name, which is a 64-bit identifier (a 60-bit value preceded by a 4-bit Network Address Authority identifier), of the Fibre Channel (FC) port.</td>
</tr>
</tbody>
</table>
Table 70 Endpoints tab (continued)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WWNN</td>
<td>Unique worldwide node name, which is a 64-bit identifier (a 60-bit value preceded by a 4-bit Network Address Authority identifier), of the FC node.</td>
</tr>
<tr>
<td>System Address</td>
<td>System address for the endpoint.</td>
</tr>
<tr>
<td>Enabled</td>
<td>HBA (host bus adapter) port operational state, which is either Yes (enabled) or No (not enabled).</td>
</tr>
<tr>
<td>Status</td>
<td>DD VTL link status, which is either Online (capable of handling traffic) or Offline.</td>
</tr>
</tbody>
</table>

Configure Resources

Selecting Configure Resources takes you to the Fibre Channel area, where you can configure endpoints and initiators.

Working with initiators

Selecting Resources > Resources > Initiators displays information about initiators. An initiator is a client system FC HBA (fibre channel host bus adapter) WWPN (worldwide port name) with which the DD system interfaces. An initiator name is an alias for the client’s WWPN, for ease of use.

While a client is mapped as an initiator – but before an access group has been added – the client cannot access any data on a DD system.

After adding an access group for the initiator or client, the client can access only the devices in that access group. A client can have access groups for multiple devices.

An access group may contain multiple initiators, but an initiator can exist in only one access group.

Note: A maximum of 1024 initiators can be configured for a DD system.

Table 71 Initiator information

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Name of initiator.</td>
</tr>
<tr>
<td>Group</td>
<td>Group associated with initiator.</td>
</tr>
<tr>
<td>Online Endpoints</td>
<td>Endpoints seen by initiator. Displays none or offline if initiator is unavailable.</td>
</tr>
<tr>
<td>WWPN</td>
<td>Unique worldwide port name, which is a 64-bit identifier (a 60-bit value preceded by a 4-bit Network Address Authority identifier), of the Fibre Channel (FC) port.</td>
</tr>
<tr>
<td>WWNN</td>
<td>Unique worldwide node name, which is a 64-bit identifier (a 60-bit value preceded by a 4-bit Network Address Authority identifier), of the FC node.</td>
</tr>
<tr>
<td>Vendor Name</td>
<td>Name of vendor for initiator.</td>
</tr>
</tbody>
</table>

Selecting Configure Initiators takes you to the Fibre Channel area, where you can configure endpoints and initiators.
## CLI Equivalent

```
# vtl initiator show
```

<table>
<thead>
<tr>
<th>Initiator</th>
<th>Group</th>
<th>Status</th>
<th>WWNN</th>
<th>WWPN</th>
<th>Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>tsm6_p1</td>
<td>tsm3500_a</td>
<td>Online</td>
<td>20:00:00:24:ff:31:ce:f8</td>
<td>21:00:00:24:ff:31:ce:f8</td>
<td>10b</td>
</tr>
</tbody>
</table>

### Initiator Symbolic Port Name

<table>
<thead>
<tr>
<th>Initiator</th>
<th>Symbolic Port Name</th>
<th>Address Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>tsm6_p1</td>
<td>QLE2562 FW:v5.06.03 DVR:v8.03.07.15.05.09-k</td>
<td>auto</td>
</tr>
</tbody>
</table>

## Working with endpoints

Selecting Resources > Resources > Endpoints provides information about endpoint hardware and connectivity.

### Table 72 Hardware Tab

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Address</td>
<td>System address of endpoint.</td>
</tr>
<tr>
<td>WWPN</td>
<td>Unique worldwide port name, which is a 64-bit identifier (a 60-bit value preceded by a 4-bit Network Address Authority identifier), of the Fibre Channel (FC) port.</td>
</tr>
<tr>
<td>WWNN</td>
<td>Unique worldwide node name, which is a 64-bit identifier (a 60-bit value preceded by a 4-bit Network Address Authority identifier), of the FC node.</td>
</tr>
<tr>
<td>Enabled</td>
<td>HBA (host bus adapter) port operational state, which is either Yes (enabled) or No (not enabled).</td>
</tr>
<tr>
<td>NPIV</td>
<td>NPIV status of this endpoint: eithe Enabled or Disabled.</td>
</tr>
<tr>
<td>Link Status</td>
<td>Link status of this endpoint: either Online or Offline.</td>
</tr>
<tr>
<td>Operation Status</td>
<td>Operation status of this endpoint: either Normal or Marginal.</td>
</tr>
<tr>
<td># of Endpoints</td>
<td>Number of endpoints associated with this endpoint.</td>
</tr>
</tbody>
</table>

### Table 73 Endpoints Tab

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Specific name of endpoint.</td>
</tr>
<tr>
<td>WWPN</td>
<td>Unique worldwide port name, which is a 64-bit identifier (a 60-bit value preceded by a 4-bit Network Address Authority identifier), of the Fibre Channel (FC) port.</td>
</tr>
<tr>
<td>WWNN</td>
<td>Unique worldwide node name, which is a 64-bit identifier (a 60-bit value preceded by a 4-bit Network Address Authority identifier), of the FC node.</td>
</tr>
<tr>
<td>System Address</td>
<td>System address of endpoint.</td>
</tr>
<tr>
<td>Enabled</td>
<td>HBA (host bus adapter) port operational state, which is either Yes (enabled) or No (not enabled).</td>
</tr>
<tr>
<td>Link Status</td>
<td>Link status of this endpoint: either Online or Offline.</td>
</tr>
</tbody>
</table>
Configure Endpoints

Selecting **Configure Endpoints** takes you to the Fibre Channel area, where you can change any of the above information for the endpoint.

**CLI Equivalent**

```
# scsitarget endpoint show list
```

<table>
<thead>
<tr>
<th>Endpoint</th>
<th>System Address</th>
<th>Transport</th>
<th>Enabled</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>endpoint-fc-0</td>
<td>5a</td>
<td>FibreChannel</td>
<td>Yes</td>
<td>Online</td>
</tr>
<tr>
<td>endpoint-fc-1</td>
<td>5b</td>
<td>FibreChannel</td>
<td>Yes</td>
<td>Online</td>
</tr>
</tbody>
</table>

**Working with a selected endpoint**

Selecting **Resources > Resources > Endpoints > endpoint** provides information about the endpoint's hardware, connectivity, and statistics.

**Table 74 Hardware tab**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Address</td>
<td>System address of endpoint.</td>
</tr>
<tr>
<td>WWPN</td>
<td>Unique worldwide port name, which is a 64-bit identifier (a 60-bit value preceded by a 4-bit Network Address Authority identifier), of the Fibre Channel port.</td>
</tr>
<tr>
<td>WWNN</td>
<td>Unique worldwide node name, which is a 64-bit identifier (a 60-bit value preceded by a 4-bit Network Address Authority identifier), of the FC node.</td>
</tr>
<tr>
<td>Enabled</td>
<td>HBA (host bus adapter) port operational state, which is either Yes (enabled) or No (not enabled).</td>
</tr>
<tr>
<td>NPIV</td>
<td>NPIV status of this endpoint: either Enabled or Disabled.</td>
</tr>
<tr>
<td>Link Status</td>
<td>Link status of this endpoint: either Online or Offline.</td>
</tr>
<tr>
<td>Operation Status</td>
<td>Operation status of this endpoint: either Normal or Marginal.</td>
</tr>
<tr>
<td># of Endpoints</td>
<td>Number of endpoints associated with this endpoint.</td>
</tr>
</tbody>
</table>

**Table 75 Summary tab**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Specific name of endpoint.</td>
</tr>
<tr>
<td>WWPN</td>
<td>Unique worldwide port name, which is a 64-bit identifier (a 60-bit value preceded by a 4-bit Network Address Authority identifier), of the Fibre Channel port.</td>
</tr>
<tr>
<td>WWNN</td>
<td>Unique worldwide node name, which is a 64-bit identifier (a 60-bit value preceded by a 4-bit Network Address Authority identifier), of the FC node.</td>
</tr>
<tr>
<td>System Address</td>
<td>System address of endpoint.</td>
</tr>
<tr>
<td>Enabled</td>
<td>HBA (host bus adapter) port operational state, which is either Yes (enabled) or No (not enabled).</td>
</tr>
<tr>
<td>Link Status</td>
<td>Link status of this endpoint: either Online or Offline.</td>
</tr>
</tbody>
</table>
Table 76 Statistics tab

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endpoint</td>
<td>Specific name of endpoint.</td>
</tr>
<tr>
<td>Library</td>
<td>Name of library containing the endpoint.</td>
</tr>
<tr>
<td>Device</td>
<td>Number of device.</td>
</tr>
<tr>
<td>Ops/s</td>
<td>Operations per second.</td>
</tr>
<tr>
<td>Read KiB/s</td>
<td>Speed of reads in KiB per second.</td>
</tr>
<tr>
<td>Write KiB/s</td>
<td>Speed of writes in KiB per second.</td>
</tr>
</tbody>
</table>

Table 77 Detailed Statistics tab

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endpoint</td>
<td>Specific name of endpoint.</td>
</tr>
<tr>
<td># of Control Commands</td>
<td>Number of control commands.</td>
</tr>
<tr>
<td># of Read Commands</td>
<td>Number of read commands.</td>
</tr>
<tr>
<td># of Write Commands</td>
<td>Number of write commands.</td>
</tr>
<tr>
<td>In (MiB)</td>
<td>Number of MiB written (the binary equivalent of MB).</td>
</tr>
<tr>
<td>Out (MiB)</td>
<td>Number of MiB read.</td>
</tr>
<tr>
<td># of Error Protocol</td>
<td>Number of error protocols.</td>
</tr>
<tr>
<td># of Link Fail</td>
<td>Number of link failures.</td>
</tr>
<tr>
<td># of Invalid Crc</td>
<td>Number of invalid CRCs (cyclic redundancy checks).</td>
</tr>
<tr>
<td># of Invalid TxWord</td>
<td>Number of invalid tx (transmission) words.</td>
</tr>
<tr>
<td># of Lip</td>
<td>Number of LIPs (loop initialization primitives).</td>
</tr>
<tr>
<td># of Loss Signal</td>
<td>Number of signals or connections that have been lost.</td>
</tr>
<tr>
<td># of Loss Sync</td>
<td>Number of signals or connections that have lost synchronization.</td>
</tr>
</tbody>
</table>

Working with pools

Selecting Pools > Pools displays detailed information for the Default pool and any other existing pools. A pool is a collection of tapes that maps to a directory on the file system. Pools are used to replicate tapes to a destination. You can convert directory-based pools to MTree-based pools to take advantage of the greater functionality of MTrees.

Note the following about pools:

- Pools can be of two types: MTree (recommended), or Directory, which is backward-compatible.
- A pool can be replicated no matter where individual tapes are located. Tapes can be in the vault or in a library (slot, cap, or drive).
- You can copy and move tapes from one pool to another.
- Pools are not accessible by backup software.
No DD VTL configuration or license is needed on a replication destination when replicating pools.

You must create tapes with unique barcodes. Duplicate barcodes may cause unpredictable behavior in backup applications and can be confusing to users.

Two tapes in two different pools on a DD system may have the same name, and in this case, neither tape can be moved to the other tape's pool. Likewise, a pool sent to a replication destination must have a name that is unique on the destination.

Table 78 Pools tab

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>The name of the pool.</td>
</tr>
<tr>
<td>Type</td>
<td>Whether it is a Directory or MTree pool.</td>
</tr>
<tr>
<td>Status</td>
<td>The status of the pool.</td>
</tr>
<tr>
<td>Tape Count</td>
<td>The number of tapes in the pool.</td>
</tr>
<tr>
<td>Size</td>
<td>The total configured data capacity of tapes in the pool, in GiB (Gibibytes base-2 equivalent of GB, Gigabytes).</td>
</tr>
<tr>
<td>Physical Used</td>
<td>The amount of space used on virtual tapes in the pool.</td>
</tr>
<tr>
<td>Compression</td>
<td>The average amount of compression achieved for data on tapes in the pool.</td>
</tr>
<tr>
<td>Cloud Unit</td>
<td>The name of the cloud unit where the DD VTL pool migrates data.</td>
</tr>
<tr>
<td>Cloud Data Movement Policy</td>
<td>The data movement policy that governs migration of DD VTL data to Cloud Tier storage.</td>
</tr>
</tbody>
</table>

Table 79 Replication tab

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>The name of the pool.</td>
</tr>
<tr>
<td>Configured</td>
<td>Whether replication is configured for the pool: yes or no.</td>
</tr>
<tr>
<td>Remote Source</td>
<td>Contains an entry only if the pool is replicated from another DD system.</td>
</tr>
<tr>
<td>Remote Destination</td>
<td>Contains an entry only if the pool replicates to another DD system.</td>
</tr>
</tbody>
</table>

From the More Tasks menu, you can create and delete pools, as well as search for tapes.

Creating pools

You can create backward-compatible pools, if necessary for your setup, for example, for replication with a pre-5.2 DD OS system.

Procedure

1. Select Pools > Pools.
2. Select More Tasks > Pool > Create.
3. In the Create Pool dialog, enter a Pool Name, noting that a pool name:
• cannot be “all,” “vault,” or “summary.”
• cannot have a space or period at its beginning or end.
• is case-sensitive.

4. If you want to create a directory pool (which is backward compatible with the previous version of DD System Manager), select the option “Create a directory backwards compatibility mode pool.” However, be aware that the advantages of using an MTree pool include the ability to:
   • make individual snapshots and schedule snapshots.
   • apply retention locks.
   • set an individual retention policy.
   • get compression information.
   • get data migration policies to the Retention Tier.
   • establish a storage space usage policy (quota support) by setting hard limits and soft limits.

5. Select OK to display the Create Pool Status dialog.

6. When the Create Pool Status dialog shows Completed, select Close. The pool is added to the Pools subtree, and you can now add virtual tapes to it.

   **CLI Equivalent**

   ```
   # vtl pool add VTL_Pool
   A VTL pool named VTL_Pool is added.
   ```

### Deleting pools

Before a pool can be deleted, you must have deleted any tapes contained within it. If replication is configured for the pool, the replication pair must also be deleted. Deleting a pool corresponds to renaming the MTree and then deleting it, which occurs at the next cleaning process.

**Procedure**

2. Select More Tasks > Pool > Delete.
3. In the Delete Pools dialog, select the checkbox of items to delete:
   • The name of each pool, or
   • Pool Names, to delete all pools.
4. Select Submit in the confirmation dialogs.
5. When the Delete Pool Status dialog shows Completed, select Close.

   The pool will have been removed from the Pools subtree.
Working with a selected pool


Pool tab

Table 80 Summary

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convert to MTree Pool</td>
<td>Select this button to convert a Directory pool to an MTree pool.</td>
</tr>
<tr>
<td>Type</td>
<td>Whether it is a Directory or MTree pool.</td>
</tr>
<tr>
<td>Tape Count</td>
<td>The number of tapes in the pool.</td>
</tr>
<tr>
<td>Capacity</td>
<td>The total configured data capacity of tapes in the pool, in GiB (Gibibytes, base-2 equivalent of GB, Gigabytes).</td>
</tr>
<tr>
<td>Logical Used</td>
<td>The amount of space used on virtual tapes in the pool.</td>
</tr>
<tr>
<td>Compression</td>
<td>The average amount of compression achieved for data on tapes in the pool.</td>
</tr>
</tbody>
</table>

Table 81 Pool Tab: Cloud Data Movement - Protection Distribution

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pool type (%)</td>
<td>VTL Pool and Cloud (if applicable), with the current percentage of data in parentheses.</td>
</tr>
<tr>
<td>Name</td>
<td>Name of the local VTL pool, or cloud provider.</td>
</tr>
<tr>
<td>Logical Used</td>
<td>The amount of space used on virtual tapes in the pool.</td>
</tr>
<tr>
<td>Tape Count</td>
<td>The number of tapes in the pool.</td>
</tr>
</tbody>
</table>

Table 82 Pool Tab: Cloud Data Movement - Cloud Data Movement Policy

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy</td>
<td>Age of tapes in days, or manual selection.</td>
</tr>
<tr>
<td>Older Than</td>
<td>Age threshold for an age-based data movement policy.</td>
</tr>
<tr>
<td>Cloud Unit</td>
<td>Destination cloud unit.</td>
</tr>
</tbody>
</table>

Tape tab

Table 83 Tape controls

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create</td>
<td>Create a new tape.</td>
</tr>
<tr>
<td>Delete</td>
<td>Delete the selected tapes.</td>
</tr>
<tr>
<td>Copy</td>
<td>Make a copy of a tape.</td>
</tr>
</tbody>
</table>
Table 83 Tape controls (continued)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Move between Pool</td>
<td>Move the selected tapes to a different pool.</td>
</tr>
<tr>
<td>Select for Cloud Move</td>
<td>Schedule the selected tapes for migration to Cloud Tier.</td>
</tr>
<tr>
<td>Unselect from Cloud Move</td>
<td>Remove the selected tapes from the schedule for migration to Cloud Tier.</td>
</tr>
<tr>
<td>Recall Cloud Tapes</td>
<td>Recall the selected tapes from Cloud Tier.</td>
</tr>
<tr>
<td>Move to Cloud Now</td>
<td>Migrate the selected tapes to Cloud Tier without waiting for the next scheduled migration.</td>
</tr>
</tbody>
</table>

a. This option is only available if the data movement policy is configured for manual selection.

Table 84 Tape information

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barcode</td>
<td>Tape barcode.</td>
</tr>
<tr>
<td>Size</td>
<td>Maximum size of the tape.</td>
</tr>
<tr>
<td>Physical Used</td>
<td>Physical storage capacity used by the tape.</td>
</tr>
<tr>
<td>Compression</td>
<td>Compression ratio on the tape.</td>
</tr>
<tr>
<td>Location</td>
<td>Location of the tape.</td>
</tr>
<tr>
<td>Modification Time</td>
<td>Last time the tape was modified.</td>
</tr>
<tr>
<td>Recall Time</td>
<td>Last time the tape was recalled.</td>
</tr>
</tbody>
</table>

Replication tab

Table 85 Replication

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>The name of the pool.</td>
</tr>
<tr>
<td>Configured</td>
<td>Whether replication is configured for this pool: yes or no.</td>
</tr>
<tr>
<td>Remote Source</td>
<td>Contains an entry only if the pool is replicated from another DD system.</td>
</tr>
<tr>
<td>Remote Destination</td>
<td>Contains an entry only if the pool replicates to another DD system.</td>
</tr>
</tbody>
</table>

You can also select the Replication Detail button, at the top right, to go directly to the Replication information panel for the selected pool.

From either the Virtual Tape Libraries or Pools area, from the More Tasks menu, you can create, delete, move, copy, or search for a tape in the pool.

From the Pools area, from the More Tasks menu, you can rename or delete a pool.
Converting a directory pool to an MTree pool

MTree pools have many advantages over directory pools. See the Creating pools section for more information.

Procedure

1. Make sure the following prerequisites have been met:
   - The source and destination pools must have been synchronized, so that the number of tapes, and the data on each side, remains intact.
   - The directory pool must not be a replication source or destination.
   - The file system must not be full.
   - The file system must not have reached the maximum number of MTrees allowed (100).
   - There must not already be an MTree with the same name.
   - If the directory pool is being replicated on multiple systems, those replicating systems must be known to the managing system.
   - If the directory pool is being replicated to an older DD OS (for example, from DD OS 5.5 to DD OS 5.4), it cannot be converted. As a workaround:
     - Replicate the directory pool to a second DD system.
     - Replicate the directory pool from the second DD system to a third DD system.
     - Remove the second and third DD systems from the managing DD system's network.
     - On any of the systems running DD OS 5.5, from the Pools submenu, select Pools and a directory pool. In the Pools tab, select Convert to MTree Pool.
   2. With the directory pool you wish to convert highlighted, choose Convert to MTree Pool.
   3. Select OK in the Convert to MTree Pool dialog.
   4. Be aware that conversion affects replication in the following ways:
      - DD VTL is temporarily disabled on the replicated systems during conversion.
      - The destination data is copied to a new pool on the destination system to preserve the data until the new replication is initialized and synced. Afterward, you may safely delete this temporarily copied pool, which is named CONVERTED-pool, where pool is the name of the pool that was upgraded (or the first 18 characters for long pool names). [This applies only to DD OS 5.4.1.0 and later.]
      - The target replication directory will be converted to MTree format. [This applies only to DD OS 5.2 and later.]
      - Replication pairs are broken before pool conversion and re-established afterward if no errors occur.
      - DD Retention Lock cannot be enabled on systems involved in MTree pool conversion.

Moving tapes between pools

If they reside in the vault, tapes can be moved between pools to accommodate replication activities. For example, pools are needed if all tapes were created in the Default pool, but you later
need independent groups for replicating groups of tapes. You can create named pools and re-organize the groups of tapes into new pools.

**About this task**

**Note:** You cannot move tapes from a tape pool that is a directory replication source. As a workaround, you can:

- Copy the tape to a new pool, then delete the tape from the old pool.
- Use an MTree pool, which allows you to move tapes from a tape pool that is a directory replication source.

**Procedure**

1. With a pool highlighted, select **More Tasks > Tapes > Move**.

   Note that when started from a pool, the Tapes Panel allows tapes to be moved only between pools.

2. In the Move Tapes dialog, enter information to search for the tapes to move, and select **Search**:

   **Table 86 Move Tapes dialog**

<table>
<thead>
<tr>
<th>Field</th>
<th>User input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Location cannot be changed.</td>
</tr>
<tr>
<td>Pool</td>
<td>Select the name of the pool where the tapes reside. If no pools have been</td>
</tr>
<tr>
<td></td>
<td>created, use the Default pool.</td>
</tr>
<tr>
<td>Barcode</td>
<td>Specify a unique barcode, or leave the default (*) to import a group of tapes.</td>
</tr>
<tr>
<td></td>
<td>Barcode allows the wildcards ? and *, where ? matches any single character</td>
</tr>
<tr>
<td></td>
<td>and * matches 0 or more characters.</td>
</tr>
<tr>
<td>Count</td>
<td>Enter the maximum number of tapes you want to be returned to you. If you</td>
</tr>
<tr>
<td></td>
<td>leave this blank, the barcode default (*) is used.</td>
</tr>
<tr>
<td>Tapes Per Page</td>
<td>Select the maximum number of tapes to display per page. Possible values are</td>
</tr>
<tr>
<td></td>
<td>15, 30, and 45.</td>
</tr>
<tr>
<td>Items Selected</td>
<td>Shows the number of tapes selected across multiple pages -- updated</td>
</tr>
<tr>
<td></td>
<td>automatically for each tape selection.</td>
</tr>
</tbody>
</table>

3. From the search results list, select the tapes to move.

4. From the Select Destination: Location list, select the location of the pool to which tapes are to be moved. This option is available only when started from the (named) Pool view.

5. Select **Next**.

6. From the Move Tapes view, verify the summary information and tape list, and select **Submit**.

7. Select **Close** in the status window.

**Copying tapes between pools**

Tapes can be copied between pools, or from the vault to a pool, to accommodate replication activities. This option is available only when started from the (named) Pool view.

**Procedure**

1. With a pool highlighted, select **More Tasks > Tapes > Copy**.
2. In the Copy Tapes Between Pools dialog, select the checkboxes of tapes to copy, or enter information to search for the tapes to copy, and select **Search**: 

**Table 87 Copy Tapes Between Pools dialog**

<table>
<thead>
<tr>
<th>Field</th>
<th>User input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Select either a library or the <strong>Vault</strong> for locating the tape. While tapes always show up in a pool (under the Pools menu), they are technically in either a library or the vault, but not both, and they are never in two libraries at the same time. Use the import/export options to move tapes between the vault and a library.</td>
</tr>
<tr>
<td>Pool</td>
<td>To copy tapes between pools, select the name of the pool where the tapes currently reside. If no pools have been created, use the <strong>Default</strong> pool.</td>
</tr>
<tr>
<td>Barcode</td>
<td>Specify a unique barcode, or leave the default (*) to import a group of tapes. Barcode allows the wildcards ? and *, where ? matches any single character and + matches 0 or more characters.</td>
</tr>
<tr>
<td>Count</td>
<td>Enter the maximum number of tapes you want to be imported. If you leave this blank, the barcode default (*) is used.</td>
</tr>
<tr>
<td>Tapes Per Page</td>
<td>Select the maximum number of tapes to display per page. Possible values are 15, 30, and 45.</td>
</tr>
<tr>
<td>Items/Selected</td>
<td>Shows the number of tapes selected across multiple pages – updated automatically for each tape selection.</td>
</tr>
</tbody>
</table>

3. From the search results list, select the tapes to copy.

4. From the Select Destination: Pool list, select the pool where tapes are to be copied. If a tape with a matching barcode already resides in the destination pool, an error is displayed, and the copy aborts.

5. Select **Next**.

6. From the Copy Tapes Between Pools dialog, verify the summary information and the tape list, and select **Submit**.

7. Select **Close** on the Copy Tapes Between Pools Status window.

**Renaming pools**

A pool can be renamed only if none of its tapes is in a library.

**Procedure**

1. Select **Pools > Pools > pool**.

2. Select **More Tasks > Pool > Rename**.

3. In the Rename Pool dialog, enter the new Pool Name, with the caveat that this name:
   - cannot be “all,” “vault,” or “summary.”
   - cannot have a space or period at its beginning or end.
   - is case-sensitive.

4. Select **OK** to display the Rename Pool status dialog.

5. After the Rename Pool status dialog shows **Completed**, select **OK**.

   The pool will have been renamed in the Pools subtree in both the Pools and the Virtual Tape Libraries areas.
This chapter includes:

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- Prerequisites for replication configuration ..................................... 333
- Replication version compatibility .................................................. 335
- Replication types ........................................................................ 337
- Using DD Encryption with DD Replicator ...................................... 342
- Replication topologies ................................................................. 343
- Managing replication ................................................................. 347
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- Using collection replication for disaster recovery with SMT .......... 368
DD Replicator overview

DD Replicator provides automated, policy-based, network-efficient, and encrypted replication for DR (disaster recovery) and multi-site backup and archive consolidation. DD Replicator asynchronously replicates only compressed, deduplicated data over a WAN (wide area network).

DD Replicator performs two levels of deduplication to significantly reduce bandwidth requirements: local and cross-site deduplication. Local deduplication determines the unique segments to be replicated over a WAN. Cross-site deduplication further reduces bandwidth requirements when multiple sites are replicating to the same destination system. With cross-site deduplication, any redundant segment previously transferred by any other site, or as a result of a local backup or archive, will not be replicated again. This improves network efficiency across all sites and reduces daily network bandwidth requirements up to 99%, making network-based replication fast, reliable, and cost-effective.

In order to meet a broad set of DR requirements, DD Replicator provides flexible replication topologies, such as full system mirroring, bi-directional, many-to-one, one-to-many, and cascaded. In addition, you can choose to replicate either all or a subset of the data on your DD system. For the highest level of security, DD Replicator can encrypt data being replicated between DD systems using the standard SSL (Secure Socket Layer) protocol.

DD Replicator scales performance and supported fan-in ratios to support large enterprise environments.

Before getting started with DD Replicator, note the following general requirements:

- DD Replicator is a licensed product. See your Dell EMC sales representative to purchase licenses.

- You can usually replicate only between machines that are within two releases of each other, for example, from 6.0 to 6.2. However, there may be exceptions to this (as a result of atypical release numbering), so review the tables in the Replication version compatibility section, or check with your Dell EMC representative.

- If you are unable to manage and monitor DD Replicator from the current version of the DD System Manager, use the replication commands described in the DD OS Command Reference Guide.
Prerequisites for replication configuration

Before configuring a replication, review the following prerequisites to minimize initial data transfer time, prevent overwriting of data, etc.

- **Contexts** – Determine the maximum number of contexts for your DD systems by reviewing the replication streams numbers in the following table.

Table 88 Data streams sent to a protection system

<table>
<thead>
<tr>
<th>Model</th>
<th>RAM / NVRAM</th>
<th>Backup write streams</th>
<th>Backup read streams</th>
<th>Repl\textsuperscript{a} source streams</th>
<th>Repl\textsuperscript{a} dest streams</th>
<th>Mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD4200</td>
<td>128 GB / 4 GB</td>
<td>270</td>
<td>75</td>
<td>150</td>
<td>270</td>
<td>(w\leq270; r\leq75; \text{ReplSrc}\leq150; \text{ReplDest}\leq270; \text{ReplDest}+w\leq270; \text{Total}\leq270)</td>
</tr>
<tr>
<td>DD4500</td>
<td>192 GB / 4 GB</td>
<td>270</td>
<td>75</td>
<td>150</td>
<td>270</td>
<td>(w\leq270; r\leq75; \text{ReplSrc}\leq150; \text{ReplDest}\leq270; \text{ReplDest}+w\leq270; \text{Total}\leq270)</td>
</tr>
<tr>
<td>DD6300</td>
<td>48 or 96 GB / 8 GB</td>
<td>270</td>
<td>75</td>
<td>150</td>
<td>270</td>
<td>(w\leq270; r\leq75; \text{ReplSrc}\leq150; \text{ReplDest}\leq270; \text{ReplDest}+w\leq270; \text{Total}\leq270)</td>
</tr>
<tr>
<td>DD6800</td>
<td>192 GB / 8 GB</td>
<td>400</td>
<td>110</td>
<td>220</td>
<td>400</td>
<td>(w\leq400; r\leq110; \text{ReplSrc}\leq220; \text{ReplDest}\leq400; \text{ReplDest}+w\leq400; \text{Total}\leq400)</td>
</tr>
<tr>
<td>DD6900</td>
<td>288 GB / 16 GB</td>
<td>400</td>
<td>110</td>
<td>220</td>
<td>400</td>
<td>(w\leq400; r\leq110; \text{ReplSrc}\leq220; \text{ReplDest}\leq400; \text{ReplDest}+w\leq400; \text{Total}\leq400)</td>
</tr>
<tr>
<td>DD7200</td>
<td>128 or 256 GB / 4 GB</td>
<td>540</td>
<td>150</td>
<td>270</td>
<td>540</td>
<td>(w\leq540; r\leq150; \text{ReplSrc}\leq270; \text{ReplDest}\leq540; \text{ReplDest}+w\leq540; \text{Total}\leq540)</td>
</tr>
<tr>
<td>DD9300</td>
<td>192 or 384 GB / 8 GB</td>
<td>800</td>
<td>220</td>
<td>440</td>
<td>800</td>
<td>(w\leq800; r\leq220; \text{ReplSrc}\leq440; \text{ReplDest}\leq800; \text{ReplDest}+w\leq800; \text{Total}\leq800)</td>
</tr>
<tr>
<td>DD9400</td>
<td>576 GB / 16 GB</td>
<td>800</td>
<td>220</td>
<td>440</td>
<td>800</td>
<td>(w\leq800; r\leq220; \text{ReplSrc}\leq440; \text{ReplDest}\leq800; \text{ReplDest}+w\leq800; \text{Total}\leq800)</td>
</tr>
<tr>
<td>DD9500</td>
<td>256 or 512 GB / 8 GB</td>
<td>1885</td>
<td>300</td>
<td>540</td>
<td>1080</td>
<td>(w\leq1885; r\leq300; \text{ReplSrc}\leq540; \text{ReplDest}\leq1080; \text{ReplDest}+w\leq1080; \text{Total}\leq1885)</td>
</tr>
<tr>
<td>DD9800</td>
<td>256 or 768 GB / 8 GB</td>
<td>1885</td>
<td>300</td>
<td>540</td>
<td>1080</td>
<td>(w\leq1885; r\leq300; \text{ReplSrc}\leq540; \text{ReplDest}\leq1080; \text{ReplDest}+w\leq1080; \text{Total}\leq1885)</td>
</tr>
<tr>
<td>DD9900</td>
<td>1152 GB / 16 GB</td>
<td>1885</td>
<td>300</td>
<td>540</td>
<td>1080</td>
<td>(w\leq1885; r\leq300; \text{ReplSrc}\leq540; \text{ReplDest}\leq1080; \text{ReplDest}+w\leq1080; \text{Total}\leq1885)</td>
</tr>
<tr>
<td>Model</td>
<td>RAM / NVRAM</td>
<td>Backup write streams</td>
<td>Backup read streams</td>
<td>Repl&lt;sup&gt;a&lt;/sup&gt; source streams</td>
<td>Repl&lt;sup&gt;a&lt;/sup&gt; dest streams</td>
<td>Mixed</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------------------</td>
<td>----------------------</td>
<td>---------------------</td>
<td>----------------------------------</td>
<td>------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>DD VE 8 TB</td>
<td>8 GB / 512 MB</td>
<td>20</td>
<td>16</td>
<td>20</td>
<td>20</td>
<td>w&lt;= 20; r&lt;= 16; ReplSrc&lt;=20; ReplDest&lt;=20; +w&lt;=20; w+r+ReplSrc &lt;=20; Total&lt;=20</td>
</tr>
<tr>
<td>DD VE 16 TB</td>
<td>16 GB / 512 MB or 24 GB / 1 GB</td>
<td>45</td>
<td>30</td>
<td>45</td>
<td>45</td>
<td>w&lt;= 45; r&lt;= 30; ReplSrc&lt;=45; ReplDest&lt;=45; +w&lt;=45; w+r+ReplSrc &lt;=45; Total&lt;=45</td>
</tr>
<tr>
<td>DD VE 32 TB</td>
<td>24 GB / 1 GB</td>
<td>90</td>
<td>50</td>
<td>90</td>
<td>90</td>
<td>w&lt;= 90; r&lt;= 50; ReplSrc&lt;=90; ReplDest&lt;=90; +w&lt;=90; w+r+ReplSrc &lt;=90; Total&lt;=90</td>
</tr>
<tr>
<td>DD VE 48 TB</td>
<td>36 GB / 1 GB</td>
<td>90</td>
<td>50</td>
<td>90</td>
<td>90</td>
<td>w&lt;= 90; r&lt;= 50; ReplSrc&lt;=90; ReplDest&lt;=90; +w&lt;=90; w+r+ReplSrc &lt;=90; Total&lt;=90</td>
</tr>
<tr>
<td>DD VE 64 TB</td>
<td>48 GB / 1 GB</td>
<td>90</td>
<td>50</td>
<td>90</td>
<td>90</td>
<td>w&lt;= 90; r&lt;= 50; ReplSrc&lt;=90; ReplDest&lt;=90; +w&lt;=90; w+r+ReplSrc &lt;=90; Total&lt;=90</td>
</tr>
<tr>
<td>DD VE 96 TB</td>
<td>64 GB / 2 GB</td>
<td>180</td>
<td>50</td>
<td>90</td>
<td>180</td>
<td>w&lt;= 180; r&lt;= 50; ReplSrc&lt;=180; ReplDest&lt;=180; +w&lt;=180; w+r+ReplSrc &lt;=180; Total&lt;=180</td>
</tr>
<tr>
<td>DD3300 4 TB</td>
<td>12 GB (virtual memory) / 512 MB</td>
<td>20</td>
<td>16</td>
<td>30</td>
<td>20</td>
<td>w&lt;= 20; r&lt;= 16; ReplSrc&lt;=30; ReplDest&lt;=20; +w&lt;=20; w+r+ReplSrc &lt;=30; Total&lt;=30</td>
</tr>
<tr>
<td>DD3300 8 TB</td>
<td>32 GB (virtual memory) / 1.536 GB</td>
<td>90</td>
<td>50</td>
<td>90</td>
<td>90</td>
<td>w&lt;= 90; r&lt;= 50; ReplSrc&lt;=90; ReplDest&lt;=90; +w&lt;=90; w+r+ReplSrc &lt;=90; Total&lt;=90</td>
</tr>
<tr>
<td>DD3300 16 TB</td>
<td>32 GB (virtual memory) / 1.536 GB</td>
<td>90</td>
<td>50</td>
<td>90</td>
<td>90</td>
<td>w&lt;= 90; r&lt;= 50; ReplSrc&lt;=90; ReplDest&lt;=90; +w&lt;=90; w+r+ReplSrc &lt;=90; Total&lt;=90</td>
</tr>
<tr>
<td>DD3300 32 TB</td>
<td>46 GB (virtual memory) / 1.536 GB</td>
<td>90</td>
<td>50</td>
<td>90</td>
<td>90</td>
<td>w&lt;= 90; r&lt;= 50; ReplSrc&lt;=90; ReplDest&lt;=90; +w&lt;=90; w+r+ReplSrc &lt;=90; Total&lt;=140</td>
</tr>
</tbody>
</table>
Table 88 Data streams sent to a protection system (continued)

a. DirRepl, OptDup, MTreeRepl streams

- **Compatibility** – If you are using DD systems running different versions of DD OS, review the next section on Replication Version Compatibility.

- **Initial Replication** – If the source holds a lot of data, the initial replication operation can take many hours. Consider putting both DD systems in the same location with a high-speed, low-latency link. After the first replication, you can move the systems to their intended locations because only new data will be sent.

- **Bandwidth Delay Settings** – Both the source and destination must have the same bandwidth delay settings. These tuning controls benefit replication performance over higher latency links by controlling the TCP (transmission control protocol) buffer size. The source system can then send enough data to the destination while waiting for an acknowledgment.

- **Only One Context for Directories/Subdirectories** – A directory (and its subdirectories) can be in only one context at a time, so be sure that a subdirectory under a source directory is not used in another directory replication context.

- **Adequate Storage** – At a minimum, the destination must have the same amount of space as the source.

- **Destination Empty for Directory Replication** – The destination directory must be empty for directory replication, or its contents no longer needed, because it will be overwritten.

- **Security** – DD OS requires that port 3009 be open in order to configure secure replication over an Ethernet connection.

**Replication version compatibility**

To use DD systems running different versions of DD OS for a source or destination, the following tables provide compatibility information for single-node, DD Retention Lock, MTree, directory, collection, delta (low bandwidth optimization), and cascaded replication.

In general:

- For DD Boost or DD Boost OST, see the *DD Boost for Partner Integration Administration Guide* or the *DD Boost for OpenStorage Administration Guide* for supported configurations.

- MTree and directory replication cannot be used simultaneously for replicating the same data.

- The recovery procedure is valid for all supported replication configurations.

- File migration is supported whenever collection replication is supported.

- For MTree replication, directory replication, or managed file replication, if a DD OS 7.1 source is configured to replicate to a target running DD OS 6.2 with gz or gzfast compression, the target system must be upgraded to DD OS 6.2.0.35 or higher.

- For collection replication, if a DD OS 7.1 source is configured to replicate to a target running DD OS 6.2, the target system must use gzfast for local compression.

- For MTree replication from a source DD system running DD OS 6.0 to a target DD system running an earlier version of DD OS, the replication process behaves according to the older version of DD OS on the destination DD system. If a restore operation or cascade replication is performed from the destination DD system, no virtual synthetics are applied.

- For cascaded configurations, the maximum number of hops is two, that is, three DD systems. Directory-to-MTree migration supports backward compatibility up to two previous releases. See *Directory-to-MTree replication migration* on page 364 for more information about directory-to-Mtree-migration.
One-to-many, many-to-one, and cascaded replication support up to three consecutive DD OS release families, as seen in these figures.

**Figure 11** Valid replication configurations

In these tables:

- Each DD OS release includes all releases in that family, for example, DD OS 7.1 includes 7.1.0.5, 7.1.0.10, etc.
- c = collection replication
- dir = directory replication
- m = MTree replication
- del = delta (low bandwidth optimization) replication
- dest = destination
- src = source
- NA = not applicable
Table 89  Configuration: single-node to single-node

<table>
<thead>
<tr>
<th>src/dest</th>
<th>6.0 (dest)</th>
<th>6.1 (dest)</th>
<th>6.2 (dest)</th>
<th>7.0 (dest)</th>
<th>7.1 (dest)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.0 (src)</td>
<td>c, dir, del, m</td>
<td>dir, del, m</td>
<td>dir, del, m</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>6.1 (src)</td>
<td>dir, del, m</td>
<td>c, dir, del, m</td>
<td>dir, del, m</td>
<td>dir, del, m</td>
<td>NA</td>
</tr>
<tr>
<td>6.2 (src)</td>
<td>dir, del, m</td>
<td>dir, del, m</td>
<td>c, dir, del, m</td>
<td>dir, del, m</td>
<td>dir, del, m</td>
</tr>
<tr>
<td>7.0 (src)</td>
<td>NA</td>
<td>dir, del, m</td>
<td>dir, del, m</td>
<td>c, dir, del, m</td>
<td>dir, del, m</td>
</tr>
<tr>
<td>7.1 (src)</td>
<td>NA</td>
<td>NA</td>
<td>dir, del, m</td>
<td>dir, del, m</td>
<td>c, dir, del, m</td>
</tr>
</tbody>
</table>

TLS version support

By default, the system supports TLS versions 1.0, 1.1, and 1.2. However, it is possible to configure the system to support TLS version 1.2 only by changing the system parameter REPL_SSL_DISABLE_TLSV1_0. Changing the system parameter requires SE access to the system. Contact Dell EMC Support if this change is required.

Replication types

Replication typically consists of a source DD system (which receives data from a backup system) and one or more destination DD systems. Each DD system can be the source and/or the destination for replication contexts. During replication, each DD system can perform normal backup and restore operations.

Each replication type establishes a context associated with an existing directory or MTree on the source. The replicated context is created on the destination when a context is established. The context establishes a replication pair, which is always active, and any data landing in the source will be copied to the destination at the earliest opportunity. Paths configured in replication contexts are absolute references and do not change based on the system in which they are configured.

A protection system can be set up for directory, collection, or MTree replication.

- **Directory replication** provides replication at the level of individual directories.
- **Collection replication** duplicates the entire data store on the source and transfers that to the destination, and the replicated volume is read-only.
- **MTree replication** replicates entire MTrees (that is, a virtual file structure that enables advanced management). Media pools can also be replicated, and by default, an MTree is created for replication. (A media pool can also be created in backward-compatibility mode that, when replicated, will be a directory replication context.)

For any replication type, note the following requirements:

- A destination system must have available storage capacity that is at least the size of the expected maximum size of the source directory. Be sure that the destination system has enough network bandwidth and disk space to handle all traffic from replication sources.
- The file system must be enabled or, based on the replication type, will be enabled as part of the replication initialization.
- The source must exist.
- The destination must not exist.
- The destination will be created when a context is built and initialized.
- After replication is initialized, ownership and permissions of the destination are always identical to those of the source.
In the replication command options, a specific replication pair is always identified by the destination.

Both systems must have an active, visible route through the IP network so that each system can resolve its partner's host name.

The choice of replication type depends on your specific needs. The next sections provide descriptions and features of these three types, plus a brief introduction to Managed File Replication, which is used by DD Boost.

**Managed file replication**

*Managed file replication*, which is used by DD Boost, is a type of replication that is managed and controlled by backup software.

With managed file replication, backup images are directly transferred from one DD system to another, one at a time, at the request of the backup software.

The backup software keeps track of all copies, allowing easy monitoring of replication status and recovery from multiple copies.

Managed file replication offers flexible replication topologies including full system mirroring, bi-directional, many-to-one, one-to-many, and cascaded, enabling efficient cross-site deduplication.

Here are some additional points to consider about managed file replication:

- Replication contexts do not need to be configured.
- Lifecycle policies control replication of information with no intervention from the user.
- DD Boost will build and tear down contexts as needed on the fly.

For more information, see the `ddboost file-replication` commands in the *DD OS Command Reference Guide*.

**Directory replication**

*Directory replication* transfers deduplicated data within a DD file system directory configured as a replication source to a directory configured as a replication destination on a different system.

With directory replication, a DD system can simultaneously be the source of some replication contexts and the destination of other contexts. And that DD system can also receive data from backup and archive applications while it is replicating data.

Directory replication has the same flexible network deployment topologies and cross-site deduplication effects as managed file replication (the type used by DD Boost).

Here are some additional points to consider when using directory replication:

- Do not mix CIFS and NFS data within the same directory. A single destination DD system can receive backups from both CIFS clients and NFS clients as long as separate directories are used for CIFS and NFS.
- Any directory can be in only one context at a time. A parent directory may not be used in a replication context if a child directory of that parent is already being replicated.
- Renaming (moving) files or tapes *into or out of* a directory replication source directory is *not* permitted. Renaming files or tapes *within* a directory replication source directory is *permitted*.
- A destination DD system must have available storage capacity of at least the post-compressed size of the expected maximum post-compressed size of the source directory.
- When replication is initialized, a destination directory is created automatically.
- After replication is initialized, ownership and permissions of the destination directory are always identical to those of the source directory. As long as the context exists, the destination directory is kept in a read-only state and can receive data only from the source directory.
• At any time, due to differences in global compression, the source and destination directory can differ in size.

Folder Creation Recommendations

Directory replication replicates data at the level of individual subdirectories under /data/col1/backup.

To provide a granular separation of data you must create, from a host system, other directories (DirA, DirB, etc.) within the /backup Mtree. Each directory should be based on your environment and the desire to replicate those directories to another location. You will not replicate the entire /backup MTtree, but instead would set up replication contexts on each subdirectory underneath /data/col1/backup/ (ex. /data/col1/backup/DirC). The purpose of this threefold:

• It allows control of the destination locations as DirA may go to one site and DirB may go to another.
• This level of granularity allows management, monitoring, and fault isolation. Each replication context can be paused, stopped, destroyed, or reported on.
• Performance is limited on a single context. The creation of multiple contexts can improve aggregate replication performance.
• As a general recommendation, approximately 5 - 10 contexts may be required to distribute replication load across multiple replication streams. This must be validated against the site design and the volume and composition of the data at the location.

Note: Recommending a number of contexts is a design-dependent issue, and in some cases, significant implications are attached to the choices made about segregating data for the purposes of optimizing replication. Data is usually optimized for the manner in which it will rest – not in manner with which it will replicate. Keep this in mind when altering a backup environment.

MTree replication

MTree replication is used to replicate MTrees between DD systems. Periodic snapshots are created on the source, and the differences between them are transferred to the destination by leveraging the same cross-site deduplication mechanism used for directory replication. This ensures that the data on the destination is always a point-in-time copy of the source, with file consistency. This also reduces replication of churn in the data, leading to more efficient utilization of the WAN.

While directory replication must replicate every change to the content of the source directory in order, the use of snapshots with MTree replication enables some intermediate changes to the source to be skipped. Skipping these changes further reduces the amount of data that is sent over the network, and therefore reduces replication lag.

With MTree replication, a DD system can be simultaneously the source of some replication contexts and the destination of other contexts. And that DD system can also receive data from backup and archive applications while it is replicating data.

MTree replication has the same flexible network deployment topologies and cross-site deduplication effects as managed file replication (the type used by DD Boost).

Here are some additional points to consider when using MTree replication:

• When replication is initialized, a destination read-only MTree is created automatically.
• Data can be logically segregated into multiple MTrees to promote greater replication performance.
• Snapshots must be created on source contexts.
• Snapshots cannot be created on a replication destination.
Snapshots are replicated with a fixed retention of one year; however, the retention is adjustable on the destination and must be adjusted there.

Snapshots are not automatically deleted after breaking a replication context, and must be expired when they are no longer required to prevent the system from filling up. The following KB articles provide more information:

- Data Domain - Checking for Snapshots that are No Longer Needed, available at https://support.emc.com/kb/336461.

Replication contexts must be configured on both the source and the destination.

Replicating DD VTL tape cartridges (or pools) simply means replicating MTrees or directories that contain DD VTL tape cartridges. Media pools are replicated by MTree replication, as a default. A media pool can be created in backward-compatibility mode and can then be replicated via directory-based replication. You cannot use the pool:// syntax to create replication contexts using the command line. When specifying pool-based replication in DD System Manager, either directory or MTree replication will be created, based on the media pool type.

Replicating directories under an MTree is not permitted.

A destination DD system must have available storage capacity of at least the post-compressed size of the expected maximum post-compressed size of the source MTree.

After replication is initialized, ownership and permissions of the destination MTree are always identical to those of the source MTree. If the context is configured, the destination MTree is kept in a read-only state and can receive data only from the source MTree.

At any time, due to differences in global compression, the source and destination MTree can differ in size.

DD Retention Lock Compliance is supported with MTree replication, by default. If DD Retention Lock is licensed on a source, the destination must also have a DD Retention Lock license, or replication will fail. (To avoid this situation, you must disable DD Retention Lock.) If DD Retention Lock is enabled on a replication context, a replicated destination context will always contain data that is retention locked.

DD Boost users should have the same user ID (UID) and primary group ID (GID) on both the source and destination systems.

MTree replication details

MTree replication involves the following steps:

1. A snapshot is created on the source replication context.
2. This snapshot is compared to the last previous snapshot.
3. Any differences between the two snapshots are sent to the destination replication context.
4. On the destination, the MTree is updated but no files are exposed to the user until all changes are received by the destination system.

These steps are repeated any time a snapshot is created on the source MTree. The following situations trigger the creation of a snapshot on the source system:

- System–generated periodic snapshot—When the replication lag is more than 15 minutes and there is no snapshot being currently replicated.
- User–created snapshot—At a time specified by the user, such as after the completion of a backup job.
For examples showing the interaction of different types of snapshots, see the KB article *How MTree Replication Works*, available at [https://support.emc.com/kb/180832](https://support.emc.com/kb/180832).

After the snapshot is replicated, the connection to the destination is closed. A new connection between the source and destination is established when the next snapshot is replicated.

**Automatic Multi-Streaming (AMS)**

Automatic Multi-Streaming (AMS) improves MTree replication performance. It uses multiple streams to replicate a single large file (32 GB or larger) to improve network bandwidth utilization during replication. By increasing the replication speed for individual files, AMS also improves the pipeline efficiency of the replication queue, and provides improved replication throughput and reduced replication lag.

When the workload presents multiple optimization choices, AMS automatically selects the best option for the workload. For example, if the workload is a large file with fastcopy attributes, the replication operation uses fastcopy optimization to avoid the overhead of scanning the file to identify unique segments between the replication pair. If the workload uses synthetics, replication uses synthetic replication on top of AMS to leverage local operations on the destination system for each replication stream to generate the file.

AMS is always enabled, and cannot be disabled.

**Collection replication**

Collection replication performs whole-system mirroring in a one-to-one topology, continuously transferring changes in the underlying collection, including all of the logical directories and files of the DD file system.

Collection replication does not have the flexibility of the other types, but it can provide higher throughput and support more objects with less overhead, which may work better for high-scale enterprise cases.

Collection replication replicates the entire `/data/col1` area from a source DD system to a destination DD system.

**Note:** Collection replication is not supported for cloud-tier enabled systems.

Here are some additional points to consider when using collection replication:

- No granular replication control is possible. All data is copied from the source to the destination producing a read-only copy.
- Collection replication requires that the storage capacity of the destination system be equal to, or greater than, the capacity of the source system. If the destination capacity is less than the source capacity, the available capacity on the source is reduced to the capacity of the destination.
- The DD system to be used as the collection replication destination must be empty before configuring replication. After replication is configured, this system is dedicated to receive data from the source system.
- With collection replication, all user accounts and passwords are replicated from the source to the destination. However, as of DD OS 5.5.1.0, other elements of configuration and user settings of the DD system are not replicated to the destination; you must explicitly reconfigure them after recovery.
- Collection replication is supported with DD Secure Multitenancy (SMT). Core SMT information, contained in the registry namespace, including the tenant and tenant-unit definitions with matching UUIDs is automatically transferred during replication operation. However, the following SMT information is not automatically included for replication, and must be configured manually on the destination system:
DD Replicator

- Alert notification lists for each tenant-unit
- All users assigned to the DD Boost protocol for use by SMT tenants, if DD Boost is configured on the system
- The default-tenant-unit associated with each DD Boost user, if any, if DD Boost is configured on the system

Using collection replication for disaster recovery with SMT on page 368 describes how to manually configure these items on the replication destination.

- DD Retention Lock Compliance supports collection replication.
- Collection replication is not supported in cloud tier-enabled systems.
- With collection replication, data in a replication context on the source system that has not been replicated cannot be processed for file system cleaning. If file system cleaning cannot complete because the source and destination systems are out of sync, the system reports the cleaning operation status as partial, and only limited system statistics are available for the cleaning operation. If collection replication is disabled, the amount of data that cannot be processed for file system cleaning increases because the replication source and destination systems remain out of sync. The KB article Data Domain: An overview of Data Domain File System (DDFS) clean/garbage collection (GC) phases, available from the Online Support site at https://support.emc.com, provides additional information.

- To enhance throughput in a high bandwidth environment, run the replication modify <destination> crepl-gc-gw-optim command to disable collection replication bandwidth optimization.

Using DD Encryption with DD Replicator

DD Replicator can be used with the optional DD Encryption feature, enabling encrypted data to be replicated using collection, directory, or MTree replication.

Replication contexts are always authenticated with a shared secret. That shared secret is used to establish a session key using a Diffie-Hellman key exchange protocol, and that session key is used to encrypt and decrypt the protection system encryption key when appropriate.

Each replication type works uniquely with encryption and offers the same level of security.

- Collection replication requires the source and destination to have the same encryption configuration, because the destination data is expected to be an exact replica of the source data. In particular, the encryption feature must be turned on or off at both the source and destination, and if the feature is turned on, the encryption algorithm and the system passphrases must also match. The parameters are checked during the replication association phase.
  
  During collection replication, the source transmits the data in encrypted form, and also transmits the encryption keys to the destination. The data can be recovered at the destination because the destination has the same passphrase and the same system encryption key.

  Note: Collection replication is not supported for cloud-tier enabled systems.

- MTree or directory replication does not require encryption configuration to be the same at both the source and destination. Instead, the source and destination securely exchange the destination’s encryption key during the replication association phase, and the data is re-encrypted at the source using the destination’s encryption key before transmission to the destination.

  If the destination has a different encryption configuration, the data transmitted is prepared appropriately. For example, if the feature is turned off at the destination, the source decrypts the data, and it is sent to the destination un-encrypted.

- In a cascaded replication topology, a replica is chained among three systems. The last system in the chain can be configured as a collection, MTree, or directory. If the last system is a
collection replication destination, it uses the same encryption keys and encrypted data as its source. If the last system is an MTree or directory replication destination, it uses its own key, and the data is encrypted at its source. The encryption key for the destination at each link is used for encryption. Encryption for systems in the chain works as in a replication pair.

Replication topologies

DD Replicator supports five replication topologies (one-to-one, one-to-one bidirectional, one-to-many, many-to-one, and cascaded). The tables in this section show (1) how these topologies work with three types of replication (MTree, directory, and collection) and (2) how mixed topologies are supported with cascaded replication.

In general:
- Single node (SN) systems support all replication topologies.
- Single node-to-single node (SN -> SN) can be used for all replication types.
- Collection replication cannot be configured from either an SN system to a DD high availability-enabled system, nor from a DD high availability-enabled system to an SN system.
- For MTtree and Directory replication, DD high availability systems are treated like SN systems.
- Collection replication cannot be configured on Cloud Tier-enabled systems.

In this table:
- SN = single node DD system without Cloud Tier
- SN + CT = single node DD system with Cloud Tier

<table>
<thead>
<tr>
<th>Topologies</th>
<th>MTree Replication</th>
<th>Directory Replication</th>
<th>Collection Replication</th>
</tr>
</thead>
<tbody>
<tr>
<td>one-to-one</td>
<td>SN -&gt; {SN</td>
<td>SN + CT}</td>
<td>SN -&gt; SN</td>
</tr>
<tr>
<td>one-to-one bidirectional</td>
<td>SN -&gt; {SN</td>
<td>SN + CT}</td>
<td>SN -&gt; SN</td>
</tr>
<tr>
<td>one-to-many</td>
<td>SN -&gt; {SN</td>
<td>SN + CT}</td>
<td>SN -&gt; SN</td>
</tr>
<tr>
<td>many-to-one</td>
<td>SN -&gt; {SN</td>
<td>SN + CT}</td>
<td>SN -&gt; SN</td>
</tr>
<tr>
<td>cascaded</td>
<td>SN -&gt; {SN</td>
<td>SN + CT}</td>
<td>SN -&gt; SN -&gt; SN</td>
</tr>
</tbody>
</table>

Cascaded replication supports mixed topologies where the second leg in a cascaded connection is different from the first type in a connection (for example, A -> B is directory replication, and B -> C is collection replication).

<table>
<thead>
<tr>
<th>Mixed Topologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>SN -&gt; Dir Repl -&gt; SN + CT -&gt; MTree Repl -&gt; SN + CT -&gt; MTree Repl</td>
</tr>
</tbody>
</table>
**Table 91 Mixed Topologies Supported with Cascaded Replication (continued)**

<table>
<thead>
<tr>
<th>Mixed Topologies</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SN – MTree Repl -&gt; SN – Col Repl -&gt; SN – Col Repl</td>
<td>SN – MTree Repl -&gt; SN + CT – Col Repl -&gt; SN + CT – Col Repl</td>
<td></td>
</tr>
</tbody>
</table>

**One-to-one replication**

The simplest type of replication is from a DD source system to a DD destination system, otherwise known as a one-to-one replication pair. This replication topology can be configured with directory, MTree, or collection replication types.

**Figure 12 One-to-one replication pair**

![One-to-one replication diagram](image)

Data flows from the source to the destination system.
Bi-directional replication

In a bi-directional replication pair, data from a directory or MTree on DD system A is replicated to DD system B, and from another directory or MTree on DD system B to DD system A.

Figure 13 Bi-directional replication

One-to-many replication

In one-to-many replication, data flows from a source directory or MTree on one DD system to several destination DD systems. You could use this type of replication to create more than two copies for increased data protection, or to distribute data for multi-site usage.

Figure 14 One-to-many replication

Data flows from a directory or MTree source system to many destination systems.
Many-to-one replication

In many-to-one replication, whether with MTree or directory, replication data flows from several source DD systems to a single destination DD system. This type of replication can be used to provide data recovery protection for several branch offices on a corporate headquarters' IT system.

Figure 15  Many-to-one replication

Cascaded replication

In a cascaded replication topology, a source directory or MTree is chained among three DD systems. The last hop in the chain can be configured as collection, MTree, or directory replication, depending on whether the source is directory or MTree.

For example, DD system A replicates one or more MTrees to DD system B, which then replicates those MTrees to DD system C. The MTrees on DD system B are both a destination (from DD system A) and a source (to DD system C).
Data recovery can be performed from the non-degraded replication pair context. For example:

- In the event DD system A requires recovery, data can be recovered from DD system B.
- In the event DD system B requires recovery, the simplest method is to perform a replication resync from DD system A to (the replacement) DD system B. In this case, the replication context from DD system B to DD system C should be broken first. After the DD system A to DD system B replication context finishes resync, a new DD system B to DD System C context should be configured and resynced.

Managing replication

You can manage replication using the DD System Manager) or the DD OS CLI.

About this task

To use a graphical user interface (GUI) to manage replication, log in to the DD System Manager.

Procedure

1. From the menu at the left of the DD System Manager, select Replication. If your license has not been added yet, select Add License.
2. Select Automatic or On-Demand (you must have a DD Boost license for on-demand).

CLI Equivalent

You can also log in at the CLI:

```
login as: sysadmin
Data Domain OS 6.0.x.x-12345
```
Replication status

*Replication Status* shows the system-wide count of replication contexts exhibiting a warning (yellow text) or error (red text) state, or if conditions are normal.

Summary view

The Summary view lists the configured replication contexts for a DD system, displaying aggregated information about the selected DD system – that is, summary information about the inbound and outbound replication pairs. The focus is the DD system, itself, and the inputs to it and outputs from it.

The Summary table can be filtered by entering a Source or Destination name, or by selecting a State (Error, Warning, or Normal).

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td>System and path name of the source context, with format <code>system.path</code>. For example, for directory <code>dir1</code> on system <code>dd9900-22</code>, you would see <code>dd9900-22.chaos.local/data/coll1/dir1</code>.</td>
</tr>
<tr>
<td>Destination</td>
<td>System and path name of destination context, with format <code>system.path</code>. For example, for MTree <code>MTree1</code> on system <code>dd9900-44</code>, you would see <code>dd9900-44.chaos.local/data/coll1/MTree1</code>.</td>
</tr>
<tr>
<td>Type</td>
<td>Type of context: MTree, directory (Dir), or Pool.</td>
</tr>
<tr>
<td>State</td>
<td>Possible states of replication pair status include:</td>
</tr>
<tr>
<td></td>
<td>• Normal – If the replica is Initializing, Replicating, Recovering, Resyncing, or Migrating.</td>
</tr>
<tr>
<td></td>
<td>• Idle – For MTree replication, this state can display if the replication process is not currently active or for network errors (such as the destination system being inaccessible).</td>
</tr>
<tr>
<td></td>
<td>• Warning – If there is an unusual delay for the first five states, or for the Uninitialized state.</td>
</tr>
<tr>
<td></td>
<td>• Error – Any possible error states, such as Disconnected.</td>
</tr>
<tr>
<td>Synced As Of Time</td>
<td>Timestamp for last automatic replication sync operation performed by the source. For MTree replication, this value is updated when a snapshot is exposed on the destination. For directory replication, it is updated when a sync point inserted by the source is applied.</td>
</tr>
<tr>
<td></td>
<td>Amount of pre-compressed data remaining to be replicated.</td>
</tr>
<tr>
<td>Completion Time (Est.)</td>
<td>Value is either Completed, or the estimated amount of time required to complete the replication data transfer based on the last 24 hours’ transfer rate.</td>
</tr>
</tbody>
</table>
Detailed information for a replication context

Selecting one replication context from the Summary view populates that context’s information in Detailed Information, Performance Graph, Completion Stats, and Completion Predictor.

**Table 93 Detailed Information**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Description</td>
<td>Message about state of replica.</td>
</tr>
<tr>
<td>Source</td>
<td>System and path name of source context, with format system.path. For example, for directory dir1 on system dd9900-22, you would see dd9900-22.chaos.local/data/ coll1/dirl.</td>
</tr>
<tr>
<td>Destination</td>
<td>System and path name of destination context, with format system.path. For example, for MTree MTree1 on system dd9900-44, you would see dd9900-44.chaos.local/data/ coll1/MTree1.</td>
</tr>
<tr>
<td>Connection Port</td>
<td>System name and listen port used for replication connection.</td>
</tr>
</tbody>
</table>

**Table 94 Performance Graph**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Comp Remaining</td>
<td>Pre-compressed data remaining to be replicated.</td>
</tr>
<tr>
<td>Pre-Comp Written</td>
<td>Pre-compressed data written on the source.</td>
</tr>
<tr>
<td>Post-Comp Replicated</td>
<td>Post-compressed data that has been replicated.</td>
</tr>
</tbody>
</table>

**Table 95 Completion Stats**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synced As Of Time</td>
<td>Timestamp for last automatic replication sync operation performed by the source. For MTree replication, this value is updated when a snapshot is exposed on the destination. For directory replication, it is updated when a sync point inserted by the source is applied. A value of unknown displays during replication initialization.</td>
</tr>
<tr>
<td>Completion Time (Est.)</td>
<td>Value is either Completed or the estimated amount of time required to complete the replication data transfer based on the last 24 hours’ transfer rate.</td>
</tr>
<tr>
<td>Pre-Comp Remaining</td>
<td>Amount of data remaining to be replicated.</td>
</tr>
<tr>
<td>Files Remaining</td>
<td>(Directory Replication Only) Number of files that have not yet been replicated.</td>
</tr>
<tr>
<td>Status</td>
<td>For source and destination endpoints, shows status (Enabled, Disabled, Not Licensed, etc.) of major components on the system, such as: Replication, File System</td>
</tr>
</tbody>
</table>
Table 95 Completion Stats (continued)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• DD Retention Lock</td>
</tr>
<tr>
<td></td>
<td>• DD Encryption at Rest</td>
</tr>
<tr>
<td></td>
<td>• DD Encryption over Wire</td>
</tr>
<tr>
<td></td>
<td>• Available Space</td>
</tr>
<tr>
<td></td>
<td>• Low Bandwidth Optimization</td>
</tr>
<tr>
<td></td>
<td>• Compression Ratio</td>
</tr>
<tr>
<td></td>
<td>• Low Bandwidth Optimization Ratio</td>
</tr>
</tbody>
</table>

**Completion Predictor**

The Completion Predictor is a widget for tracking a backup job’s progress and for predicting when replication will complete, for a selected context.

Creating a replication pair

Before creating a replication pair, make sure the destination does not exist, or you will get an error.

**Procedure**

1. Select Replication > Automatic > Summary tab > Create Pair.
2. In the Create Pair dialog, add information to create an inbound or outbound MTree, directory, collection, or pool replication pair, as described in the next sections.

Adding a DD system for replication

You may need to add a DD system as either a host or a destination before you can create a replication pair.

**About this task**

*Note:* Make sure the system being added is running a compatible DD OS version as described in Replication version compatibility on page 335.

**Procedure**

1. In the Create Pair dialog, select Add System.
2. For System, enter the hostname or IP address of the system to be added.
3. For User Name and Password, enter the sysadmin's user name and password.
4. Optionally, select More Options to enter a proxy IP address (or system name) of a system that cannot be reached directly. If configured, enter a custom port instead of the default port 3009.

*Note:* IPv6 addresses are supported only when adding a DD OS 5.5 or later system to a management system using DD OS 5.5 or later.

5. Select OK.

*Note:* If the system is unreachable after adding it to DD System Manager, make sure that there is a route from the managing system to the system being added. If a hostname (either a fully qualified domain name (FQDN) or non-FQDN) is entered, make sure it is resolvable on the managed system. Configure a domain name for the managed system.
system, ensure a DNS entry for the system exists, or ensure an IP address to hostname mapping is defined.

6. If the system certificate is not verified, the Verify Certificate dialog shows details about the certificate. Check the system credentials. Select OK if you trust the certificate, or select Cancel.

Creating a collection replication pair
See the Collection replication section for general information about this type of replication.

About this task
Before creating a collection replication pair, make sure:

- The storage capacity of the destination system is equal to, or greater than, that of the source system. (If the destination capacity is less than that of the source, the available capacity on the source is reduced to that of the destination.)
- The destination has been destroyed, and subsequently re-created, but not enabled.
- Each destination and each source is in only one context at a time.
- The file system is disabled on the replica, while configuring and enabling encryption on the source.
- The file system is disabled on the source, while configuring and enabling encryption on the replica.

Procedure
1. In the Create Pair dialog, select Collection from the Replication Type menu.
2. Select the source system hostname from the Source System menu.
3. Select the destination system hostname from the Destination System menu. The list includes only those hosts in the DD-Network list.
4. If you want to change any host connection settings, select the Advanced tab.
5. Select OK. Replication from the source to the destination begins.

Results
Test results returned the following performance guidelines for replication initialization. These are guidelines only, and actual performance seen in production environments may vary.

- Over a gibibit LAN: With a high enough shelf count to drive maximum input/output and ideal conditions, collection replication can saturate a 1GigE link (modulo 10% protocol overhead), as well as 400-900 MB/sec on 10gigE, depending on the platform.
- Over a WAN, performance is governed by the WAN link line speed, bandwidth, latency, and packet loss rate.

Creating an MTree, directory, or pool replication pair
See the MTree replication and Directory replication sections for general information about these types of replication.

About this task
When creating an MTree, directory, or pool replication pair:

- Make sure the replication is transiting\exiting the correct interface. When defining a replication context, the host names of the source and destination must resolve with forward and reverse lookups. To make the data transit alternate interfaces on the system, other than the default resolving interface, the replication context must be modified after creation. It may
be necessary to set up host files to ensure that contexts are defined on non-resolving (cross-over) interfaces.

- You can “reverse” the context for an MTree replication, that is, you can switch the destination and the source.
- Subdirectories within an MTree cannot be replicated, because the MTree, in its entirety, is replicated.
- The destination DD system must have available storage capacity of at least the post-compressed size of the expected maximum post-compressed size of the source directory or MTree.
- When replication is initialized, a destination directory is created automatically.
- A DD system can simultaneously be the source for one context and the destination for another context.

**Procedure**

1. In the Create Pair dialog, select **Directory**, **MTree** (default), or **Pool** from the Replication Type menu.
2. Select the source system hostname from the **Source System** menu.
3. Select the destination system hostname from the **Destination System** menu.
4. Enter the source path in the **Source Path** text box (notice the first part of the path is a constant that changes based on the type of replication chosen).
5. Enter the destination path in the **Destination Path** text box (notice the first part of the path is a constant that changes based on the type of replication chosen).
6. If you want to change any host connection settings, select the **Advanced** tab.
7. Select **OK**.

The Replication from the source to the destination begins.

Test results from returned the following guidelines for estimating the time needed for replication initialization.

These are guidelines only and may not be accurate in specific production environments.

- Using a T3 connection, 100ms WAN, performance is about 40 MiB/sec of pre-compressed data, which gives data transfer of:
  40 MiB/sec = 25 seconds/GiB = 3.456 TiB/day
- Using the base-2 equivalent of gigabit LAN, performance is about 80 MiB/sec of pre-compressed data, which gives data transfer of about double the rate for a T3 WAN.

**Example 2 CLI Equivalent**

Here is an example of creating MTree replication pairs at the CLI. In this example, the source system is `dd9900` and the destination system is `dlh5`. For details about usage in other scenarios, see the **DD OS Command Reference Guide**.

1. Create an MTree on the source system:
   ```bash
   sysadmin@dd9900# mtree create /data/col1/Oracle2
   MTree "/data/col1/Oracle2" created successfully.
   ```

2. Create the replication context in the destination system, using the full hostname.
   ```bash
   sysadmin@dlh5# replication add source mtree://dd9900.chaos.local/data/col1/Oracle2
   destination mtree://dlh5.chaos.local/data/col1/Oracle2
   ```

3. Create the replication context in the source, using the full hostname.
Example 2  CLI Equivalent (continued)

```
sysadmin@dd9900# replication add source mtree://dd9900.chaos.local/data/coll/Oracle2 destination mtree://dlh5.chaos.local/data/coll/Oracle2
```

4. To verify that the MTree replication context has been created, use the `replication show config` command.

The output is horizontally truncated in this example.

```
sysadmin@dlh5# replication show config
CTX  Source
----  -------------------------------------------
1  dir://dd9900.chaos.local/backup/Oracle2  dir://dlh5.chaos.local/backup/Oracle2
2  mtree://dd9900.chaos.local/data/coll/Oracle2 mtree://dlh5.chaos.local/data/coll/Oracle2
---  -------------------------------------------
* Used for recovery only.
```

5. To start replication between a source and destination, use the `replication initialize` command on the source. This command checks that the configuration and connections are correct and returns error messages if any problems occur.

```
sysadmin@dd9900# replication initialize mtree://dlh5.chaos.local/data/coll/Oracle2
(00:08) Waiting for initialize to start...
(00:10) Initialize started.
Use 'replication watch mtree://dlh5.chaos.local/data/coll/Oracle2' to monitor progress.
```

**Configuring bi-directional replication**

To create a bi-directional replication pair, use the directory or MTree replication pair procedure (for example, using mtree2) from host A to host B. Use the same procedure to create a replication pair (for example, using mtree1) from host B to host A. For this configuration, destination pathnames cannot be the same.

**Configuring one-to-many replication**

To create a one-to-many replication pair, use the directory or MTree replication pair procedure (for example, using mtree1) on host A to: (1) mtree1 on host B, (2) mtree1 on host C, and (3) mtree1 on host D. A replication recovery cannot be done to a source context whose path is the source path for other contexts; the other contexts must be broken and resynced after the recovery.

**Configuring many-to-one replication**

To create a many-to-one replication pair, use the directory or MTree replication pair procedure (for example, (1) mtree1 from host A to mtree1 on host C and (2) mtree2 on host B to mtree2 on host C.)

**Configuring cascaded replication**

To create a cascaded replication pair, use the directory or MTree replication pair procedure: (1) mtree1 on host A to mtree1 on host B, and (2) on host B, create a pair for mtree1 to mtree1 on host C. The final destination context (on host C in this example, but more than three hops are supported) can be a collection replica or a directory or MTree replica.
Disabling and enabling a replication pair

Disabling a replication pair temporarily pauses the active replication of data between a source and a destination. The source stops sending data to the destination, and the destination stops serving as an active connection to the source.

Procedure

1. Select one or more replication pairs in the Summary table, and select Disable Pair.
2. In the Display Pair dialog, select Next and then OK.
3. To resume operation of a disabled replication pair, select one or more replication pairs in the Summary table, and select Enable Pair to display the Enable Pair dialog.
4. Select Next and then OK. Replication of data is resumed.

CLI Equivalent

```
# replication disable {destination | all}
# replication enable {destination | all}
```

Deleting a replication pair

When a directory or MTree replication pair is deleted, the destination directory or MTree, respectively, becomes writable. When a collection replication pair is deleted, the destination DD system becomes a stand-alone read/write system, and the file system is disabled.

Procedure

1. Select one or more replication pairs in the Summary table, and select Delete Pair.
2. In the Delete Pair dialog, select Next and then OK. The replication pairs are deleted.

CLI Equivalent

```
Before running this command, always run the filesys disable command. Then, afterward, run the filesys enable command

# replication break {destination | all}
```

Certain situations may arise in which you must resynchronize replication to resolve an issue. For information about breaking and resynchronizing replication, see the KB article Break and Resync Directory Replication, available at https://support.emc.com/kb/180668.

Changing host connection settings

To direct traffic out of a specific port, modify a current context by altering the connection host parameter using a host name previously defined in the local hosts file to address the alternate system. That host name will correspond to the destination. The host entry will indicate an alternate destination address for that host. This may be required on both the source and destination systems.

Procedure

1. Select the replication pair in the Summary table, and select Modify Settings. You can also change these settings when you are performing Create Pair, Start Resync, or Start Recover by selecting the Advanced tab.
2. In the Modify Connection Settings dialog, modify any or all of these settings:
   a. **Use Low Bandwidth Optimization** – For enterprises with small data sets and 6 Mb/s or less bandwidth networks, DD Replicator can further reduce the amount of data to be sent using *low bandwidth optimization*. This enables remote sites with limited bandwidth
to use less bandwidth or to replicate and protect more of their data over existing networks. Low bandwidth optimization must be enabled on both the source and destination DD systems. If the source and destination have incompatible low bandwidth optimization settings, low bandwidth optimization will be inactive for that context. After enabling low bandwidth optimization on the source and destination, both systems must undergo a full cleaning cycle to prepare the existing data, so run `filesys clean` on both systems. The duration of the cleaning cycle depends on the amount of data on the DD system, but takes longer than a normal cleaning. For more information on the `filesys` commands, see the `DD OS Command Reference Guide`.

**Important:** Low bandwidth optimization is not supported for Collection Replication.

b. **Enable Encryption Over Wire** – DD Replicator supports encryption of data-in-flight by using standard SSL (Secure Socket Layer) protocol version 1.0.1, which uses the ADH-AES256-GCM-SHA384 and DHE-RSA-AES256-GCM-SHA384 cipher suites to establish secure replication connections. Both sides of the connection must enable this feature for encryption to proceed.

c. **Network Preference** – You may choose IPv4 or IPv6. An IPv6-enabled replication service can still accept connections from an IPv4 replication client if the service is reachable via IPv4. An IPv6-enabled replication client can still communicate with an IPv4 replication service if the service is reachable via IPv4.

d. **Use Non-default Connection Host** – The source system transmits data to a destination system listen port. Since a source system can have replication configured for many destination systems (each of which can have a different listen port), each context on the source can configure the connection port to the corresponding listen port of the destination.

3. Select **Next** and then **Close**.

The replication pair settings are updated, and replication resumes.

**CLI Equivalent**

```
#replication modify <destination> connection-host <new-host-name> [port <port>]
```

Managing replication systems

You can add or delete protection systems to be used for replication using the Manage Systems dialog.

**Procedure**

1. Select **Manage Systems**.
2. In the Manage Systems dialog, add and/or delete systems, as required.
3. Select **Close**.

Recovering data from a replication pair

If source replication data becomes inaccessible, it can be recovered from the replication pair destination. The source must be empty before recovery can proceed. Recovery can be performed for all replication topologies, except for MTree replication.

Recovery of data from a directory pool, as well as from directory and collection replication pairs, is described in the next sections.
Recovering directory pool data
You can recover data from a directory-based pool, but not from an MTree-based pool.

Procedure
1. Select More > Start Recover.
2. In the Start Recover dialog, select Pool from the Replication Type menu.
3. Select the source system hostname from the System to recover to menu.
4. Select the destination system hostname from the System to recover from menu.
5. Select the context on the destination from which data is recovered.
6. If you want to change any host connection settings, select the Advanced tab.
7. Select OK to start the recovery.

Recovering collection replication pair data
To successfully recover collection replication pair data, the source file system must be in a pristine state, and the destination context must be fully initialized.

Procedure
1. Select More > Start Recover to display the Start Recover dialog.
2. Select Collection from the Replication Type menu.
3. Select the source system host name from the System to recover to menu.
4. Select the destination system host name from the System to recover from menu.
5. Select the context on the destination from which data is recovered. Only one collection will exist on the destination.
6. To change any host connection settings, select the Advanced tab.
7. Select OK to start the recovery.

Recovering directory replication pair data
To successfully recover directory replication pair data, the same directory used in the original context must be created (but left empty).

Procedure
1. Select More > Start Recover to display the Start Recover dialog.
2. Select Directory from the Replication Type menu.
3. Select the host name of the system to which data needs to be restored from the System to recover to menu.
4. Select the host name of the system that will be the data source from the System to recover from menu.
5. Select the context to restore from the context list.
6. To change any host connection settings, select the Advanced tab.
7. Select OK to start the recovery.

Aborting a replication pair recovery
If a replication pair recovery fails or must be terminated, you can stop the replication recovery.

Procedure
1. Select the More menu, and select Abort Recover to display the Abort Recover dialog, which shows the contexts currently performing recovery.
2. Select the checkbox of one or more contexts to abort from the list.
3. Select OK.

After you finish
As soon as possible, you should restart recovery on the source.

Resyncing an MTree, directory, or pool replication pair

Resynchronization is the process of recovering (or bringing back into sync) the data between a source and a destination replication pair after a manual break. The replication pair are resynchronized so both endpoints contain the same data. Resynchronization is available for MTree, directory, and pool replication, but not for collection replication.

About this task
A replication resynchronization can also be used:

- To recreate a context that has been deleted.
- When a destination runs out of space, but the source still has data to replicate.
- To convert a directory replication pair to an MTree replication pair.

Procedure
1. Delete the context on both the replication source and replication destination systems.
2. From either the replication source or replication destination system, select More > Start Resync to display the Start Resync dialog.
3. Select the Replication Type to be resynced: Directory, MTree, or Pool.
4. Select the replication source system host name from the Source System menu.
5. Select the replication destination system host name from the Destination System menu.
6. Enter the replication source path in the Source Path text box.
7. Enter the replication destination path in the Destination Path text box.
8. To change any host connection settings, select the Advanced tab.
9. Select OK.

CLI Equivalent

```
# replication resync destination
```

Aborting a replication pair resynchronization

If a replication pair resynchronization fails or must be terminated, you can stop the resynchronization.

Procedure
1. From either the replication source or replication destination system, select More > Abort Resync to display the Abort Resync dialog, which lists all contexts currently performing resynchronization.
2. Select the checkboxes of one or more contexts to abort their resynchronization.
3. Select OK.
DD Boost view

The DD Boost view provides configuration and troubleshooting information to NetBackup administrators who have configured DD systems to use DD Boost AIR (Automatic Image Replication) or any DD Boost application that uses managed file replication.

See the *DD Boost for OpenStorage Administration Guide* for DD Boost AIR configuration instructions.

The File Replication tab displays:

- **Currently Active File Replication:**
  - Direction (Out-Going and In-Coming) and the number of files in each.
  - Remaining data to be replicated (pre-compressed value in GiB) and the amount of data already replicated (pre-compressed value in GiB).
  - Total size: The amount of data to be replicated and the already replicated data (pre-compressed value in GiB).

- **Most Recent Status:** Total file replications and whether completed or failed
  - during the last hour
  - over the last 24 hours

- **Remote Systems:**
  - Select a replication from the list.
  - Select the time period to be covered from the menu.
  - Select Show Details for more information about these remote system files.

The Storage Unit Associations tab displays the following information, which you can use for audit purposes or to check the status of DD Boost AIR events used for the storage unit's image replications:

- A list of all storage unit Associations known to the system. The source is on the left, and the destination is on the right. This information shows the configuration of AIR on the protection system.

- The Event Queue is the pending event list. It shows the local storage unit, the event ID, and the status of the event.

An attempt is made to match both ends of a DD Boost path to form a pair and present this as one pair/record. If the match is impossible, for various reasons, the remote path will be listed as Unresolved.

Remote system files

The Show Details button provides information for the selected remote file replication system. File Replications shows starting and ending information, as well as size and data amount, for the selected remote file replication system. The Performance Graph shows performance over time for the selected remote file replication system.

**Table 96 File Replications**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>Starting point of time period.</td>
</tr>
<tr>
<td>End</td>
<td>Ending point of time period.</td>
</tr>
<tr>
<td>File Name</td>
<td>Name of specific replication file.</td>
</tr>
</tbody>
</table>
Table 96 File Replications (continued)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status</td>
<td>Most recent status (Success, Failure).</td>
</tr>
<tr>
<td>Pre-Comp Size (MiB)</td>
<td>Amount of pre-compressed outbound and inbound data, as compared to network throughput or post-compressed data (in MiB).</td>
</tr>
<tr>
<td>Network Bytes (MiB)</td>
<td>Amount of network throughput data (in MiB).</td>
</tr>
</tbody>
</table>

Table 97 Performance Graph

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>Duration for replication (either 1d, 7d or 30d).</td>
</tr>
<tr>
<td>Interval</td>
<td>Interval for replication (either Daily or Weekly).</td>
</tr>
<tr>
<td>Pre-Comp Replicated</td>
<td>Amount of pre-compressed outbound and inbound data (in GiB).</td>
</tr>
<tr>
<td>Post-Comp Replicated</td>
<td>Amount of post-compressed data (in GiB).</td>
</tr>
<tr>
<td>Network Bytes</td>
<td>Amount of network throughput data (in GiB).</td>
</tr>
<tr>
<td>Files Succeeded</td>
<td>Number of files that were successfully replicated.</td>
</tr>
<tr>
<td>Files Failed</td>
<td>Number of files that failed to be replicated.</td>
</tr>
<tr>
<td>Show in new window</td>
<td>Brings up a separate window.</td>
</tr>
<tr>
<td>Print</td>
<td>Prints the graph.</td>
</tr>
</tbody>
</table>

Performance view

The Performance view displays a graph that represents the fluctuation of data during replication. These are aggregated statistics of each replication pair for this DD system.

- **Duration** (x-axis) is 30 days by default.
- **Replication Performance** (y-axis) is in GibiBytes or MebiBytes (the binary equivalents of GigaBytes and MegaBytes).
- **Network In** is the total replication network bytes entering the system (all contexts).
- **Network Out** is the total replication network bytes leaving the system (all contexts).
- For a reading of a specific point in time, hover the cursor over a place on the graph.
- During times of inactivity (when no data is being transferred), the shape of the graph may display a gradually descending line, instead of an expected sharply descending line.

Advanced Settings view

Advanced Settings lets you manage throttle and network settings.

**Throttle Settings**

- **Throttle Override** – Displays throttle rate if configured, or 0 meaning all replication traffic is stopped.
- **Permanent Schedule** – Displays the time and days of the week on which scheduled throttling occurs.
Network Settings

- **Bandwidth** – Displays the configured data stream rate if bandwidth has been configured, or Unlimited (default) if not. The average data stream to the replication destination is at least 98,304 bits per second (12 KiB).
- **Delay** – Displays the configured network delay setting (in milliseconds) if it has been configured, or None (default) if not.
- **Listen Port** – Displays the configured listen port value if it has been configured, or 2051 (default) if not.

Adding throttle settings

To modify the amount of bandwidth used by a network for replication, you can set a replication throttle for replication traffic.

About this task

There are three types of replication throttle settings:

- **Scheduled throttle** – The throttle rate is set at a predetermined time or period.
- **Current throttle** – The throttle rate is set until the next scheduled change, or until a system reboot.
- **Override throttle** – The previous two types of throttle are overridden. This persists – even through reboot – until you select Clear Throttle Override or issue the replication throttle reset override command.

You can also set a default throttle or a throttle for specific destinations, as follows:

- **Default throttle** – When configured, all replication contexts are limited to this throttle, except for those destinations specified by destination throttles (see next item).
- **Destination throttle** – This throttle is used when only a few destinations need to be throttled, or when a destination requires a throttle setting different from the default throttle. When a default throttle already exists, this throttle takes precedence for the destination specified. For example, you can set the default replication throttle to 10 kbps, but – using a destination throttle – you can set a single collection replication context to unlimited.

**Note:** Currently, you can set and modify destination throttle only by using the command-line interface (CLI); this functionality is not available in the DD System Manager. For documentation on this feature, see the replication throttle command in the DD OS Command Reference Guide. If the DD System Manager detects that you have one or more destination throttles set, you will be given a warning, and you should use the CLI to continue.

Additional notes about replication throttling:

- Throttles are set only at the source. The only throttle that applies to a destination is the **0 Bps (Disabled)** option, which disables all replication traffic.
- The minimum value for a replication throttle is 98,304 bits per second.

Procedure

1. Select Replication > Advanced Settings > Add Throttle Setting to display the Add Throttle Setting dialog.
2. Set the days of the week for which throttling is to be active by selecting Every Day or by selecting checkbox(es) next to individual day(s).
3. Set the time that throttling is to start with the Start Time drop-down selectors for the hour:minute and AM/PM.
4. For Throttle Rate:
Select Unlimited to set no limits.
- Enter a number in the text box (for example, 20000), and select the rate from the menu (bps, Kbps, Bps, or KBps).
- Select the 0 Bps (disabled) option to disable all replication traffic.

5. Select OK to set the schedule. The new schedule is shown under Permanent Schedule.

Results
Repetition runs at the given rate until the next scheduled change, or until a new throttle setting forces a change.

Deleting Throttle Settings
You can delete a single throttle setting or all throttle settings at once.

Procedure
1. Select Replication > Advanced Settings > Delete Throttle Setting to display the Delete Throttle Setting dialog.
2. Select the checkbox for the throttle setting to delete, or select the heading checkbox to delete all settings. This list can include settings for the “disabled” state.
3. Select OK to remove the setting.
4. In the Delete Throttle Setting Status dialog, select Close.

Temporarily overriding a throttle setting
A throttle override temporarily changes a throttle setting. The current setting is listed at the top of the window.

Procedure
1. Select Replication > Advanced Settings > Set Throttle Override to display the Throttle Override dialog.
2. Either set a new throttle override, or clear a previous override.
   a. To set a new throttle override:
      - Select Unlimited to revert to the system-set throttle rate (no throttling performed), or
      - Set the throttling bit and rate in the text box (for example, 20000) and (bps, Kbps, Bps, or KBps), or
      - Select 0 Bps (Disabled) to set the throttle rate to 0, effectively stopping all replication network traffic.
      - To enforce the change temporarily, select Clear at next scheduled throttle event.
   b. To clear an override previously set, select Clear Throttle Override.
3. Select OK.

Changing network settings
Using the bandwidth and network-delay settings together, replication calculates the proper TCP (transmission control protocol) buffer size for replication usage. These network settings are global to the DD system and should be set only once per system.

About this task
Note the following:
You can determine the actual bandwidth and the actual network delay values for each server by using the `ping` command.

The default network parameters in a restorer work well for replication in low latency configurations, such as a local 100Mbps or 1000Mbps Ethernet network, where the latency round-trip time (as measured by the `ping` command) is usually less than 1 millisecond. The defaults also work well for replication over low- to moderate-bandwidth WANs, where the latency may be as high as 50-100 milliseconds. However, for high-bandwidth high-latency networks, some tuning of the network parameters is necessary. The key number for tuning is the bandwidth-delay number produced by multiplying the bandwidth and round-trip latency of the network. This number is a measure of how much data can be transmitted over the network before any acknowledgments can return from the far end. If the bandwidth-delay number of a replication network is more than 100,000, then replication performance benefits from setting the network parameters in both restorers.

**Procedure**

1. Select `Replication > Advanced Settings > Change Network Settings` to display the Network Settings dialog.
2. In the Network Settings area, select `Custom Values`.
3. Enter `Delay` and `Bandwidth` values in the text boxes. The network delay setting is in milliseconds, and bandwidth is in bytes per second.
4. In the Listen Port area, enter a new value in the text box. The default IP Listen Port for a replication destination for receiving data streams from the replication source is 2051. This is a global setting for the DD system.

**Monitoring replication**

The DD System Manager provides many ways to track the status of replication – from checking replication pair status, to tracking backup jobs, to checking performance, to tracking a replication process.

**Viewing estimated completion time for backup jobs**

You can use the Completion Predictor to see the estimated time for when a backup replication job will be completed.

**Procedure**

1. Select `Replication > Summary`.
2. Select a Replication context for which to display Detailed Information.
3. In the Completion Predictor area, select options from the `Source Time` drop-down list for a replication’s completion time, and select `Track`.

   The estimated time displays, in the Completion Time area, for when a particular backup job will finish its replication to the destination. If the replication is finished, the area shows `Completed`.
Checking replication context performance

To check the performance of a replication context over time, select a Replication context in the Summary view, and select Performance Graph in the Detailed Information area.

Tracking status of a replication process

To display the progress of a replication initialization, resynchronization, or recovery operation, use the Replication > Summary view to check the current state.

**CLI Equivalent**

```
# replication show config all

<table>
<thead>
<tr>
<th>CTX</th>
<th>Source</th>
<th>Destination</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Host and Port</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>dir://host2/backup/dir2</td>
<td>dir://host3/backup/dir3</td>
<td>host3.company.com</td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>dir://host3/backup/dir3</td>
<td>dir://host2/backup/dir2</td>
<td>host3.company.com</td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

When specifying an IP version, use the following command to check its setting:

```
# replication show config rctx://2

<table>
<thead>
<tr>
<th>CTX:</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source:</td>
<td>mtree://ddbeta1.dallasrdc.com/data/coll1/EDM1</td>
</tr>
<tr>
<td>Destination:</td>
<td>mtree://ddbeta2.dallasrdc.com/data/coll1/EDM_ipv6</td>
</tr>
<tr>
<td>Connection Host:</td>
<td>ddbeta2-ipv6.dallasrdc.com</td>
</tr>
<tr>
<td>Connection Port:</td>
<td>(default)</td>
</tr>
<tr>
<td>Ipversion:</td>
<td>ipv6</td>
</tr>
<tr>
<td>Low-bw-optim:</td>
<td>disabled</td>
</tr>
<tr>
<td>Encryption:</td>
<td>disabled</td>
</tr>
<tr>
<td>Enabled:</td>
<td>yes</td>
</tr>
<tr>
<td>Propagate-retention-lock:</td>
<td>enabled</td>
</tr>
</tbody>
</table>
```

Replication lag

The amount of time between two copies of data is known as replication lag.

You can measure the replication lag between two contexts with the replication status command. For information about determining the cause of replication lag and mitigating its impact, see the KB article Troubleshooting Replication Lag, available at https://support.emc.com/kb/180482.

Replication with HA

Floating IP addresses allow HA systems to specify a single IP address for replication configuration that will work regardless of which node of the HA pair is active.

Over IP networks, HA systems use a floating IP address to provide data access to the HA pair, regardless of which physical node is the active node. The net config command provides the [type {fixed | floating}] option to configure a floating IP address. The DD OS Command Reference Guide provides more information.

If a domain name is needed to access the floating IP address, specify the HA system name as the domain name. Run the ha status command to locate the HA system name.

**Note:** Run the net show hostname type ha-system command to display the HA system name, and if required, run the net set hostname ha-system command to change the HA system name.
All file system access should be through the floating IP address. When configuring backup and replication operations on an HA pair, always specify the floating IP address as the IP address for the protection system. Other system features such as DD Boost and replication will accept the floating IP address for the HA pair the same way as they accept the system IP address for a non-HA system.

**Replication between HA and non-HA systems**

Collection replication between HA and non-HA systems is not supported. Directory or MTree replication is required to replicate data between HA and non-HA systems.

**Replicating a system with quotas to one without**

Replicate a system with a DD OS that supports quotas, to a system with a DD OS that does not have quotas.

- A reverse resync, which takes the data from the system without quotas and puts it back in an MTree on the system that has quotas enabled (and which continues to have quotas enabled).
- A reverse initialization from the system without quotas, which takes its data and creates a new MTree on the system that supports quotas, but does not have quotas enabled because it was created from data on a system without quotas.

**Replication Scaling Context**

The Replication Scaling Context feature gives you more flexibility when configuring replication contexts.

In environments with more than 299 replication contexts that include both directory and MTree replication contexts, this feature allows you to configure the contexts in any order. Previously, you had to configure the directory replication contexts first, followed by the MTree replication contexts.

The total number of replication contexts cannot exceed 540.

**Directory-to-MTree replication migration**

The directory-to-MTree (D2M) replication optimization feature allows you to migrate existing directory replication contexts to new replication contexts based on MTrees, which are logical partitions of the file system. This feature also lets you monitor the process as it unfolds and verify that has successfully completed.

Although you can use the graphical user interface (GUI) for this operation, it is recommended you use the Command Line Interface (CLI) for optimal performance.

**Performing migration from directory replication to MTree replication**

**About this task**

Do not shut down or reboot your system during directory-to-MTree (D2M) migration.

**Procedure**

1. Stop all ingest operations to the directory replication source directory.
2. Create an MTree on the source DD system: `mtree create /data/coll/mtree-name`  
   
   **Note:** Do not create the MTree on the destination DD system.
3. (Optional) Enable DD Retention Lock on the MTree.

   **Note:** If the source system contains retention-locked files, you might want to maintain DD Retention Lock on the new MTree.

   See Enabling DD Retention Lock Compliance on an MTree.

4. Create the MTree replication context on both the source and destination DD systems:

   ```
   replication add source mtree://source-system-name/source mtree replication
   add destination mtree://destination-system-name/destination mtree
   ```

5. Start the D2M migration:

   ```
   replication dir-to-mtree start from rctx://1 to rctx://2
   ```

   In the previous example,
   ```
   rctx://1
   ```
   refers to the directory replication context, which replicates the directory `backup backup/dir1` on the source system;
   ```
   rctx://2
   ```
   refers to the MTree replication context, which replicates the MTree `/data/col1/mtree1` on the source system.

   **Note:** This command might take longer than expected to complete. Do not press Ctrl-C during this process; if you do, you will cancel the D2M migration.

---

### Viewing directory-to-MTree migration progress

You can see which stage of the migration is currently in progress in the directory-to-MTree (D2M) replication.

**Procedure**

1. Enter `replication dir-to-mtree watch rctx://2` to see the progress.

   ```
   rctx://2
   ```
   specifies the replication context.
Use Control-C to stop monitoring.
Phase 4 of 4 (initialize).
(00:00) Replication initialize started...
(00:02) initializing:
(00:14) 100% complete, pre-comp: 0 KB/s, network: 0 KB/s
(00:14) Replication initialize completed.
Migration for ctx 2 successfully completed.

Checking the status of directory-to-MTree replication migration

You can use the replication dir-to-mtree status command to check whether the directory-to-MTree migration (D2M) has successfully completed.

Procedure
1. Enter the following command; here, rctx://2 represents the MTree replication context on the source system: replication dir-to-mtree status rctx://2

   The output should be similar to the following:

<table>
<thead>
<tr>
<th>Directory Replication CTX:</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTree Replication CTX:</td>
<td>2</td>
</tr>
<tr>
<td>Directory Replication Source:</td>
<td>dir://127.0.0.2/backup/dir1</td>
</tr>
<tr>
<td>MTree Replication Source:</td>
<td>mtree://127.0.0.2/data/col1/mtree1</td>
</tr>
<tr>
<td>MTree Replication Destination:</td>
<td>mtree://127.0.0.3/data/col1/mtree1</td>
</tr>
<tr>
<td>Migration Status:</td>
<td>completed</td>
</tr>
</tbody>
</table>

   If there is no migration in progress, you should see the following:

   # replication dir-to-mtree status rctx://2
   No migration status for context 2.

2. Begin ingesting data to the MTree on the source DD system when the migration process is complete.

3. (Optional) Break the directory replication context on the source and target systems.

   See the DD OS Command Reference Guide for more information about the replication break command.

Aborting D2M replication

If necessary, you can abort the directory-to-MTree (D2M) migration procedure.

About this task

The replication dir-to-mtree abort command aborts the ongoing migration process and reverts the directory from a read-only to a read-write state.

Procedure
1. In the Command-Line Interface (CLI), enter the following command; here, rctx://2 is the MTree replication context: replication dir-to-mtree abort rctx://2
Troubleshooting D2M

If you encounter a problem setting directory-to-MTree (D2M) replication, there is an operation you can perform to address several different issues.

About this task

The dir-to-mtree abort procedure can help cleanly abort the D2M process. You should run this procedure in the following cases:

- The status of the D2M migration is listed as aborted.
- The system rebooted during D2M migration.
- An error occurred when running the replication dir-to-mtree start command.
- Ingest was not stopped before beginning migration.
- The MTree replication context was initialized before the replication dir-to-mtree start command was entered.

**Note:** Do not run replication break on the MTree replication context before the D2M process finishes.

Always run replication dir-to-mtree abort before running the replication break command on the mrepl ctx.

Running the replication break command prematurely will permanently render the drepl source directory as read-only.

If this occurs, please contact Support.

Procedure

1. Enter replication dir-to-mtree abort to abort the process.

2. Break the newly created MTree replication context on both the source and destination systems.

   In the following example, the MTree replication context is `rctx://2`.

   ```
   replication break rctx://2
   ```

3. Delete the corresponding MTrees on both the source and destination systems.

   ```
   mtree delete mtree-path
   ```
Note: MTrees marked for deletion remain in the file system until the `filesys clean` command is run.

See the *DD OS Command Reference Guide* for more information.

4. Run the `filesys clean start` command on both the source and destination systems.

   For more information on the `filesys clean` commands, see the *DD OS Command Reference Guide*.

5. Restart the process.

   See Performing migration from directory replication to MTree replication.

**Additional D2M troubleshooting**

There are solutions available if you forgot to enable DD Retention Lock for the new MTree or an error occurs after directory-to-MTree migration has been initialized.

**DD Retention Lock has not been enabled**

If you forgot to enable DD Retention Lock for the new MTree and the source directory contains retention-locked files or directories, you have the following options:

- Let the D2M migration continue. However, you will not have DD Retention Lock information in the MTree after the migration.
- Abort the current D2M process as described in Aborting D2M replication on page 366 and restart the process with DD Retention Lock enabled on the source MTree.

**An error occurs after initialization**

If the `replication dir-to-mtree start` process finishes without error but you detect an error during the MTree replication initialization (phase 4 of the D2M migration process), you can perform the following steps:

1. Make sure that there is no network issue.
2. Initialize the MTree replication context.

**Using collection replication for disaster recovery with SMT**

To use the destination system of a collection replication pair configured with SMT as a replacement system for disaster recovery, additional SMT configuration steps must be performed in addition to the other configuration steps required to bring a replacement system online.

**Before you begin**

Using the collection replication destination system in this manner requires autosupport reports to be configured and saved. The KB article *Collection replica with smt enabled*, available on [https://support.emc.com](https://support.emc.com), provides additional information.

**About this task**

The replacement system will not have the following SMT details:

- Alert notification lists for each tenant-unit
- All users assigned to the DD Boost protocol for use by SMT tenants, if DD Boost is configured on the system
- The default-tenant-unit associated with each DD Boost user, if any, if DD Boost is configured on the system

Complete the following steps to configure SMT on the replacement system.
**Procedure**

1. In the autosupport report, locate the output for the `smt tenant-unit show detailed` command.

<table>
<thead>
<tr>
<th>Tenant-unit: &quot;tu1&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summary:</strong></td>
</tr>
<tr>
<td>Name</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>tu1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Management-User:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>User</strong></td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>tu1_ta</td>
</tr>
<tr>
<td>tu1_tu</td>
</tr>
<tr>
<td>tum_ta</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Management-Group:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group</strong></td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>qatest</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DDBoost:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name</strong></td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>su1</td>
</tr>
</tbody>
</table>

**Quota:**

- **Tenant-unit: tu1**
- **Mtree** | **Pre-Comp (MiB)** | **Soft-Limit (MiB)** | **Hard-Limit (MiB)** |
- /data/coll/ml | 0 | 71680 | 81920 |
- /data/coll/sul | 2048 | 30720 | 51200 |

**Alerts:**

- **Tenant-unit: "tu1"**
- Notification list "tu1_grp"
- **Members**
  - tom.tenant@abc.com

---

DD Replicator

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2. On the replacement system, enable SMT if it is not already enabled.
3. On the replacement system, license and enable DD Boost if it is required and not already enabled.
4. If DD Boost is configured, assign each user listed in the DD Boost section of the "smt tenant-unit show detailed" output as a DD Boost User.
   
   ```
   # ddboost user assign ddbu1
   ```

5. If DD Boost is configured, assign each user listed in the DD Boost section of the `smt tenant-unit show detailed` output to the default tenant-unit shown, if any, in the output.
   
   ```
   # ddboost user option set ddbu1 default-tenant-unit tu1
   ```

6. Create a new alert notification group with the same name as the alert notification group in the Alerts section of the `smt tenant-unit show detailed` output.
   
   ```
   # alert notify-list create tu1_grp tenant-unit tu1
   ```

7. Assign each email address in the alert notification group in the Alerts section of the `smt tenant-unit show detailed` output to the new alert notification group.
   
   ```
   # alert notify-list add tu1_grp emails tom.tenant@abc.com
   ```
CHAPTER 24

DD Secure Multitenancy

This chapter includes:

- Secure Multi-Tenancy overview ................................................................. 372
- Provisioning a Tenant Unit ........................................................................ 375
- Enabling Tenant Self-Service mode ......................................................... 379
- Data access by protocol .......................................................................... 379
- Data management operations ................................................................. 381
Secure Multi-Tenancy overview

Secure Multi-Tenancy (SMT) is the simultaneous hosting, by an internal IT department or an external provider, of an IT infrastructure for more than one consumer or workload (business unit, department, or Tenant).

SMT provides the ability to securely isolate many users and workloads in a shared infrastructure, so that the activities of one Tenant are not apparent or visible to the other Tenants.

A Tenant is a consumer (business unit, department, or customer) who maintains a persistent presence in a hosted environment.

Within an enterprise, a Tenant may consist of one or more business units or departments on a protection system that is configured and managed by IT staff.

- For a business unit (BU) use case, the Finance and Human Resources departments of a corporation could share the same system, but each department would be unaware of the presence of the other.
- For a service provider (SP) use case, the SP could deploy one or more systems to accommodate different Protection Storage services for multiple end-customers.

Both use cases emphasize the segregation of different customer data on the same physical system.

SMT architecture basics

Secure Multitenancy (SMT) provides a simple approach to setting up Tenants and Tenant Units, using MTrees. SMT setup is performed using DD Management Center and/or the DD OS command line interface. This administration guide provides the theory of SMT and some general command line instructions.

The basic architecture of SMT is as follows.

- A Tenant is created on the DD Management Center and/or DD system.
- A Tenant Unit is created on a DD system for the Tenant.
- One or more MTrees are created to meet the storage requirements for the Tenant's various types of backups.
- The newly created MTrees are added to the Tenant Unit.
- Backup applications are configured to send each backup to its configured Tenant Unit MTree.

Note: For more information about DD Management Center, see the DD Management Center User Guide. For more information about the DD OS command line interface, see the DD OS Command Reference.

Terminology used in Secure Multi-Tenancy (SMT)

Understanding the terminology that is used in SMT will help you better understand this unique environment.

MTrees

MTrees are logical partitions of the file system and offer the highest degree of management granularity, meaning users can perform operations on a specific MTree without affecting the entire file system. MTrees are assigned to Tenant Units and contain that Tenant Unit's individualized settings for managing and monitoring SMT.
Multi-Tenancy

Multi-Tenancy refers to the hosting of an IT infrastructure by an internal IT department, or an external service provider, for more than one consumer/workload (business unit/department/Tenant) simultaneously. DD SMT enables Data Protection-as-a-Service.

RBAC (role-based access control)

RBAC offers multiple roles with different privilege levels, which combine to provide the administrative isolation on a multi-tenant protection system.

Storage Unit

A Storage Unit is an MTree configured for the DD Boost protocol. Data isolation is achieved by creating a Storage Unit and assigning it to a DD Boost user. The DD Boost protocol permits access only to Storage Units assigned to DD Boost users connected to the system.

Tenant

A Tenant is a consumer (business unit/department/customer) who maintains a persistent presence in a hosted environment.

Tenant Self-Service

Tenant Self-Service is a method of letting a Tenant log in to a protection system to perform some basic services (add, edit, or delete local users, NIS groups, and/or AD groups). This reduces the bottleneck of always having to go through an administrator for these basic tasks. The Tenant can access only their assigned Tenant Units. Tenant Users and Tenant Admins will, of course, have different privileges.

Tenant Unit

A Tenant Unit is the partition of a system that serves as the unit of administrative isolation between Tenants. Tenant units that are assigned to a tenant can be on the same or different systems and are secured and logically isolated from each other, which ensures security and isolation of the control path when running multiple Tenants simultaneously on the shared infrastructure. Tenant Units can contain one or more MTrees, which hold all configuration elements that are needed in a multi-tenancy setup. Users, management-groups, notification-groups, and other configuration elements are part of a Tenant Unit.

Control path and network isolation

Control path isolation is achieved by providing the user roles of tenant-admin and tenant-user for a Tenant Unit. Network isolation for data and administrative access is achieved by associating a fixed set of data access IP address(es) and management IP address(es) with a Tenant Unit.

The tenant-admin and tenant-user roles are restricted in scope and capability to specific Tenant Units and to a restricted set of operations they can perform on those Tenant Units. To ensure a logically secure and isolated data path, a system administrator must configure one or more Tenant Unit MTrees for each protocol in an SMT environment. Supported protocols include DD Boost, NFS, CIFS, and DD VTL. Access is strictly regulated by the native access control mechanisms of each protocol.

Tenant-self-service sessions (through ssh) can be restricted to a fixed set of management IP address(es) on a DD system. Administrative access sessions (through ssh/http/https) can also be restricted to a fixed set of management IP address(es) on DD systems. By default, however, there are no management IP address(es) associated with a Tenant Unit, so the only standard restriction is through the use of the tenant-admin and tenant-user roles. You must use smt tenant-unit management-ip to add and maintain management IP address(es) for Tenant Units.

Similarly, data access and data flow (into and out of Tenant Units) can be restricted to a fixed set of local or remote data access IP address(es). The use of assigned data access IP address(es)
enhances the security of the DD Boost and NFS protocols by adding SMT-related security checks. For example, the list of storage units returned over DD Boost RPC can be limited to those which belong to the Tenant Unit with the assigned local data access IP address. For NFS, access and visibility of exports can be filtered based on the local data access IP address(es) configured. For example, using `showmount -e` from the local data access IP address of a Tenant Unit will only display NFS exports belonging to that Tenant Unit.

The `sysadmin` must use `smt tenant-unit data-ip` to add and maintain data access IP address(es) for Tenant Units.

Note: If you attempt to mount an MTree in an SMT using a non-SMT IP address, the operation will fail.

If multiple Tenant Units are belong to the same tenant, they can share a default gateway. However, if multiple Tenant Units that belong to different tenants are prevented from using the same default gateway.

Multiple Tenant Units belonging to the same tenant can share a default gateway. Tenant Units that belong to different tenants cannot use the same default gateway.

**Understanding RBAC in SMT**

In Secure Multi-Tenancy (SMT), permission to perform a task depends on the role that is assigned to a user. DDMC uses role-based access control (RBAC) to control these permissions.

All DDMC users can:

- View all tenants
- Create, read, update, or delete tenant units belonging to any tenant if the user is an administrator on the protection system hosting the tenant unit
- Assign and unassign tenant units to and from a tenant if the user is an administrator on the system hosting the tenant unit
- View tenant units belonging to any tenant if the user has any assigned role on the system hosting the tenant unit

To perform more advanced tasks depends on the role of the user, as follows:

**admin role**

A user with an `admin` role can perform all administrative operations on a protection system. An `admin` can also perform all SMT administrative operations on the system, including setting up SMT, assigning SMT user roles, enabling tenant self-service mode, creating a tenant, and so on. In the context of SMT, the `admin` is typically referred to as the landlord. In DD OS, the role is known as the `sysadmin`.

To have permission to edit or delete a tenant, you must be both a DDMC `admin` and a DD OS `sysadmin` on all systems that are associated with the tenant units of that tenant. If the tenant does not have any tenant units, you need only to be a DDMC `admin` to edit or delete that tenant.

**limited-admin role**

A user with a `limited-admin` role can perform all administrative operations on a system as the admin. However, users with the `limited-admin` role cannot delete or destroy MTrees. In DD OS, there is an equivalent `limited-admin` role.

**tenant-admin role**

A user with a `tenant-admin` role can perform certain tasks only when `tenant self-service` mode is enabled for a specific tenant unit. Responsibilities include scheduling and running a backup application for the tenant and monitoring resources and statistics within the assigned tenant unit. The `tenant-admin` can view audit logs, but RBAC ensures that only audit logs from the tenant units belonging to the `tenant-admin` are accessible. In addition, `tenant-admins` ensure administrative
separation when tenant self-service mode is enabled. In the context of SMT, the tenant-admin is referred to as the backup admin.

**tenant-user role**
A user with a tenant-user role can monitor the performance and usage of SMT components only on tenant unit(s) assigned to them and only when tenant self-service is enabled, but a user with this role cannot view audit logs for their assigned tenant units. Also, tenant-users may run the show and list commands.

**none role**
A user with a role of none is not allowed to perform any operations on a system other than changing their password and accessing data using DD Boost. However, after SMT is enabled, the admin can select a user with a none role from the system and assign them an SMT-specific role of tenant-admin or tenant-user. Then, that user can perform operations on SMT management objects.

**management groups**
BSPs (backup service providers) can use management groups defined in a single, external AD (active directory) or NIS (network information service) to simplify managing user roles on tenant units. Each BSP tenant may be a separate, external company and may use a name-service such as AD or NIS.

With SMT management groups, the AD and NIS servers are set up and configured by the admin in the same way as SMT local users. The admin can ask their AD or NIS administrator to create and populate the group. The admin then assigns an SMT role to the entire group. Any user within the group who logs in to the system is logged in with the role that is assigned to the group.

When users leave or join a tenant company, they can be removed or added to the group by the AD or NIS administrator. It is not necessary to modify the RBAC configuration on a system when users who are part of the group are added or removed.

## Provisioning a Tenant Unit

Launching the configuration wizard begins the initial provisioning procedure for Secure Multitenancy (SMT). During the procedure, the wizard creates and provisions a new Tenant Unit based on Tenant configuration requirements. Information is entered by the administrator, as prompted. After completing the procedure, the administrator proceeds to the next set of tasks, beginning with enabling Tenant Self-Service mode. Following the initial setup, manual procedures and configuration modifications can be performed as required.

### Procedure

1. Start SMT.
   ```
   # smt enable
   SMT enabled.
   ```

2. Verify that SMT is enabled.
   ```
   # smt status
   SMT is enabled.
   ```

3. Launch the SMT configuration wizard.
   ```
   # smt tenant-unit setup
   No tenant-units.
   ```

4. Follow the configuration prompts.

   **SMT TENANT-UNIT Configuration**

   Configure SMT TENANT-UNIT at this time (yes|no) [no]: yes
   Do you want to create new tenant-unit (yes/no)? : yes
Tenant-unit Name

Enter tenant-unit name to be created : SMT_5.7_tenant_unit
Invalid tenant-unit name.
Enter tenant-unit name to be created : SMT_57_tenant_unit

Pending Tenant-unit Settings
Create Tenant unit  SMT_57_tenant_unit

Do you want to save these settings (Save|Cancel|Retry): save
SMT Tenant-unit Name Configurations saved.

SMT TENANT-UNIT MANAGEMENT-IP Configuration

Configure SMT TENANT-UNIT MANAGEMENT-IP at this time (yes|no) [no]: yes
Do you want to add a local management ip to this tenant-unit? (yes|no) [no]: yes

<table>
<thead>
<tr>
<th>port</th>
<th>enabled</th>
<th>state</th>
<th>DHCP</th>
<th>IP address</th>
<th>netmask</th>
<th>type additional setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>ethMa</td>
<td>yes</td>
<td>running</td>
<td>no</td>
<td>192.168.10.57</td>
<td>255.255.255.0</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>fe80::260:16ff:fe49:f4b0**</td>
<td>/64</td>
<td></td>
</tr>
<tr>
<td>eth3a</td>
<td>yes</td>
<td>running</td>
<td>ipv4</td>
<td>192.168.10.236*</td>
<td>255.255.255.0*</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>fe80::260:48ff:fe1c:60fc**</td>
<td>/64</td>
<td></td>
</tr>
<tr>
<td>eth3b</td>
<td>yes</td>
<td>running</td>
<td>no</td>
<td>192.168.50.57</td>
<td>255.255.255.0</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>fe80::260:48ff:fe1c:60fd**</td>
<td>/64</td>
<td></td>
</tr>
<tr>
<td>eth4b</td>
<td>yes</td>
<td>running</td>
<td>no</td>
<td>192.168.60.57</td>
<td>255.255.255.0</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>fe80::260:48ff:fe1f:5183**</td>
<td>/64</td>
<td></td>
</tr>
</tbody>
</table>

* Value from DHCP
** auto_generated IPv6 address

Choose an ip from above table or enter a new ip address. New ip addresses will need to be created manually.

Ip Address
Enter the local management ip address to be added to this tenant-unit : 192.168.10.57
Do you want to add a remote management ip to this tenant-unit? (yes|no) [no]:

Pending Management-ip Settings
Add Local Management-ip  192.168.10.57
Do you want to save these settings (Save|Cancel|Retry): yes
unrecognized input, expecting one of Save|Cancel|Retry

Do you want to save these settings (Save|Cancel|Retry): save
Local management access ip "192.168.10.57" added to tenant-unit "SMT_57_tenant_unit".

SMT Tenant-unit Management-IP Configurations saved.

SMT TENANT-UNIT MANAGEMENT-IP Configuration

Do you want to add another local management ip to this tenant-unit? (yes|no) [no]:
Do you want to add another remote management ip to this tenant-unit? (yes|no) [no]:

SMT TENANT-UNIT DDBOOST Configuration
Configure SMT TENANT-UNIT DDBOOST at this time (yes|no) [no]:

SMT TENANT-UNIT MTREE Configuration
Configure SMT TENANT-UNIT MTREE at this time (yes|no) [no]: yes

<table>
<thead>
<tr>
<th>Name</th>
<th>Pre-Comp (GiB)</th>
<th>Status</th>
<th>Tenant-Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>/data/coll/laptop_backup</td>
<td>4846.2</td>
<td>RO/RD</td>
<td>-</td>
</tr>
</tbody>
</table>
Do you want to assign an existing MTree to this tenant-unit? (yes|no) [no]: yes

Do you want to create a mtree for this tenant-unit now? (yes|no) [no]: yes

**MTree Name**
Enter MTree name
: SMT_57_tenant_unit

Invalid mtree path name.
Enter MTree name
:
SMT_57_tenant_unit

Invalid mtree path name.
Enter MTree name
: /data/col1/SMT_57_tenant_unit

**MTree Soft-Quota**
Enter the quota soft-limit to be set on this MTree (<n> {MiB|GiB|TiB|PiB}|none)
:

**MTree Hard-Quota**
Enter the quota hard-limit to be set on this MTree (<n> {MiB|GiB|TiB|PiB}|none)
:

Pending MTree Settings
Create MTree /data/col1/SMT_57_tenant_unit
MTree Soft Limit none
MTree Hard Limit none

Do you want to save these settings (Save|Cancel|Retry): save
MTree "/data/col1/SMT_57_tenant_unit" created successfully.
MTree "/data/col1/SMT_57_tenant_unit" assigned to tenant-unit "SMT_57_tenant_unit".

SMT Tenant-unit MTree Configurations saved.

SMT TENANT-UNIT MTREE Configuration

<table>
<thead>
<tr>
<th>Name</th>
<th>Pre-Comp (GiB)</th>
<th>Status</th>
<th>Tenant-Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>/data/col1/laptop_backup</td>
<td>4846.2</td>
<td>RO/RD</td>
<td>-</td>
</tr>
<tr>
<td>/data/col1/random</td>
<td>23469.9</td>
<td>RO/RD</td>
<td>-</td>
</tr>
<tr>
<td>/data/col1/software2</td>
<td>2003.7</td>
<td>RO/RD</td>
<td>-</td>
</tr>
<tr>
<td>/data/col1/tsm6</td>
<td>763704.9</td>
<td>RO/RD</td>
<td>-</td>
</tr>
</tbody>
</table>

D : Deleted
Q : Quota Defined
RO : Read Only
RW : Read Write
RD : Replication Destination
RLGE : Retention-Lock Governance Enabled
RLGD : Retention-Lock Governance Disabled
RLCE : Retention-Lock Compliance Enabled

Do you want to assign another MTree to this tenant-unit? (yes|no) [no]: yes
Do you want to assign an existing MTree to this tenant-unit? (yes|no) [no]: yes
Do you want to create another mtree for this tenant-unit? (yes|no) [no]:

SMT TENANT-UNIT SELF-SERVICE Configuration
Configure SMT TENANT-UNIT SELF-SERVICE at this time (yes|no) [no]: yes
Self-service of this tenant-unit is disabled
Do you want to enable self-service of this tenant-unit? (yes|no) [no]: yes
Do you want to configure a management user for this tenant-unit? (yes|no) [no]:
Do you want to configure a management group for this tenant-unit (yes|no) [no]: yes

Management-Group Name
Enter the group name to be assigned to this tenant-unit
: SMT_57_tenant_unit_group

What role do you want to assign to this group (tenant-user|tenant-admin) [tenant-user]:
            tenant-admin

Management-Group Type
What type do you want to assign to this group (nis|active-directory)?
: nis

Pending Self-Service Settings
Enable Self-Service       SMT_57_tenant_unit
Assign Management-group   SMT_57_tenant_unit_group
Management-group role     tenant-admin
Management-group type     nis

Do you want to save these settings (Save|Cancel|Retry): save
Tenant self-service enabled for tenant-unit "SMT_57_tenant_unit"
Management group "SMT_57_tenant_unit_group" with type "nis" is assigned to tenant-unit
"SMT_57_tenant_unit" as "tenant-admin".

SMT Tenant-unit Self-Service Configurations saved.

SMT TENANT-UNIT SELF-SERVICE Configuration
Do you want to configure another management user for this tenant-unit? (yes|no) [no]:
Do you want to configure another management group for this tenant-unit? (yes|no) [no]:

SMT TENANT-UNIT ALERT Configuration
Configure SMT TENANT-UNIT ALERT at this time (yes|no) [no]: yes
No notification lists.

Alert Configuration
Alert Group Name
Specify alert notify-list group name to be created
: SMT_57_tenant_unit_notify

Alert email addresses
Enter email address to receive alert for this tenant-unit
: dd_proserv@emc.com

Do you want to add more emails (yes/no)?
: no

Pending Alert Settings
Create Notify-list group       SMT_57_tenant_unit_notify
Add emails                     dd_proserv@emc.com

Do you want to save these settings (Save|Cancel|Retry): save
Created notification list "SMT_57_tenant_unit_notify" for tenant "SMT_57_tenant_unit".
Added emails to notification list "SMT_57_tenant_unit_notify".

Tenant self-service enabled for tenant-unit "SMT_57_tenant_unit".
Management group "SMT_57_tenant_unit_group" with type "nis" is assigned to tenant-unit
"SMT_57_tenant_unit" as "tenant-admin".

SMT Tenant-unit Self-Service Configurations saved.

SMT TENANT-UNIT ALERT Configuration
Configure SMT TENANT-UNIT ALERT at this time (yes|no) [no]: yes
No notification lists.

Alert Configuration
Alert Group Name
Specify alert notify-list group name to be created
: SMT_57_tenant_unit_notify

Alert email addresses
Enter email address to receive alert for this tenant-unit
: dd_proserv@emc.com

Do you want to add more emails (yes/no)?
: no

Pending Alert Settings
Create Notify-list group       SMT_57_tenant_unit_notify
Add emails                     dd_proserv@emc.com

Do you want to save these settings (Save|Cancel|Retry): save
Created notification list "SMT_57_tenant_unit_notify" for tenant "SMT_57_tenant_unit".
Added emails to notification list "SMT_57_tenant_unit_notify".
Enabling Tenant Self-Service mode

For administrative separation of duties and delegation of administrative/management tasks to implement Tenant Self-Service, which is required for control path isolation, the system administrator can enable this mode on a Tenant Unit and then assign users to manage the unit in the roles of tenant-admin or tenant-user. These roles allow users other than the administrator to perform specific tasks on the Tenant Unit to which they are assigned. In addition to administrative separation, Tenant Self-Service mode helps reduce the management burden on internal IT and service provider staff.

Procedure

1. View Tenant Self-Service mode status for one or all Tenant Units.

```
# smt tenant-unit option show { tenant-unit | all }
```

2. Enable Tenant Self-Service mode on the selected Tenant Unit.

```
# smt tenant-unit option set tenant-unit self-service { enabled | disabled }
```

Data access by protocol

Secure data paths, with protocol-specific access controls, enable security and isolation for Tenant Units. In a Secure Multitenancy (SMT) environment, data access protocol management commands are also enhanced with a Tenant Unit parameter to enable consolidated reporting.

DD systems support multiple data access protocols simultaneously, including DD Boost, NFS, CIFS, and DD VTL. A DD system can present itself as an application-specific interface, such as a file server offering NFS or CIFS access over the Ethernet, a DD VTL device, or a DD Boost device.

The native access control mechanisms of each supported protocol ensure that the data paths for each Tenant remain separate and isolated. Such mechanisms include access control lists (ACLs) for CIFS, exports for NFS, DD Boost credentials, and Multi-User Boost credential-aware access control.

Multi-User DD Boost and Storage Units in SMT

When using Multi-User DD Boost with Secure Multi-Tenancy (SMT), user permissions are set by Storage Unit ownership.

*Multi-User DD Boost* refers to the use of multiple DD Boost user credentials for DD Boost Access Control, in which each user has a separate username and password.

A *Storage Unit* is an MTree configured for the DD Boost protocol. A user can be associated with, or “own,” one or more Storage Units. Storage Units that are owned by one user cannot be owned by another user. Only the user owning the Storage Unit can access the Storage Unit for any type of data access, such as backup/restore. The number of DD Boost user names cannot exceed the maximum number of MTrees. (See the “MTrees” chapter in this book for the current maximum number of MTrees for each model.) Storage Units that are associated with SMT must have the *none* role that is assigned to them.

Each backup application must authenticate using its DD Boost username and password. After authentication, DD Boost verifies the authenticated credentials to confirm ownership of the Storage Unit. The backup application is granted access to the Storage Unit only if the user credentials that are presented by the backup application match the user names associated with
the Storage Unit. If user credentials and user names do not match, the job fails with a permission error.

Configuring access for CIFS

Common Internet File System (CIFS) is a file-sharing protocol for remote file access. In a Secure Multitenancy (SMT) configuration, backup and restores require client access to the CIFS shares residing in the MTree of the associated Tenant Unit. Data isolation is achieved using CIFS shares and CIFS ACLs.

Procedure

1. Create an MTree for CIFS and assign the MTree to the tenant unit.
   
   ```
   # mtree create mtree-path tenant-unit tenant-unit
   ```

2. Set capacity soft and hard quotas for the MTree.
   
   ```
   # mtree create mtree-path tenant-unit tenant-unit] [quota-soft-limit n(MiB|GiB|TiB|PiB] } [quota-hard-limit n (MiB|GiB|TiB|PiB]
   ```

3. Create a CIFS share for `pathname` from the MTree.
   
   ```
   # cifs share create share path pathname clients clients
   ```

Configuring NFS access

NFS is a UNIX-based, file-sharing protocol for remote file access. In a Secure Multitenancy (SMT) environment, backup and restores require client access to the NFS exports residing in the MTree of the associated Tenant Unit. Data isolation is achieved using NFS exports and network isolation. NFS determines if an MTree is associated with a network-isolated Tenant Unit. If so, NFS verifies the connection properties associated with the Tenant Unit. Connection properties include the destination IP address and interface or client hostname.

Procedure

1. Create an MTree for NFS and assign the MTree to the tenant unit.
   
   ```
   # mtree create mtree-path tenant-unit tenant-unit
   ```

2. Set capacity soft and hard quotas for the MTree.
   
   ```
   # mtree create mtree-path tenant-unit tenant-unit] [quota-soft-limit n(MiB|GiB|TiB|PiB] } [quota-hard-limit n (MiB|GiB|TiB|PiB]
   ```

3. Create an NFS export by adding one or more clients to the MTree.
   
   ```
   # nfs add path client-list
   ```

Configuring access for DD VTL

DD VTL Tenant data isolation is achieved using DD VTL access groups that create a virtual access path between a host system and the DD VTL. (The physical Fibre Channel connection between the host system and DD VTL must already exist.)

Placing tapes in the DD VTL allows them to be written to, and read by, the backup application on the host system. DD VTL tapes are created in a DD VTL pool, which is an MTree. Because DD VTL pools are MTrees, the pools can be assigned to Tenant Units. This association enables SMT monitoring and reporting.

For example, if a tenant-admin is assigned a Tenant Unit that contains a DD VTL pool, the tenant-admin can run MTree commands to display read-only information. Commands can run only on the DD VTL pool assigned to the Tenant Unit.

These commands include:

- `mtree list` to view a list of MTrees in the Tenant Unit
Using DD VTL NDMP TapeServer

DD VTL Tenant data isolation is also achieved using NDMP. DD OS implements a NDMP (Network Data Management Protocol) tape server that allows NDMP-capable systems to send backup data to the DD system via a three-way NDMP backup.

The backup data is written to virtual tapes (which are in a pool) by a DD VTL assigned to the special DD VTL group \textit{TapeServer}.

Because the backup data is written to tapes in a pool, information in the DD VTL topic regarding MTrees also applies to the DD NDMP TapeServer.

Data management operations

Secure Multitenancy (SMT) management operations include monitoring Tenant Units and other objects, such as Storage Units and MTrees. For some SMT objects, additional configuration or modification may also be required.

Collecting performance statistics

Each MTree can be measured for performance or “usage” statistics and other real-time information. Historical consumption rates are available for DD Boost Storage Units. Command output lets the tenant-admin collect usage statistics and compression ratios for an MTree associated with a Tenant Unit, or for all MTrees and associated Tenant Units. Output may be filtered to display usage in intervals ranging from minutes to months. Results are passed to the administrator, who uses the statistics as a chargeback metric. A similar method is used to gather usage statistics and compression ratios for Storage Units.

Procedure

   
   ```
   # mtree show stats
   ```

2. Collect performance statistics for MTrees associated with a Tenant Unit.
   
   ```
   # mtree show performance
   ```

3. Collect compression statistics for MTrees associated with a Tenant Unit.
   
   ```
   # mtree show compression
   ```

Modifying quotas

To meet QoS criteria, a system administrator uses DD OS “knobs” to adjust the settings required by the Tenant configuration. For example, the administrator can set “soft” and “hard” quota limits on DD Boost Storage Units. Stream “soft” and “hard” quota limits can be allocated only to DD Boost Storage Units assigned to Tenant Units. After the administrator sets the quotas, the tenant-admin can monitor one or all Tenant Units to ensure no single object exceeds its allocated quotas and deprives others of system resources.
**About this task**

Quotas are set initially when prompted by the configuration wizard, but they can be adjusted or modified later. The example below shows how to modify quotas for DD Boost. (You can also use quota capacity and quota streams to deal with capacity and stream quotas and limits.)

**Procedure**

1. To modify soft and hard quota limits on DD Boost Storage Unit “su33”:
   ```
   ddboost storage-unit modify su33 quota-soft-limit 10 Gib quota-hard-limit 20 Gib
   ```
2. To modify stream soft and hard limits on DD Boost Storage Unit “su33”:
   ```
   ddboost storage-unit modify su33 write-stream-soft-limit 20 read-stream-soft-limit 6 repl -stream-soft-limit 20 combined-stream-soft-limit 20
   ```
3. To report physical size for DD Boost Storage Unit “su33”:
   ```
   ddboost storage-unit modify su33 report-physical-size 8 GiB
   ```

**SMT and replication**

In case of disaster, user roles dictate how a user can assist in data recovery operations. Several replication types are available in an SMT configuration. (See the DD Replicator chapter for more detail on how to perform replication.)

Here are some points to consider regarding user roles:

- The admin can recover MTrees from a replicated copy.
- The tenant-admin can replicate MTrees from one system to another, using DD Boost managed file replication.
- The tenant-admin can recover MTrees from a replicated copy, also by using DD Boost managed file replication.

**Collection replication**

Collection replication replicates core Tenant Unit configuration information.

**Secure replication over public internet**

To protect against man-in-the-middle (MITM) attacks when replicating over a public internet connection, authentication includes validating SSL certificate-related information at the replication source and destination.

**MTree replication (NFS/CIFS)**

MTree replication is supported on MTrees assigned to Tenant Units. During MTree replication, an MTree assigned to a Tenant Unit on one system can be replicated to an MTree assigned to a Tenant Unit on another system. MTree replication is not allowed between two different Tenants on the two DD systems. When security mode is set to strict, MTree replication is allowed only when the MTrees belong to same Tenants.

For backward compatibility, MTree replication from an MTree assigned to a Tenant Unit to an unassigned MTree is supported, but must be configured manually. Manual configuration ensures the destination MTree has the correct settings for the Tenant Unit. Conversely, MTree replication from an unassigned MTree to an MTree assigned to a Tenant Unit is also supported.

When setting up SMT-aware MTree replication, security mode defines how much checking is done on the Tenant. The default mode checks that the source and destination do not belong to different Tenants. The strict mode makes sure the source and destination belong to the same Tenant. Therefore, when you use strict mode, you must create a Tenant on the destination machine with the same UUID as the UUID of the Tenant on the source machine that is associated with the MTree being replicated.
DD Boost managed file replication (also with DD Boost AIR)

DD Boost managed file replication is supported between Storage Units, regardless of whether one Storage Unit, or both, are assigned to Tenant Units.

During DD Boost managed file replication, Storage Units are not replicated in total. Instead, certain files within a Storage Unit are selected by the backup application for replication. The files selected in a Storage Unit and assigned to a Tenant Unit on one system can be replicated to a Storage Unit assigned to a Tenant Unit on another system.

For backward compatibility, selected files in a Storage Unit assigned to a Tenant Unit can be replicated to an unassigned Storage Unit. Conversely, selected files in an unassigned Storage Unit can be replicated to a Storage Unit assigned to a Tenant Unit.

DD Boost managed file replication can also be used in DD Boost AIR deployments.

Replication control for QoS

An upper limit on replication throughput (repl-in) can be specified for an MTree. Since MTrees for each tenant are assigned to a Tenant Unit, each tenant's replication resource usage can be capped by applying these limits. The relation of this feature to SMT is that MTree Replication is subject to this throughput limit.

SMT Tenant alerts

A DD system generates events when it encounters potential problems with software or hardware. When an event is generated, an alert notification is sent immediately via email to members designated in the notification list and to the system administrator.

SMT alerts are specific to each Tenant Unit and differ from DD system alerts. When Tenant Self-Service mode is enabled, the tenant-admin can choose to receive alerts about the various system objects he or she is associated with and any critical events, such as an unexpected system shutdown. A tenant-admin may only view or modify notification lists to which he or she is associated.

The example below shows a sample alert. Notice that the two event messages at the bottom of the notification are specific to a Multi-Tenant environment (indicated by the word “Tenant”). For the entire list of DD OS and SMT alerts, see the DD OS MIB Quick Reference Guide or the SNMP MIB.

EVT-ENVIRONMENT-00021 – Description: The system has been shutdown by abnormal method; for example, not by one of the following: 1) Via IPMI chassis control command 2) Via power button 3) Via OS shutdown.

Action: This alert is expected after loss of AC (main power) event. If this shutdown is not expected and persists, contact your contracted support provider or visit us online at https://my.datadomain.com.

Tenant description: The system has experienced an unexpected power loss and has restarted.

Tenant action: This alert is generated when the system restarts after a power loss. If this alert repeats, contact your System Administrator.

Managing snapshots

A snapshot is a read-only copy of an MTree captured at a specific point in time. A snapshot can be used for many things, for example, as a restore point in case of a system malfunction. The required role for using snapshot is admin or tenant-admin.

To view snapshot information for an MTree or a Tenant Unit:

# snapshot list mtree mtree-path | tenant-unit tenant-unit

To view a snapshot schedule for an MTree or a Tenant Unit:
Performing a file system Fast Copy

A Fast Copy operation clones files and directory trees of a source directory to a target directory on a DD system. There are special circumstances regarding Fast Copy with Secure Multitenancy (SMT).

Here are some considerations when performing a file system Fast Copy with Tenant Self-Service mode enabled:

- A tenant-admin can Fast Copy files from one Tenant Unit to another when the tenant-admin is the tenant-admin for both Tenant Units, and the two Tenant Units belong to the same Tenant.
- A tenant-admin can Fast Copy files within the same Tenant Unit.
- A tenant-admin can Fast Copy files within the Tenant Units at source and destination.

To perform a file system Fast Copy:

```
# filesys fastcopy source <src> destination <dest>
```
CHAPTER 25
Cloud Tier

This chapter includes:

- Cloud Tier overview
- Configuring Cloud Tier
- Configuring cloud units
- Data movement
- Using the CLI to configure Cloud Tier
- Configuring encryption for DD cloud units
- Information needed in the event of system loss
- Using DD Replicator with Cloud Tier
- Using DD Virtual Tape Library (VTL) with Cloud Tier
- Displaying capacity consumption charts for Cloud Tier
- Cloud Tier logs
- Using the CLI to remove Cloud Tier
Cloud Tier overview

Cloud Tier is a native feature of DD OS 6.0 (or later) for moving data from the active tier to low-cost, high-capacity object storage in the public, private, or hybrid cloud for long-term retention. Cloud Tier is best suited for long-term storage of infrequently accessed data that is being held for compliance, regulatory, and governance reasons. The ideal data for Cloud Tier is data that is past its normal recovery window.

Cloud Tier is managed using a single protection system namespace. There is no separate cloud gateway or virtual appliance required. Data movement is supported by the native policy management framework. Conceptually, the cloud storage is treated as an additional storage tier (Cloud Tier) attached to the system, and data is moved between tiers as needed. File system metadata associated with the data stored in the cloud is maintained in local storage, and also mirrored to the cloud. The metadata that resides in local storage facilitates operations such as deduplication, cleaning, Fast Copy, and replication. This local storage is divided into self-contained buckets, called cloud units, for ease of manageability.

Supported platforms

Cloud Tier is supported on physical platforms that have the necessary memory, CPU, and storage connectivity to accommodate another storage tier.

Cloud Tier is supported on these systems:

<table>
<thead>
<tr>
<th>Model</th>
<th>Memory</th>
<th>Cloud capacity</th>
<th>Required number of SAS I/O modules</th>
<th>Supported disk shelf types for metadata storage</th>
<th>Number of ES30 shelves, ES40 shelves, or DS60 disk packs required</th>
<th>Required capacity for metadata storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD3300 4 TB</td>
<td>16 GB</td>
<td>8 TB</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1 x 1 TB virtual disk = 1 TB</td>
</tr>
<tr>
<td>DD3300 8 TB</td>
<td>48 GB</td>
<td>16 TB</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>2 x 1 TB virtual disks = 2 TB</td>
</tr>
<tr>
<td>DDD3300 16 TB</td>
<td>48 GB</td>
<td>32 TB</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>2 x 1 TB virtual disks = 2 TB</td>
</tr>
<tr>
<td>DD3300 32 TB</td>
<td>64 GB</td>
<td>64 TB</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>4 x 1 TB virtual disks = 4 TB</td>
</tr>
<tr>
<td>DD4200</td>
<td>128 GB</td>
<td>378 TB</td>
<td>3</td>
<td>DS60 or ES30</td>
<td>2</td>
<td>30 x 3 TB HDDs = 90 TB</td>
</tr>
<tr>
<td>DD4500</td>
<td>192 GB</td>
<td>570 TB</td>
<td>3</td>
<td>DS60 or ES30</td>
<td>2</td>
<td>30 x 4 TB HDDs = 120 TB</td>
</tr>
</tbody>
</table>
### Table 98 Cloud Tier supported configurations (continued)

<table>
<thead>
<tr>
<th>Model</th>
<th>Memory</th>
<th>Cloud capacity</th>
<th>Required number of SAS I/O modules</th>
<th>Supported disk shelf types for metadata storage</th>
<th>Number of ES30 shelves, ES40 shelves, or DS60 disk packs required</th>
<th>Required capacity for metadata storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD6800</td>
<td>192 GB</td>
<td>576 TB</td>
<td>2</td>
<td>DS60 or ES30</td>
<td>2</td>
<td>30 x 4 TB HDDs = 120 TB</td>
</tr>
<tr>
<td>DD6900</td>
<td>288 GB</td>
<td>576 TB</td>
<td>2</td>
<td>DS60, ES40, or ES30a</td>
<td>2</td>
<td>30 x 4 TB HDDs = 120 TB</td>
</tr>
<tr>
<td>DD7200</td>
<td>256 GB</td>
<td>856 TB</td>
<td>4</td>
<td>DS60 or ES30</td>
<td>4</td>
<td>60 x 4 TB HDDs = 240 TB</td>
</tr>
<tr>
<td>DD9300</td>
<td>384 GB</td>
<td>1400 TB</td>
<td>2</td>
<td>DS60 or ES30</td>
<td>4</td>
<td>60 x 4 TB HDDs = 240 TB</td>
</tr>
<tr>
<td>DD9400</td>
<td>576 GB</td>
<td>1536 TB</td>
<td>2</td>
<td>DS60, ES40, or ES30a</td>
<td>4</td>
<td>60 x 4 TB HDDs = 240 TB</td>
</tr>
<tr>
<td>DD9500</td>
<td>512 GB</td>
<td>1728 TB</td>
<td>4</td>
<td>DS60 or ES30</td>
<td>5</td>
<td>75 x 4 TB HDDs = 300 TB</td>
</tr>
<tr>
<td>DD9800</td>
<td>768 GB</td>
<td>2016 TB</td>
<td>4</td>
<td>DS60 or ES30</td>
<td>5</td>
<td>75 x 4 TB HDDs = 300 TB</td>
</tr>
<tr>
<td>DD9900</td>
<td>1152 GB</td>
<td>2016 TB</td>
<td>2</td>
<td>DS60, ES40, or ES30a</td>
<td>5</td>
<td>75 x 4 TB HDDs = 300 TB</td>
</tr>
<tr>
<td>DDVE 16 TB</td>
<td>32 GB</td>
<td>32 TB</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1 x 500 GB virtual disk = 500 GBb</td>
</tr>
<tr>
<td>DDVE 64 TB</td>
<td>60 GB</td>
<td>128 TB</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1 x 500 GB virtual disk = 500 GBb</td>
</tr>
<tr>
<td>DDVE 96 TB</td>
<td>80 GB</td>
<td>192 TB</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1 x 500 GB virtual disk = 500 GBb</td>
</tr>
</tbody>
</table>

a. ES30 shelves are only supported after a controller upgrade from an older system model.

b. The minimum metadata size is a hard limit. Dell EMC recommends that you start with 1 TB for metadata storage and expand in 1 TB increments. The **DDVE Installation and Administration Guide** provides more details about using Cloud Tier with DDVE.
Cloud Tier performance

The system uses internal optimizations to maximize Cloud Tier performance.

Cloud seeding

The current migration engine to cloud is file-based and an efficient de-duplication optimized engine is used for identifying and migrating only unique segments to cloud. This file-based migration engine's efficiency is high when migrating higher generation data to Cloud Tier, which already has some data to de-duplicate against. However, when Cloud Tier is empty or nearly empty, there is no data to de-duplicate against. There is an overhead of compute cycles that are invested in deduplication. With seeding-based migration, the deduplication filtering is maintained on active tier storage and only unique data is migrated in bulk to Cloud Tier. In cloud seeding, the engine migrates the content from local storage to cloud storage without processing it for deduplication. When cloud seeding is active, files that are marked for migration to cloud storage are not cleaned (i.e. space is not freed-up) as part of the active tier file system cleaning until the migration of all identified files by seeding is complete. Active tier storage must be sized to account for this in environments where large amounts of data are migrated to cloud storage. If the Cloud Tier storage is less than five percent full and has post-comp data usage of 30 TiB (or more), as seen in `filesys show space` command, the system automatically uses cloud seeding when migrating data to cloud storage.

After five percent of the Cloud Tier capacity is consumed, cloud seeding automatically deactivates. Data is then processed for deduplication before migration to cloud storage.

Here are additional points to consider when using Seeding migration:

- Migration is supported in Seeding mode only when:
  - Active tier postcomp used size is 30 TiB or more as reported in `filesys show space` output.
  - Active tier is less than 70% full, when migration starts as reported in `filesys show space` output.

  **Note:** While in seeding mode, if Active Tier usage during a migration cycle exceeds 90%, migration is halted and restarted in regular Filecopy mode.

- Migration in seeding mode is auto-suspended by cleaning on active tier, for the entire duration of the active tier cleaning. Once cleaning completes, seeding resumes automatically and restarts the migration to cloud.

- Migration in seeding mode auto-suspends if a cloud UNAVAIL event is received on the cloud-unit (cloud-unit is reported as "disconnected") to which it is migrating, and only resumes once the cloud-unit is available reports as active.

- Cleaning cannot start on a cloud-unit that is the destination of an in-progress migration operation in Seeding mode.
Note: In two cloud-unit systems, to force cleaning to start on a second cloud-unit which is not being seeded, suspend migration in seeding mode using the `data-movement suspend` command and run the `cloud clean start` command on the second cloud-unit.

- Probabilistic File Verification in cloud does not run against cloud-units on which seeding mode migration is in progress, even if it is the default policy.
- If cleaning is in progress on Active Tier or Cloud Tier and scheduled data movement starts in seeding mode, the data movement operation suspends for the duration of the cleaning activity.
- Migration in seeding mode does not migrate files from MTrees which are replication destinations, even if the files are eligible for migration. Files from these replication destination MTrees are migrated with the Filecopy engine once migration in seeding mode from all eligible MTree is complete.
- Seeding mode migration suspends physical capacity reporting for the duration of the migration activity.
- Migration in Seeding mode is only supported on all cloud enabled systems and configurations that have more than 80 Gb of RAM. Seeding based migration is disabled by default for DD VEs.

**Large object size**

Cloud Tier uses object sizes of 1 MB or 4 MB (depending on the cloud storage provider) to reduce the metadata overhead, and lower the number of objects to migrate to cloud storage.

## Configuring Cloud Tier

To configure Cloud Tier, add the license and enclosures, set a system passphrase, and create a file system with support for data movement to the cloud.

- For Cloud Tier, the cloud capacity license is required.
- To license Cloud Tier, refer to the applicable *DD OS Release Notes* for the most up-to-date information on product features, software updates, software compatibility guides, and information about protection products, licensing, and service.
- To set a system passphrase, use the `Administration > Access > Administrator Access` tab. If the system passphrase is not set, the `Set Passphrase` button appears in the Passphrase area. If a system passphrase is configured, the `Change Passphrase` button appears, and your only option is to change the passphrase.
- To create a file system, use the File System Create Wizard.

## Configuring storage for Cloud Tier

Cloud Tier storage is required for the DD system to support cloud-units. The Cloud Tier holds the metadata for the migrated files, while the actual data resides in the cloud.

### Before you begin

The file system must be disabled to configure Cloud Tier.

### Procedure

1. Select `Data Management > File System` and click `Disable` (at the bottom of the screen) to disable the file system.
2. Select `Hardware > Storage`.
3. In the Overview tab, expand `Cloud Tier`.
4. Click `Configure`.
   
   The Configure Cloud Tier dialog box is displayed.
5. Select the checkbox for the shelf to be added from the Addable Storage section.

**CAUTION:** DD3300 systems require the use of 1 TB storage devices for Cloud Tier metadata storage.

6. Click the **Add to Tier** button.

7. Click **Save** to add the storage.

8. Select **Data Management > File System** and click **Enable Cloud Tier**.

   To enable the cloud tier, you must meet the storage requirement for the licensed capacity.
   Configure the cloud tier of the file system. Click **Next**.
   A cloud file system requires a local store for a local copy of the cloud metadata.

9. Click **Enable**.

   The cloud tier is enabled with the designated storage.

10. Click **OK**.

    You must create cloud units separately, after the file system is enabled.

11. Select **Enable file system**.

### Cleanable Space Estimation

The Cleanable Space Estimation tool assesses the amount of space that can be reclaimed on the Active Tier when the data-movement process migrates eligible files to the cloud and GC cleans the file system.

This tool can work with or without a cloud license present.

When there is no active CLOUDTIER-CAPACITY license, manually provide the age-threshold to use to assess total cleanable space on the active tier. If there is both an age-threshold and there is a policy set on MTrees, the preference is given to the user provided age-threshold.

There are three workflows:

- A system with cloud migration policies set: Files are identified as "eligible" based on the policy set on the respective MTrees and calculates the cleanable space.
- A system with cloud migration policies set but with a user provided age-threshold: Files are identified based on the user given age-threshold, overriding the system policies.
- A system with no cloud: Mandatory requirement for user to provide an age-threshold which would be used to determine total cleanable space.

Some additional points to consider:

- Data-movement cannot run in parallel with the data-movement eligibility-check process.
- Cleaning on Active Tier cannot be started if the eligibility-check is running.
- The eligibility-check cannot start if cleaning on the Active Tier is running.
- Cleaning on Cloud Tier cannot be started if the eligibility-check is running.
- The eligibility-check cannot start if cleaning on the Cloud Tier is running.
- If an UNAVAIL event is received, it should not have any impact on the eligibility-check operation.
- If the file system stops or crashes, eligibility-check stops and does not auto-resume once file system comes back up again.

**Note:** There is no provision for initiating the eligibility-check from DD System Manager.
Configuring cloud units

The cloud tier consists of a maximum of two cloud units, and each cloud unit is mapped to a cloud provider, enabling multiple cloud providers per protection system. The system must be connected to the cloud and have an account with a supported cloud provider.

Configuring cloud units includes these steps:

- Configuring the network, including firewall and proxy settings
- Importing CA certificates
- Adding cloud units

Firewall and proxy settings

Network firewall ports

- Port 443 (HTTPS) and/or Port 80 (HTTP) must be open to the cloud provider networks for both the endpoint IP and the provider authentication IP for bi-directional traffic.
  
  For example, for Amazon S3, both s3-ap-southeast-1.amazonaws.com and s3.amazonaws.com must have port 80 and/or port 443 unblocked and set to allow bi-directional IP traffic.

  **Note:** Several public cloud providers use IP ranges for their endpoint and authentication addresses. In this situation, the IP ranges used by the provider need to be unblocked to accommodate potential IP changes.

- Remote cloud provider destination IP and access authentication IP address ranges must be allowed through the firewall.

- For ECS private cloud, local ECS authentication and web storage (S3) access IP ranges and ports 9020 (HTTP) and 9021 (HTTPS) must be allowed through local firewalls.

  **Note:** ECS private cloud load balancer IP access and port rules must also be configured.

Proxy settings

If there are any existing proxy settings that cause data above a certain size to be rejected, those settings must be changed to allow object sizes up to 4.5MB.

If customer traffic is being routed through a proxy, the self-signed/CA-signed proxy certificate must be imported. See "Importing CA certificates" for details.

OpenSSL cipher suites

- Ciphers - ECDHE-RSA-AES256-SHA384, AES256-GCM-SHA384
- TLS Version: 1.2

  **Note:** Default communication with all cloud providers is initiated with strong cipher.

Supported protocols

- HTTP
- HTTPS

  **Note:** Default communication with all public cloud providers occurs on secure HTTP (HTTPS), but you can overwrite the default setting to use HTTP.
Importing CA certificates

Before you can add cloud units for Alibaba, Amazon Web Services S3 (AWS), Azure, Elastic Cloud Storage (ECS), and Google Cloud Provider (GCP), you must import CA certificates.

Before you begin

For AWS and Azure public cloud providers, root CA certificates can be downloaded from https://www.digicert.com/digicert-root-certificates.htm.

- For an AWS cloud provider, download the Baltimore CyberTrust Root certificate.
- For an Azure cloud provider, download the Baltimore CyberTrust Root certificate.
- For ECS, the root certificate authority varies by customer. Implementing cloud storage on ECS requires a load balancer. If an HTTPS endpoint is used as an endpoint in the configuration, be sure to import the root CA certificate. Contact your load balancer provider for details.
- For an S3 Flexible provider, import the root CA certificate. Contact your S3 Flexible provider for details.

If your downloaded certificate has a .crt extension, it is likely that it will need to be converted to a PEM-encoded certificate. If so, use OpenSSL to convert the file from .crt format to .pem (for example, openssl x509 -inform der -in BaltimoreCyberTrustRoot.crt -out BaltimoreCyberTrustRoot.pem).

- For Alibaba:
  2. Convert the downloaded certificate to a PEM-encoded format. The OpenSSL command for this conversion is: openssl x509 -inform der -in <root_cert.crt> -out <root_cert.pem>.
  3. Import the certificate to the system.
- For GCP:
  2. Convert the downloaded certificate to a PEM-encoded format. The OpenSSL command for this conversion is: openssl x509 -inform der -in <root_cert.crt> -out <root_cert.pem>.
  3. Import the certificate to the system.

Procedure

1. Select Data Management > File System > Cloud Units.
2. In the tool bar, click Manage Certificates.
   The Manage Certificates for Cloud dialog is displayed.
3. Click Add.
4. Select one of these options:
   - I want to upload the certificate as a .pem file. Browse to and select the certificate file.
   - I want to copy and paste the certificate text.
     Copy the contents of the .pem file to your copy buffer.
5. Click Add.

**Adding a cloud unit for Elastic Cloud Storage (ECS)**

**About this task**
A protection system or DDVE instance requires a close time synchronization with the ECS system to configure a DD cloud unit. Configuring NTP on the protection system or DDVE instance, and the ECS system addresses this issue.

**Procedure**
1. Select **Data Management > File System > Cloud Units**.
2. Click **Add**.
   - The **Add Cloud Unit** dialog box appears.
3. Enter a name for this cloud unit. Only alphanumeric characters are allowed.
   - The remaining fields in the Add Cloud Unit dialog pertain to the cloud provider account.
4. For **Cloud provider**, select **EMC Elastic Cloud Storage (ECS)** from the list.
5. Enter the provider **Access key** as password text.
6. Enter the provider **Secret key** as password text.
7. Enter the provider **Endpoint** in this format: `http://<ip/hostname>:<port>`. If you are using a secure endpoint, use `https` instead.
   - **Note:** Implementing cloud storage on ECS requires a load balancer.
   - By default, ECS runs the S3 protocol on port 9020 for HTTP and 9021 for HTTPS. With a load balancer, these ports are sometimes remapped to 80 for HTTP and 443 for HTTPS, respectively. Check with your network administrator for the correct ports.
8. If an HTTP proxy server is required to get around a firewall for this provider, click **Configure** for **HTTP Proxy Server**.
   - Enter the proxy hostname, port, user, and password.
   - **Note:** There is an optional step to run the cloud provider verify tool before adding the cloud unit. This tool performs pre-check tests to ensure that all requirements are met before to adding the actual cloud unit.
9. Click **Add**.
   - The File System main window displays summary information for the new cloud unit as well a control for enabling and disabling the cloud unit.

**Adding a cloud unit for Alibaba**

**About this task**
Regions are configured at bucket level instead of object level. Therefore, all objects contained in a bucket are stored in the same region. A region is specified when a bucket is created, and cannot be changed once it is created.
### Table 99 Alibaba regions

<table>
<thead>
<tr>
<th>Regions</th>
<th>Location</th>
<th>Region Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mainland China regions</td>
<td>China East 1 (Hangzhou)</td>
<td>oss-cn-hangzhou</td>
</tr>
<tr>
<td></td>
<td>China East 2 (Shanghai)</td>
<td>oss-cn-shanghai</td>
</tr>
<tr>
<td></td>
<td>China North 1 (Qingdao)</td>
<td>oss-cn-qingdao</td>
</tr>
<tr>
<td></td>
<td>China North 2 (Beijing)</td>
<td>oss-cn-beijing</td>
</tr>
<tr>
<td></td>
<td>China North 3 (zhangjiakou)</td>
<td>oss-cn-zhangjiakou</td>
</tr>
<tr>
<td></td>
<td>China North 5 (huhehaote)</td>
<td>oss-cn-huhehaote</td>
</tr>
<tr>
<td></td>
<td>China South 1 (Shenzhen)</td>
<td>oss-cn-shenzhen</td>
</tr>
<tr>
<td>International Regions</td>
<td>Hong Kong</td>
<td>oss-cn-hongkong</td>
</tr>
<tr>
<td></td>
<td>US West 1 (Silicon Valley)</td>
<td>oss-us-west-1</td>
</tr>
<tr>
<td></td>
<td>US East 1 (Virginia)</td>
<td>oss-us-east-1</td>
</tr>
<tr>
<td></td>
<td>Asia Pacific SE 1 (Singapore)</td>
<td>oss-ap-southeast-1</td>
</tr>
<tr>
<td></td>
<td>Asia Pacific SE 2 (Sydney)</td>
<td>oss-ap-southeast-2</td>
</tr>
<tr>
<td></td>
<td>Asia Pacific SE 3 (Kuala Lumpur)</td>
<td>oss-ap-southeast-3</td>
</tr>
<tr>
<td></td>
<td>Asia Pacific SE 5 (Jakarta)</td>
<td>oss-ap-southeast-5</td>
</tr>
<tr>
<td></td>
<td>Asia Pacific NE 1 (Tokyo)</td>
<td>oss-ap-northeast-1</td>
</tr>
<tr>
<td></td>
<td>Asia Pacific SOU 1 (Mumbai)</td>
<td>oss-ap-south-1</td>
</tr>
<tr>
<td></td>
<td>EU Central 1 (Frankfurt)</td>
<td>oss-eu-central-1</td>
</tr>
<tr>
<td></td>
<td>Middle East 1 (Dubai)</td>
<td>oss-me-east-1</td>
</tr>
</tbody>
</table>

The Alibaba Cloud user credentials must have permissions to create and delete buckets and to add, modify, and delete files within the buckets they create. AliyunOSSFullAccess is preferred, but these are the minimum requirements:

- ListBuckets
- GetBucket
- PutBucket
- DeleteBucket
-GetObject
- PutObject
- DeleteObject

**Procedure**

1. Select **Data Management > File System > Cloud Units**.
2. Click **Add**.
   
   The Add Cloud Unit dialog is displayed.
3. Enter a name for this cloud unit. Only alphanumeric characters are allowed.
   
   The remaining fields in the **Add Cloud Unit** dialog pertain to the cloud provider account.
4. For **Cloud provider**, select **Alibaba Cloud** from the drop-down list.

5. Select **Standard** or **IA** from the **Storage class** drop-down list.

6. Select the region from the **Storage region** drop-down list.

7. Enter the provider **Access key** as password text.

8. Enter the provider **Secret key** as password text.

9. Ensure that port 443 (HTTPS) is not blocked in firewalls. Communication with the Alibaba cloud provider occurs on port 443.

10. If an HTTP proxy server is required to get around a firewall for this provider, click **Configure for HTTP Proxy Server**.

    Enter the proxy hostname, port, user, and password.

    ❯ **Note:** There is an optional step to run the cloud provider verify tool before adding the cloud unit. This tool performs pre-check tests to ensure that all requirements are met before to adding the actual cloud unit.

11. Click **Add**.

    The file system main window now displays summary information for the new cloud unit as well a control for enabling and disabling the cloud unit.

### Adding a cloud unit for Amazon Web Services S3

AWS offers a range of storage classes. The *Cloud Providers Compatibility Matrix*, available from [http://compatibilityguide.emc.com:8080/CompGuideApp/] provides up-to-date information about the supported storage classes.

#### About this task

For enhanced security, the Cloud Tier feature uses Signature Version 4 for all AWS requests. Signature Version 4 signing is enabled by default.

The following endpoints are used by the AWS cloud provider, depending on storage class and region. Be sure that DNS is able to resolve these hostnames before configuring cloud units.

- s3.amazonaws.com
- s3-us-west-1.amazonaws.com
- s3-us-west-2.amazonaws.com
- s3-eu-west-1.amazonaws.com
- s3-ap-northeast-1.amazonaws.com
- s3-ap-southeast-1.amazonaws.com
- s3-ap-southeast-2.amazonaws.com
- s3-sa-east-1.amazonaws.com
- ap-south-1
- ap-northeast-2
- eu-central-1

**Note:** The China region is not supported.

**Note:** The AWS user credentials must have permissions to create and delete buckets and to add, modify, and delete files within the buckets they create. S3FullAccess is preferred, but these are the minimum requirements:
Procedure

1. Select Data Management > File System > Cloud Units.
2. Click Add.
   The Add Cloud Unit dialog is displayed.
3. Enter a name for this cloud unit. Only alphanumeric characters are allowed.
   The remaining fields in the Add Cloud Unit dialog pertain to the cloud provider account.
4. For Cloud provider, select Amazon Web Services S3 from the drop-down list.
5. Select the storage class from the drop-down list.
6. Select the appropriate Storage region from the drop-down list.
7. Enter the provider Access key as password text.
8. Enter the provider Secret key as password text.
9. Ensure that port 443 (HTTPS) is not blocked in firewalls. Communication with the AWS cloud provider occurs on port 443.
10. If an HTTP proxy server is required to get around a firewall for this provider, click Configure for HTTP Proxy Server.
    Enter the proxy hostname, port, user, and password.

   ⚠️ Note: There is an optional step to run the cloud provider verify tool before adding the cloud unit. This tool performs pre-check tests to ensure that all requirements are met before to adding the actual cloud unit.

11. Click Add.
   The file system main window now displays summary information for the new cloud unit as well a control for enabling and disabling the cloud unit.

Adding a cloud unit for Azure


About this task
The following endpoints are used by the Azure cloud provider, depending on storage class and region. Be sure that DNS is able to resolve these hostnames before configuring cloud units.

- `<account-name>.blob.core.windows.net`
  ⚠️ Note: Do not include the domain blob.core.windows.net as part of the account name.

The account name is obtained from the Azure cloud provider console.
Procedure

1. Select **Data Management > File System > Cloud Units**.
2. Click **Add**.
   The Add Cloud Unit dialog is displayed.
3. Enter a name for this cloud unit. Only alphanumeric characters are allowed.
   The remaining fields in the Add Cloud Unit dialog pertain to the cloud provider account.
4. For **Cloud provider**, select **Microsoft Azure Storage** from the drop-down list.
5. For **Account type**, select **Government** or **Public**.
6. Select the storage class from the drop-down list.
7. Enter the provider **Account name**.
8. Enter the provider **Primary key** as password text.
9. Enter the provider **Secondary key** as password text.
10. Ensure that port 443 (HTTPS) is not blocked in firewalls. Communication with the Azure cloud provider occurs on port 443.
11. If an HTTP proxy server is required to get around a firewall for this provider, click **Configure** for **HTTP Proxy Server**.
   Enter the proxy hostname, port, user, and password.

   **Note:** There is an optional step to run the cloud provider verify tool before adding the cloud unit. This tool performs pre-check tests to ensure that all requirements are met before to adding the actual cloud unit.

12. Click **Add**.
   The file system main window now displays summary information for the new cloud unit as well a control for enabling and disabling the cloud unit.

Adding a cloud unit for Google Cloud Provider

**About this task**

The following tables list the Cloud Storage locations available for storing data.

**Table 100 Multi-regional locations**

<table>
<thead>
<tr>
<th>Multi-regional name</th>
<th>Multi-regional description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia</td>
<td>Data centers in Asia</td>
</tr>
<tr>
<td>US</td>
<td>Data centers in the United States</td>
</tr>
<tr>
<td>EU</td>
<td>Data centers in the European Union</td>
</tr>
</tbody>
</table>

**Table 101 Regional locations**

<table>
<thead>
<tr>
<th>Regional locations</th>
<th>Location</th>
<th>Region name</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>northamerica-northeast1</td>
<td>Montréal</td>
</tr>
<tr>
<td></td>
<td>us-central1</td>
<td>Iowa</td>
</tr>
<tr>
<td></td>
<td>us-east1</td>
<td>South Carolina</td>
</tr>
</tbody>
</table>
Table 101 Regional locations (continued)

<table>
<thead>
<tr>
<th>Regional locations</th>
<th>Location</th>
<th>Region name</th>
</tr>
</thead>
<tbody>
<tr>
<td>us-east4</td>
<td>Northern Virginia</td>
<td></td>
</tr>
<tr>
<td>us-west1</td>
<td>Oregon</td>
<td></td>
</tr>
<tr>
<td>South America</td>
<td>southamerica-east1</td>
<td>São Paulo</td>
</tr>
<tr>
<td>Europe</td>
<td>europe-north1</td>
<td>Finland</td>
</tr>
<tr>
<td></td>
<td>europe-west1</td>
<td>Belgium</td>
</tr>
<tr>
<td></td>
<td>europe-west2</td>
<td>London</td>
</tr>
<tr>
<td></td>
<td>europe-west3</td>
<td>Frankfurt</td>
</tr>
<tr>
<td></td>
<td>europe-west4</td>
<td>Netherlands</td>
</tr>
<tr>
<td>Asia</td>
<td>asia-east1</td>
<td>Taiwan</td>
</tr>
<tr>
<td></td>
<td>asia-northeast1</td>
<td>Tokyo</td>
</tr>
<tr>
<td></td>
<td>asia-south1</td>
<td>Mumbai</td>
</tr>
<tr>
<td></td>
<td>asia-southeast1</td>
<td>Singapore</td>
</tr>
<tr>
<td>Australia</td>
<td>australia-southeast1</td>
<td>Sydney</td>
</tr>
</tbody>
</table>

The Google Cloud Provider user credentials must have permissions to create and delete buckets and to add, modify, and delete files within the buckets they create. These are the minimum requirements:

- ListBucket
- PutBucket
- GetBucket
- DeleteBucket
- GetObject
- PutObject
- DeleteObject

**Note:**
Cloud Tier only supports Nearline and is selected automatically during setup.

**Procedure**

1. Select **Data Management > File System > Cloud Units**.
2. Click **Add**.
   The Add Cloud Unit dialog is displayed.
3. Enter a name for this cloud unit. Only alphanumeric characters are allowed.
   The remaining fields in the **Add Cloud Unit** dialog pertain to the cloud provider account.
4. For **Cloud provider**, select **Google Cloud Storage** from the drop-down list.
5. Enter the provider **Access key** as password text.
6. Enter the provider **Secret key** as password text.
7. **Storage class** is set as **Nearline** by default.
If a multi-regional location is selected (Asia, EU or US), then the storage class and the location constraint is Nearline Multi-regional. All other regional locations have the storage class set as Nearline Regional.

8. Select the Region.

9. Ensure that port 443 (HTTPS) is not blocked in firewalls. Communication with Google Cloud Provider occurs on port 443.

10. If an HTTP proxy server is required to get around a firewall for this provider, click Configure for HTTP Proxy Server.

   Enter the proxy hostname, port, user, and password.

   **Note:** There is an optional step to run the cloud provider verify tool before adding the cloud unit. This tool performs pre-check tests to ensure that all requirements are met before adding the actual cloud unit.

11. Click Add.

The file system main window now displays summary information for the new cloud unit as well as a control for enabling and disabling the cloud unit.

### Adding an S3 Flexible provider cloud unit

The Cloud Tier feature supports additional qualified S3 cloud providers under an S3 Flexible provider configuration option.

**About this task**

The S3 Flexible provider option supports the standard and standard-infrequent-access storage classes. The endpoints will vary depending on cloud provider, storage class and region. Be sure that DNS is able to resolve these hostnames before configuring cloud units.

**Procedure**

1. Select Data Management > File System > Cloud Units.

2. Click Add.

   The Add Cloud Unit dialog is displayed.

3. Enter a name for this cloud unit. Only alphanumeric characters are allowed.

   The remaining fields in the Add Cloud Unit dialog pertain to the cloud provider account.

4. For Cloud provider, select **Flexible Cloud Tier Provider Framework for S3** from the drop-down list.

5. Enter the provider **Access key** as password text.

6. Enter the provider **Secret key** as password text.

7. Specify the appropriate **Storage region**.

8. Enter the provider **Endpoint** in this format: http://<ip/hostname>:<port>. If you are using a secure endpoint, use https instead.

9. For **Storage class**, select the appropriate storage class from the drop-down list.

10. Ensure that port 443 (HTTPS) is not blocked in firewalls. Communication with the S3 cloud provider occurs on port 443.

11. If an HTTP proxy server is required to get around a firewall for this provider, click **Configure for HTTP Proxy Server**.

   Enter the proxy hostname, port, user, and password.
Note: There is an optional step to run the cloud provider verify tool before adding the cloud unit. This tool performs pre-check tests to ensure that all requirements are met before to adding the actual cloud unit.

12. Click Add.

The File System main window now displays summary information for the new cloud unit as well a control for enabling and disabling the cloud unit.

Modifying a cloud unit or cloud profile

About this task
Modify cloud unit credentials, an S3 Flexible provider name, or details of a cloud profile.

Modifying cloud unit credentials

Procedure
1. Select Data Management > File System > Cloud Units.
2. Click the pencil icon for the cloud unit whose credentials you want to modify.
   The Modify Cloud Unit dialog is displayed.
3. For Account name, enter the new account name.
4. For Access key, enter the new provider access key as password text.
   Note: Modifying the access key is not supported for ECS environments.
5. For Secret key, enter the new provider secret key as password text.
6. For Primary key, enter the new provider primary key as password text.
   Note: Modifying the primary key is only supported for Azure environments.
7. If an HTTP proxy server is required to get around a firewall for this provider, click Configure for HTTP Proxy Server.
8. Click OK.

Modifying an S3 Flexible provider name

Procedure
1. Select Data Management > File System > Cloud Units.
2. Click the pencil icon for the S3 Flexible cloud unit whose name you want to modify.
   The Modify Cloud Unit dialog is displayed.
3. For S3 Provider Name, enter the new provider name.
4. Click OK.

Using the CLI to modify a cloud profile

Procedure
1. Run the cloud profile modify command to modify the details of a cloud profile. The system prompts you to modify individual details of the cloud profile.
   For AWS S3, or Azure profiles, run this command to add a storage class to an existing cloud profile.
The profile details that can be modified depend on the cloud provider:

- Alibaba Cloud supports modification of the access key, and secret key.
- AWS S3 supports modification of the access key, and secret key.
- Azure supports modification of the access key, secret key, and primary key.
- ECS supports modification of the secret key.
- S3 Flexible supports modification of the access key, secret key, and provider name.

**Deleting a cloud unit**

This operation results in the loss of all data in the cloud unit selected for deletion. Be sure to delete all files before deleting the cloud units.

**Before you begin**

- Check if data movement to the cloud is running (CLI command: data-movement status). If it is, stop data movement using the “data-movement stop” CLI command.
- Check if cloud cleaning is running for this cloud unit (CLI command: cloud clean status). If it is, stop cloud cleaning using the “cloud clean” CLI command.
- Check if a data movement policy is configured for this cloud unit (CLI command: data-movement policy show). If it is, remove this policy using the “data-movement policy reset” CLI command.

**Procedure**

1. Use the following CLI command to identify files in the cloud unit.
   
   ```bash
   # filesys report generate file-location
   ```

2. Delete the files that are in the cloud unit to be deleted.

3. Use the following CLI command to run cloud cleaning.
   
   ```bash
   # cloud clean start unit-name
   ```
   
   Wait for cleaning to complete. The cleaning may take time depending on how much data is present in the cloud unit.

4. Disable the file system.

5. Use the following CLI command to delete the cloud unit.
   
   ```bash
   # cloud unit del unit-name
   ```
   
   Internally, this marks the cloud unit as DELETE_PENDING.

6. Use the following CLI command to validate that the cloud unit is in the DELETE_PENDING state.
   
   ```bash
   # cloud unit list
   ```

7. Enable the file system.

   The file system initiates the procedure in the background to delete any remaining objects from the buckets in the cloud for this cloud unit and then delete the buckets. This process can take a long time, depending on how many objects were remaining in these buckets. Until the bucket cleanup completes, this cloud unit continues to consume a slot on the protection system, which may prevent creation of a new cloud unit if both slots are occupied.

8. Periodically check the state using this CLI command:
# cloud unit list

The state remains DELETE_PENDING while the background cleanup is running.

9. Verify from the cloud provider S3 portal that all corresponding buckets have been deleted and the associated space has been freed up.

10. If needed, reconfigure data movement policies for affected MTrees and restart data movement.

**Results**

If you have difficulty completing this procedure, contact Support.

## Data movement

Data is moved from the active tier to the cloud tier as specified by your individual data movement policy. The policy is set on a per-MTree basis. Data movement can be initiated manually or automatically using a schedule.

### Adding data movement policies to MTrees

A file is moved from the Active to the Cloud Tier based on the date it was last modified. For data integrity, the entire file is moved at this time. The *Data Movement Policy* establishes the file age threshold, age range, and the destination.

**About this task**

| Note: A data movement policy cannot be configured for the /backup MTree. |

**Procedure**

1. Select Data Management > MTree.
2. In the top panel, select the MTree to which you want to add a data movement policy.
3. Click the Summary tab.
5. For File Age in Days, set the file age threshold (Older than) and optionally, the age range (Younger than).

| Note: The minimum number of days for Older than is 14. For nonintegrated backup applications, files moved to the cloud tier cannot be accessed directly and need to be recalled to the active tier before you can access them. So, choose the age threshold value as appropriate to minimize or avoid the need to access a file moved to the cloud tier. |

6. For Destination, specify the destination cloud unit.
7. Click Add.

### Moving data manually

You can start and stop data movement manually. Any MTree that has a valid data movement policy has its files moved.

**Procedure**

1. Select Data Management > File System.
2. At the bottom of the page, click Show Status of File System Services.

These status items are displayed:
Moving data automatically

You can move data automatically, using a schedule and a throttle. Schedules can be daily, weekly, or monthly.

Procedure

1. Select Data Management > File System > Settings.
2. Click the Data Movement tab.
3. Set the throttle and schedule.
   
   Note: The throttle is for adjusting resources for internal system processes; it does not affect network bandwidth.

   Note: If a cloud unit is inaccessible when cloud tier data movement runs, the cloud unit is skipped in that run. Data movement on that cloud unit occurs in the next run if the cloud unit becomes available. The data movement schedule determines the duration between two runs. If the cloud unit becomes available and you cannot wait for the next scheduled run, you can start data movement manually.

Recalling a file from the Cloud Tier

For nonintegrated backup applications, you must recall the data to the active tier before you can restore the data. Backup administrators must trigger a recall or backup applications must perform a recall before cloud-based backups can be restored. Once a file is recalled, its aging is reset and starts again from 0, and the file is eligible based on the age policy set. A file can be recalled on the same MTree only. Integrated applications can restore a file directly.

About this task

Note: In an MTree replication context, the file is read-only on the destination MTree.

Note: If a file resides only in a snapshot, it cannot be recalled directly. To recall a file in a snapshot, use fastcopy to copy the file from the snapshot back to the active MTree, then recall the file from the cloud. A file can only be recalled from the cloud to an active MTree.

Procedure

1. Select Data Management > File System > Summary.
2. Do one of the following:
   - In the Cloud Tier section of the Space Usage panel, click Recall.
   - Expand the File System status panel at the bottom of the screen and click Recall.
     Note: The Recall link is available only if a cloud unit is created and has data.
3. In the Recall File from Cloud dialog, enter the exact file name (no wildcards) and full path of the file to be recalled, for example: /data/coll/mt11/file1.txt. Click Recall.
4. To check the status of the recall, do one of the following:
In the Cloud Tier section of the Space Usage panel, click **Details**.

Expand the File System status panel at the bottom of the screen and click **Details**.

The Cloud File Recall Details dialog is displayed, showing the file path, cloud provider, recall progress, and amount of data transferred. If there are unrecoverable errors during the recall, an error message is displayed. Hover the cursor over the error message to display a tool tip with more details and possible corrective actions.

**Results**

Once the file has been recalled to the active tier, you can restore the data.

**Note:** For nonintegrated applications, once a file has been recalled from the cloud tier to the active tier, a minimum of 14 days must elapse before the file is eligible for data movement. After 14 days, normal data movement processing will occur for the file. The file now has to wait the age-threshold or age-range to move back to the cloud as this time the ptime will be examined rather than the mtime. This restriction does not apply to integrated applications.

**Note:** For data-movement, nonintegrated applications configure an age-based data movement policy on the protection system to specify which files get migrated to the cloud tier, and this policy applies uniformly to all files in an MTree. Integrated applications use an application-managed data movement policy, which lets you identify specific files to be migrated to the cloud tier.

**Using the CLI to recall a file from the cloud tier**

For nonintegrated backup applications, you must recall the data to the active tier before you can restore the data. Backup administrators must trigger a recall or backup applications must perform a recall before cloud-based backups can be restored. Once a file is recalled, its aging is reset and will start again from 0, and the file will be eligible based on the age policy set. A file can be recalled on the source MTree only. Integrated applications can recall a file directly.

**About this task**

**Note:** If a file resides only in a snapshot, it cannot be recalled directly. To recall a file in a snapshot, use fastcopy to copy the file from the snapshot back to the active MTree, then recall the file from the cloud. A file can only be recalled from the cloud to an active MTree.

**Procedure**

1. **Check the location of the file using:**
   ```bash
   filesys report generate file-location [path {<path-name> | all}] [output-file <filename>]
   ```
   The pathname can be a file or directory; if it is a directory, all files in the directory are listed.

<table>
<thead>
<tr>
<th>Filename</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>/data/coll/mt11/file1.txt</td>
<td>Cloud Unit 1</td>
</tr>
</tbody>
</table>

2. **Recall the file using:**
   ```bash
   data-movement recall path <path-name>
   ```
   This command is asynchronous, and it starts the recall.
   ```bash
   data-movement recall path /data/coll/mt11/file1.txt
   Recall started for "/data/coll/mt11/file1.txt".
   ```

3. **Monitor the status of the recall using:**
   ```bash
   data-movement status [path {pathname | all | [queued] [running] [completed] [failed]} | to-tier cloud | all]
   ```
   ```bash
   data-movement status path /data/coll/mt11/file1.txt
   Data-movement recall:
   ```
Data-movement for "/data/col1/mt11/file1.txt": phase 2 of 3 (Verifying)
80% complete; time: phase XX:XX:XX total XX:XX:XX
Copied (post-comp): XX XX, (pre-comp) XX XX

If the status shows that the recall isn't running for a given path, the recall may have finished, or it may have failed.

4. Verify the location of the file using
filesys report generate file-location [path {<path-name> | all}] [output-file <filename>]

<table>
<thead>
<tr>
<th>Filename</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>/data/col1/mt11/file1.txt</td>
<td>Active</td>
</tr>
</tbody>
</table>

Results

Once the file has been recalled to the active tier, you can restore the data.

**Note:** For nonintegrated applications, once a file has been recalled from the cloud tier to the active tier, a minimum of 14 days must elapse before the file is eligible for data movement. After 14 days, normal data movement processing will occur for the file. This restriction does not apply to integrated applications.

**Note:** For data-movement, nonintegrated applications configure an age-based data movement policy on the protection system to specify which files get migrated to the cloud tier, and this policy applies uniformly to all files in an MTree. Integrated applications use an application-managed data movement policy, which lets you identify specific files to be migrated to the cloud tier.

Direct restore from the cloud tier

Direct restore lets nonintegrated applications read files directly from the cloud tier without going through the active tier.

Key considerations in choosing to use direct restore include:

- Direct restore does not require an integrated application and is transparent for nonintegrated applications.
- Reading from the cloud tier does not require copying first into the active tier.
- Histograms and statistics are available for tracking direct reads from the cloud tier.
- Direct restore is supported only for ECS cloud providers.
- Applications do experience cloud tier latency.
- Reading directly from the cloud tier is not bandwidth optimized.
- Direct restore supports a small number of jobs.

Direct restore is useful with nonintegrated applications that do not need to know about the cloud tier and won’t need to restore cloud files frequently.

Using the CLI to configure Cloud Tier

You can use the CLI to configure Cloud Tier.

Procedure

1. Configure storage for both active and cloud tier. As a prerequisite, the appropriate capacity licenses for both the active and cloud tiers must be installed.
a. Ensure licenses for the features CLOUDTIER-CAPACITY and CAPACITY-ACTIVE are installed. To check the ELMS license:

```bash
# elicense show
```

If the license is not installed, use the `elicense update` command to install the license. Enter the command and paste the contents of the license file after this prompt. After pasting, ensure there is a carriage return, then press `Control-D` to save. You are prompted to replace licenses, and after answering yes, the licenses are applied and displayed.

```bash
# elicense update
```

Enter the content of license file and then press Control-D, or press `Control-C` to cancel.

b. Display available storage:

```bash
# storage show all
# disk show state
```

c. Add storage to the active tier:

```bash
# storage add enclosures <enclosure no> tier active
```

d. Add storage to the cloud tier:

```bash
# storage add enclosures <enclosure no> tier cloud
```

2. Install certificates.

Before you can create a cloud profile, you must install the associated certificates.

For AWS and Azure public cloud providers, root CA certificates can be downloaded from https://www.digicert.com/digicert-root-certificates.htm.

- For an AWS or Azure cloud provider, download the Baltimore CyberTrust Root certificate.
- For Alibaba, Alibaba download the GlobalSign Root R1 certificate from https://support.globalsign.com/customer/portal/articles/1426602-globalsign-rootcertificates.
- For ECS, the root certificate authority will vary by customer. Contact your load balancer provider for details.

Downloaded certificate files have a `.crt` extension. Use openssl on any Linux or Unix system where it is installed to convert the file from `.crt` format to `.pem`.

```bash
$ openssl x509 -inform der -in DigiCertHighAssuranceEVRootCA.crt -out DigiCertHighAssuranceEVRootCA.pem
$ openssl x509 -inform der -in BaltimoreCyberTrustRoot.crt -out BaltimoreCyberTrustRoot.pem
```

```bash
# adminaccess certificate import ca application cloud
```

Enter the certificate and then press Control-D, or press Control-C to cancel.

3. To configure the system for data-movement to the cloud, you must first enable the “cloud” feature and set the system passphrase if it has not already been set.

```bash
# cloud enable
```

Cloud feature requires that passphrase be set on the system.
Enter new passphrase:
Re-enter new passphrase:
Passphrases matched.
The passphrase is set.
Encryption is recommended on the cloud tier.

Do you want to enable encryption? (yes|no) [yes]:

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Encryption feature is enabled on the cloud tier.
Cloud feature is enabled.

4. Configure the cloud profile using the cloud provider credentials. The prompts and variables vary by provider.

```
# cloud profile add <profilename>
```

**Note:** For security reasons, this command does not display the access/secret keys you enter.

Select the provider:

```
Enter provider name (alibabacloud|aws|azure|ecs|google|s3_flexible)
```

- Alibaba Cloud requires access key, secret key, storage class and region.
- AWS S3 requires access key, secret key, storage class, and region.
- Azure requires account name, whether or not the account is an Azure Government account, primary key, secondary key, and storage class.
- ECS requires entry of access key, secret key and endpoint.
- Google Cloud Platform requires access key, secret key, and region. (Storage class is Nearline.)
- S3 Flexible providers require the provider name, access key, secret key, region, endpoint, and storage class.

At the end of each profile addition you are asked if you want to set up a proxy. If you do, these values are required: `proxy hostname`, `proxy port`, `proxy username`, and `proxy password`.

5. Verify the cloud profile configuration:

```
# cloud profile show
```

6. Create the active tier file system if it is not already created:

```
# filesys create
```

7. Enable the file system:

```
# filesys enable
```

8. Configure the cloud unit:

```
# cloud unit add unitname profile profilename

Use the `cloud unit list` command to list the cloud units.
```

9. Optionally, configure encryption for the cloud unit.
   a. Verify that the ENCRYPTION license is installed:

```
# elicense show
```

   b. Enable encryption for the cloud unit:

```
# filesys encryption enable cloud-unit unitname
```

   c. Check encryption status:

```
# filesys encryption status
```
10. Create one or more MTrees:

   # mtree create /data/coll/mt11

11. Verify the Cloud Tier configuration:

   # cloud provider verify
   
   This operation will perform test data movement after creating a temporary profile and bucket.
   
   Do you want to continue? (yes|no) [yes]:
   
   Enter provider name (aws|azure|ecs|s3_generic): aws
   
   Enter the access key:
   
   Enter the secret key:
   
   Enter the region (us-east-1|us-west-1|us-west-2|eu-west-1|apnortheast-1|ap-southeast-1|ap-southeast-2|
   sa-east-1|ap-south-1|ap-northeast-2|eu-central-1):
   
   Verifying cloud provider ...
   
   This process may take a few minutes.
   
   Cloud Enablement Check:
   
   Checking Cloud feature enabled: PASSED
   
   Checking Cloud volume: PASSED
   
   Connectivity Check:
   
   Checking firewall access: PASSED
   
   Validating certificate PASSED
   
   Account Validation:
   
   Creating temporary profile: PASSED
   
   Creating temporary bucket: PASSED
   
   S3 API Validation:
   
   Validating Put Bucket: PASSED
   
   Validating List Bucket: PASSED
   
   Validating Put Object: PASSED
   
   Validating Get Object: PASSED
   
   Validating List Object: PASSED
   
   Validating Delete Object: PASSED
   
   Validating Bulk Delete: PASSED
   
   Cleaning Up:
   
   Deleting temporary bucket: PASSED
   
   Deleting temporary profile: PASSED
   
   Provider verification passed.

12. Configure the file migration policy for this MTree. You can specify multiple MTrees in this command. The policy can be based on the age threshold or the range.

   a. To configure the age-threshold (migrating files older than the specified age to cloud):

      # data-movement policy set age-threshold age_in_days to-tier cloud cloud-unit unitname mtrees mtreename

   b. To configure the age-range (migrating only those files that are in the specified age-range):

      # data-movement policy set age-range min-age age_in_days max-age age_in_days to-tier cloud cloud-unit unitname mtrees mtreename

13. Export the file system, and from the client, mount the file system and ingest data into the active tier. Change the modification date on the ingested files such that they now qualify for data migration. (Set the date to older than the age-threshold value specified when configuring the data-movement policy.)

14. Initiate file migration of the aged files. Again, you can specify multiple MTrees with this command.
### Configuring encryption for DD cloud units

Encryption can be enabled at three levels: System, Active Tier, and cloud unit. Encryption of the Active Tier is only applicable if encryption is enabled for the system. Cloud units have separate controls for enabling encryption.

**Procedure**

1. Select *Data Management > File System > DD Encryption*.  
   ![Note: If no encryption license is present on the system, the Add Licenses page is displayed.](image)

2. In the DD Encryption panel, do one of the following:
   - To enable encryption for *Cloud Unit x*, click *Enable*.
   - To disable encryption for *Cloud Unit x*, click *Disable*.
   ![Note: You are prompted to enter security officer credentials to enable encryption.](image)

3. Enter the security officer *Username* and *Password*. Optionally, check *Restart file system now*.

4. Click *Enable* or *Disable*, as appropriate.

5. In the File System Lock panel, lock or unlock the file system.

6. In the Key Management panel, click *Configure*.

7. In the Change Key Manager dialog, configure security officer credentials and the key manager.
   ![Note: Cloud encryption is allowed only through the Embedded Key Manager. External key managers are not supported.](image)

8. Click *OK*.

9. Use the DD Encryption Keys panel to configure encryption keys.
Information needed in the event of system loss

Once Cloud Tier is configured, record the following information about the system and store it in a safe location apart from the system. This information will be needed to recover the Cloud Tier data in case the system is lost.

- Serial number of the original system
- System passphrase of the original system
- DD OS version number of the original system
- Cloud Tier profile and configuration information

Note: This process is designed for emergency situations only and will involve significant time and effort from the Dell EMC engineering staff.

Using DD Replicator with Cloud Tier

Collection replication is not supported on systems with Cloud Tier enabled.

Directory replication only works on the /backup MTree, and this MTree cannot be assigned to the Cloud Tier. So, directory replication is not affected by Cloud Tier.

Managed file replication and MTree replication are supported on Cloud Tier enabled systems. One or both systems can have Cloud Tier enabled. If the source system is Cloud Tier enabled, data may need to be read from the cloud if the file was already migrated to the Cloud Tier. A replicated file is always placed first in the Active Tier on the destination system even when Cloud Tier is enabled. A file can be recalled from the Cloud Tier back to the Active Tier on the source MTree only. Recall of a file on the destination MTree is not allowed.

Note: If the source system is running DD OS 5.6 or 5.7 and replicating into a Cloud Tier enabled system using MTree replication, the source system must be upgraded to a release that can replicate to a Cloud Tier enabled system. Please see the DD OS Release Notes system requirements.

Note: Files in the Cloud Tier cannot be used as base files for virtual synthetic operations. The incremental forever or synthetic full backups need to ensure that the files remain in the Active Tier if they will be used in virtual synthesis of new backups.

Using DD Virtual Tape Library (VTL) with Cloud Tier

On systems configured with Cloud Tier and DD VTL, the cloud storage is supported for use as the VTL vault. To use DD VTL tape out to cloud, license and configure the cloud storage first, and then select it as the vault location for the VTL.

DD VTL tape out to cloud on page 286 provides additional information about using VTL with Cloud Tier.

Displaying capacity consumption charts for Cloud Tier

Three charts are available for displaying Cloud Tier consumption statistics—Space Usage, Consumption, and Daily Written.

Procedure

1. Select Data Management > File System > Charts.
2. For **Chart**, select one of the following:
   - Space Usage
   - Consumption
   - Daily Written

3. For **Scope**, select **Cloud Tier**.
   - The **Space Usage Tab** displays space usage over time, in MiB. You can select a duration (one week, one month, three months, one year, or All). The data is presented (color-coded) as pre-compression used (blue), post-compression used (red), and the compression factor (green).
   - The **Consumption Tab** displays the amount of post-compression storage used and the compression ratio over time, which enables you to analyze consumption trends. You can select a duration (one week, one month, three months, one year, or All). The data is presented (color-coded) as capacity (blue), post-compression used (red), compression factor (green), cleaning (orange) and data movement (violet).
   - The **Daily Written Tab** displays the amount of data written per day. You can select a duration (one week, one month, three months, one year, or All). The data is presented (color-coded) as pre-compression written (blue), post-compression used (red), and the total compression factor (green).

### Cloud Tier logs

If Cloud Tier suffers a failure of any kind, in configuration or operation, the system automatically creates a folder with a timestamp that is associated with the time of the failure.

Mount the `/ddvar/log/debug` directory to access the logs.

| Note: The output of the `log list view` command does not list all the detailed log files that are created for the Cloud Tier failure. |

### Using the CLI to remove Cloud Tier

You can use the CLI to remove the Cloud Tier configuration.

#### Before you begin

Delete all files in the cloud units before removing the Cloud Tier configuration from the system.
Run the `filesys report generate file-location path all output-file file_loc` command to identify the files in the cloud units, and delete them from the NFS mount points of the MTrees.

| Note: The command above creates the report file_loc in the `/ddr/var/` directory. |

#### Procedure

1. Disable the file system.

   ```bash
   # filesys disable
   
   This action will disable the file system. Applications may experience interruptions while the file system is disabled.
   Are you sure? (yes|no) [no]: yes
   
   ok, proceeding.
   ```
2. List the cloud units on the system.

<table>
<thead>
<tr>
<th>Name</th>
<th>Profile</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>cloud_unit-1</td>
<td>cloudProfile</td>
<td>Active</td>
</tr>
<tr>
<td>cloud_unit-2</td>
<td>cloudProfile2</td>
<td>Active</td>
</tr>
</tbody>
</table>

3. Delete the cloud units individually.

```bash
# cloud unit del cloud_unit-1
This command irrevocably destroys all data in the cloud unit "cloud_unit-1".
Are you sure? (yes|no) [no]: yes
ok, proceeding.

Enter sysadmin password to confirm:

Destroying cloud unit "cloud_unit-1"
Cloud unit 'cloud_unit-1' deleted. The data in the cloud will be deleted asynchronously on the filesystem startup.

# cloud unit del cloud_unit-2
This command irrevocably destroys all data in the cloud unit "cloud_unit-2".
Are you sure? (yes|no) [no]: yes
ok, proceeding.

Enter sysadmin password to confirm:

Destroying cloud unit "cloud_unit-2"
Cloud unit 'cloud_unit-2' deleted. The data in the cloud will be deleted asynchronously on the filesystem startup.
```

4. Verify the delete operations are in progress.

<table>
<thead>
<tr>
<th>Name</th>
<th>Profile</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>cloud_unit-1</td>
<td>cloudProfile</td>
<td>Delete-Pending</td>
</tr>
<tr>
<td>cloud_unit-2</td>
<td>cloudProfile2</td>
<td>Delete-Pending</td>
</tr>
</tbody>
</table>

5. Restart the file system.

```bash
# filesys enable
Please wait.................................
The filesystem is now enabled.
```

6. Run the `cloud unit list` command to verify that neither cloud unit appears.

Contact Support if one or both cloud units still display with the status `Delete-Pending`.

7. Identify the disk enclosures that are assigned to Cloud Tier.

```bash
# storage show tier cloud
Cloud tier details:
<table>
<thead>
<tr>
<th>Disk</th>
<th>Disks</th>
<th>Count</th>
<th>Disk</th>
<th>Additional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>------</td>
<td>------</td>
<td></td>
<td>Information</td>
</tr>
</tbody>
</table>
```

Contact Support if one or both cloud units still display with the status `Delete-Pending`.
8. Remove the disk enclosures from Cloud Tier.

```
# storage remove enclosures 2, 3
Removing enclosure 2...Enclosure 2 successfully removed.
Updating system information...done
Successfully removed: 2 done
Removing enclosure 3...Enclosure 3 successfully removed.
Updating system information...done
Successfully removed: 3 done
```
Cloud Tier
CHAPTER 26
DD Retention Lock

This chapter includes:

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- Enabling DD Retention Lock on an MTree ........................................ 421
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DD Retention Lock overview

When data is locked on an MTree that is enabled with DD Retention Lock, DD Retention Lock helps ensure that data integrity is maintained. Any data that is locked cannot be overwritten, modified, or deleted for a user-defined retention period of up to 70 years.

There are two DD Retention Lock editions:

- **DD Retention Lock Governance Edition** retains the functionality of DD Retention Lock prior to DD OS 5.2. You can use DD Retention Lock Governance to define retention policies on data that is to be retained for a specific period of time to meet internal IT governance policies implemented by the system administrator.

- **DD Retention Lock Compliance Edition** enables you to meet the strictest data permanence requirements of regulatory standards, such as those of SEC 17a-4(f). The full list of regulatory standards includes:
  - CFTC Rule 1.31b
  - FDA 21 CFR Part 11
  - Sarbanes-Oxley Act
  - IRS 98025 and 97-22
  - ISO Standard 15489-1
  - MoREQ2010


Compliance with these standards ensures that files locked on a Data Domain or PowerProtect system using DD Retention Lock Compliance Edition software cannot be altered or destroyed before the retention period expires. DD Retention Lock Compliance Edition requires a security officer for implementation of policies. An audit log file is accessible by the administrator or security officer.

Each edition requires a separate, add-on license, and either or both can be used on a single system.

The retention-locking protocol is the same for both the DD Retention Lock Governance and Compliance Editions. The differences in use stem from the system behavior for the DD Retention Lock Compliance Edition, since it places strict restrictions to meet compliance requirements. For an overview, see the *EMC Data Domain Retention Lock Software – A Detailed Review* (a white paper) available at [https://www.dellemc.com/en-us/index.htm](https://www.dellemc.com/en-us/index.htm). Login is required.

The DD Retention Lock Governance Edition does not require a security officer and provides a higher degree of flexibility for archive data retention.

For archive compliance storage requirements, SEC rules require that a separate copy of retention-locked data must be stored with the same retention requirements as the original. Retention-locked files can be replicated using DD Replicator to another Data Domain or PowerProtect system. If a retention-locked file is replicated, it remains retention locked on the destination system, with the same level of protection as the source file.

DD Retention Lock Governance Edition is supported for on-premises, cloud-based, and DD3300 DD VE instances. DD Retention Lock Compliance Edition is not supported for on-premises, cloud-based, or DD3300 DD VE instances.

The topics that follow provide additional information on DD Retention Lock.
DD Retention Lock protocol

Only files that are explicitly committed to be retention-locked files are retention locked on the protection system. Files are committed to be retention-locked files through client-side file commands issued while DD Retention Lock Governance or Compliance is enabled on the MTree containing the files.

Note: Linux, Unix, and Windows client environments are supported.

Files that are written to shares or exports that are not committed to be retained (even if DD Retention Lock Governance or Compliance is enabled on the MTree containing the files) can be modified or deleted at any time.

Retention locking prevents any modification or deletion of files under retention from occurring directly from CIFS shares or NFS exports during the retention period specified by a client-side atime update command. Some archive applications and backup applications can issue this command when appropriately configured. Applications or utilities that do not issue this command cannot lock files using DD Retention Lock.

Retention-locked files are always protected from modification and premature deletion, even if retention locking is subsequently disabled or if the retention-lock license is no longer valid.

You cannot rename or delete non-empty folders or directories within an MTree that is retention-lock enabled. However, you can rename or delete empty folders or directories and create new ones.

The retention period of a retention-locked file can be extended (but not reduced) by updating the file’s atime.

For both DD Retention Lock Governance and Compliance, once the retention period for a file expires, the file can be deleted using a client-side command, script, or application. However, the file cannot be modified even after the retention period for the file expires. The system never automatically deletes a file when its retention period expires.

DD Retention Lock flow

The general flow of activities with DD Retention Lock.

1. Enable MTrees for DD Retention Lock Governance or Compliance retention locking using the DD System Manager or DD OS commands issued from the system console.

2. Commit files to be retention locked on the protection system using client-side commands issued by an appropriately configured archiving or backup application, manually, or via scripts.

   Note: Windows clients may need to download utility programs for DD OS compatibility.


4. Optionally, delete files with expired retention periods using client-side commands.

Automatic retention lock

The automatic retention lock functionality allows you to set automatic values for the retention period, and the lock delay (the time before a file becomes locked) on a per MTree basis. The automatic retention lock settings apply to new files created on the MTree after the retention lock settings are configured. Existing files are not impacted. This feature is supported for both Retention Lock Compliance and Retention Lock Governance.

Set the automatic retention period to ensure that every new file created on the MTree will be automatically locked and retained for the specified amount of time.

Set the automatic lock delay on the MTree to allow a period of time where a new file can be modified before it gets locked.
Automatic retention lock is subject to the following limitations:

- Retention Lock must be re-applied manually to any files reverted when automatic retention lock is in use.
- MTree replication of an MTree with automatic retention lock enabled to a system with an earlier version of DD OS that does not support automatic retention lock, results in the locked files replicating to the target system as regular files.
- In Automatic Retention Lock, for the files which are being ingested, the `mtree retention-lock report generate` command may incorrectly report those files as locked as well report an incorrect cooling off period.
- After configuration, automatic retention lock cannot be disabled on Retention Lock Compliance or Retention Lock Governance-enabled systems.
- After it is set, the automatic retention period cannot be reset on Retention Lock Compliance or Retention Lock Governance-enabled systems.

**Supported data access protocols**

DD Retention Lock is compatible with industry-standard, NAS-based Write-Once-Read-Many (WORM) protocols, and integration is qualified with archive applications such as Symantec Enterprise Vault, SourceOne, Cloud Tiering Appliance, or DiskXtender. Customers using backup applications such as CommVault can also develop custom scripts to use DD Retention Lock.

The protocol support of DD Retention Lock is as follows:

- NFS is supported with both DD Retention Lock Governance and Compliance.
- CIFS is supported with both DD Retention Lock Governance and Compliance.
- Automatic retention lock is supported on NFS and CIFS with both Retention Lock Governance and Compliance.
- DD VTL is supported with DD Retention Lock Governance, but not with DD Retention Lock Compliance. Automatic retention lock is not supported on DD VTL.

Virtual tapes, here referred to as *tapes*, are represented as files on the file system.

- You can retention-lock one or more tapes using the `vtl tape modify` command, described in the *DD OS Command Reference Guide*. The `mtree retention-lock revert path` command can be used to revert the retention-locked state of tapes that are locked with the `vtl tape modify` command. After the tape is unlocked, updates can be made to it. The unlocked state will not be visible via the DD System Manager or CLI until the DD VTL service is disabled then enabled. However, updates are applied to the unlocked tape. This capability is only for the DD Retention Lock Governance Edition.
- The retention time for tapes can be displayed using the `vtl tape show` command with the `time-display retention` argument.
- You can retention-lock an individual tape using the DD System Manager.
- DD Boost is supported with both DD Retention Lock Governance and Compliance. Automatic retention lock is not supported on DD Boost.

If client-side scripts are used to retention-lock backup files or backup images, and if a backup application (Veritas NetBackup, for example) is also used on the system via DD Boost, be aware that the backup application may not share the context of the client-side scripts. Thus, when a backup application attempts to expire or delete files that were retention locked via the client-side scripts, space is not released on the Data Domain or PowerProtect system.
Dell EMC recommends that administrators change their retention period policy to align with the retention lock time. This applies to many of the backup applications that are integrated with DD Boost, including Veritas NetBackup, Veritas Backup Exec, and NetWorker.

Setting retention lock during data ingest to a DD BOOST file in DSP mode is not allowed, and the client setting the RL receives an error. Retention lock should be set after the data ingest is complete.

Setting retention lock during data ingest to a DD BOOST file in OST mode, or to an NFS file is not allowed and the client writing the data receives error as soon as RL is set. The partial file written before RL is set and committed to disk as a worm file.

**Compliance mode on iDRAC**

DD6900, DD9400, and DD9900 systems require that compliance mode be enabled on iDRAC before Retention Lock Compliance can be configured on the system.

Navigate to Administration > Compliance to view, and enable or disable iDRAC compliance access for DD6900, DD9400, and DD9900 systems.

The **Enabled Administrators** table displays the iDRAC administrator users currently enabled on the PowerProtect system, and the amount of time those users will be allowed to access the system.

The **iDRAC Users** table displays the iDRAC users currently configured on the system, the role for each user, and whether access for that user is enabled or disabled.

**Create an iDRAC user account**

Enable compliance mode on iDRAC for DD6900, DD9400, and DD9900 systems to use DD Retention Lock Compliance.

**Before you begin**

This task is only for DD6900, DD9400, and DD9900 systems.

Configure a security officer authorization policy on the system, and run the `system retention-lock configure` command to configure Retention Lock Compliance Edition on the system.

**Procedure**

1. Select Administration > Compliance.
2. Click **Enable Retention Lock Compliance**.
   
   ![Note](image)

   **Note:** This button is only available if Retention Lock Compliance Edition has been configured.
3. Specify the security officer credentials, and click **Enable**.
4. Create one or more iDRAC user accounts.
   a. In the **Role** list box, select **Administrator (Disabled)** or **Operator (Enabled)**.
   b. In the **Username** field, specify a username for the iDRAC user account.
   c. In the **Password** and **Confirm Password** fields, specify a password for the iDRAC user account.
   d. Click **Add User** to add the user.
   e. Specify details for another user account, or click **Save** to proceed.
Request PowerProtect access for iDRAC administrators

Request PowerProtect access for iDRAC administrator users for DD6900, DD9400, and DD9900 systems to use DD Retention Lock Compliance.

Before you begin
This task is only for DD6900, DD9400, and DD9900 systems.

Procedure
1. Select Administration > Compliance.
2. Select an iDRAC administrator from the iDRAC Users table.
3. Click Enable.
4. Specify the security officer credentials, and click OK.
5. In the Duration list box, select the amount of time to allow access and click OK.

Extend PowerProtect access for iDRAC administrators

Extend PowerProtect access for iDRAC administrator users for DD6900, DD9400, and DD9900 systems when access is required for a longer period of time.

Before you begin
This task is only for DD6900, DD9400, and DD9900 systems.

Procedure
1. Select Administration > Compliance.
2. Select an iDRAC administrator from the Enabled Administrators table.
3. Click Enable and select the duration from the list box.
4. Specify the security officer credentials, and click Authorize.
5. In the Duration list box, select the amount of time to allow access and click Save.
6. Click Yes at the confirmation prompt.

Disable PowerProtect access for iDRAC administrators

Disable PowerProtect access for iDRAC administrator users for DD6900, DD9400, and DD9900 systems when access is no longer required.

Before you begin
This task is only for DD6900, DD9400, and DD9900 systems.

Procedure
1. Select Administration > Compliance.
2. Select an iDRAC administrator from the iDRAC Users table.
3. Click Disable.
4. Specify the security officer credentials, and click OK.
Enabling DD Retention Lock on an MTree

Only files within DD Retention Lock Governance or Compliance enabled MTrees can be retention-locked.

MTrees enabled for DD Retention Lock Compliance cannot be converted to DD Retention Lock Governance MTrees and vice versa.

The procedures that follow show how to enable MTrees for either DD Retention Lock Governance or DD Retention Lock Compliance.

Enabling DD Retention Lock Governance on an MTree

Add a DD Retention Lock Governance license to a system, and then enable DD Retention Lock Governance on one or more MTrees.

Procedure

1. Add the DD Retention Lock Governance license, if it is not listed under Feature Licenses.
   a. Select Administration > Licenses
   b. In the Licenses area click Add Licenses.
   c. In the License Key text box, type the license key.
      Note: License keys are case-insensitive. Include the hyphens when typing keys.
   d. Click Add.

2. Select an MTree for retention locking.
   a. Select Data Management > MTree.
   b. Select the MTree you want to use for retention locking. You can also create an empty MTree and add files to it later.

3. Click the MTree Summary tab to display information for the selected MTree.

4. Scroll down to Retention Lock area and click Edit to the right of Retention Lock.

5. Enable DD Retention Lock Governance on the MTree and change the default minimum and maximum retention lock periods for the MTree, if required.

   Perform the following actions in the Modify Retention Lock dialog box:
   a. Select Enabled to enable DD Retention Lock Governance on the MTree.
   b. In the Use drop-down list, select Manual or Automatic.

   • For manual retention lock, to change the minimum or maximum retention period for the MTree:
     a. Type a number for the interval in the text box (for example, 5 or 14).
     b. From the drop-down list, select an interval (minutes, hours, days, years).
        Note: Specifying a minimum retention period of less than 12 hours, or a maximum retention period longer than 70 years, results in an error.

   • For automatic retention lock, to change the minimum, maximum, or automatic retention period, or the automatic lock delay for the MTree:
     a. Type a number for the interval in the text box (for example, 5 or 14).
b. From the drop-down list, select an interval (minutes, hours, days, years).  

   **Note:** Specifying a minimum retention period of less than 12 hours, a maximum retention period longer than 70 years, an automatic retention period that does not fall between the minimum and maximum values, or an automatic lock delay less than 5 minutes or more than 7 days results in an error.

   **Note:** If a file is modified before the automatic lock delay has elapsed, the lock delay time starts over when the file modification is complete. For example, if the lock delay is 120 minutes and the file is modified after 60 minutes, the lock delay will start again at 120 minutes after the file is modified.

c. Click **OK** to save the settings.

   After you close the Modify Retention Lock dialog box, which is updated MTree information appears in the Retention Lock area.

6. Check retention lock information for the MTree.

Note the following retention lock fields:

- **Top:**
  - The Status field indicates the read/write access for the MTree, the type of retention locking on the MTree, and whether retention locking is enabled or disabled.

- **Bottom:**
  - The Status field indicates whether retention locking is enabled for the MTree.
  - The Retention Period field indicates minimum and maximum retention periods for the MTree. The retention period that is specified for a file in the MTree must be equal to or greater than the minimum retention period and equal to or less than the maximum retention period.
  - The UUID field is a unique identification number that is generated for the MTree.

   **Note:** To check retention lock configuration settings for any MTree, select the MTree in the Navigation Panel, then click the Summary tab.

---

**After you finish**

Retention-lock files in a retention-lock-enabled MTree.

### Enabling DD Retention Lock Compliance on an MTree

Add a DD Retention Lock Compliance license to a system, set up a system administrator and one or more security officers, configure and enable the system to use DD Retention Lock Compliance software, and then enable DD Retention Lock Compliance on one or more MTrees.

**About this task**

Enabling Retention Lock Compliance on a DD6900, DD9400, or DD9900 system locks down the iDRAC GUI and SSH interfaces. Do not use the iDRAC interfaces to create additional iDRAC users because DD OS automatically disables those new users and reboots the system. Use the `user idrac create` command to create new iDRAC users after enabling Retention Lock Compliance.

**Procedure**

1. Add the DD Retention Lock Compliance license on the system, if it is not present.
   a. First, check whether the license is already installed.

      `elicence show`
b. If the RETENTION-LOCK-COMPLIANCE feature is not displayed, install the license.

```
elicense update license-file
```

2. Set up one or more security officer users accounts according to Role-Base Access Control (RBAC) rules.

a. In the system administrator role, add a security officer account.

```
user add user role security
```

b. Enable the security officer authorization.

```
authorization policy set security-officer enabled
```

3. Configure and enable the system to use DD Retention Lock Compliance.

```
Note: Enabling DD Retention Lock Compliance enforces many restrictions on low-level access to system functions used during troubleshooting. Once enabled, the only way to disable DD Retention Lock Compliance is to initialize and reload the system, which results in destroying all data on the system.

CAUTION: When setting the lock period for Retention Lock Compliance MTrees, users cannot set the period to be less than the current minimum or maximum period allowed. Doing so generates a message notifying the user that the entry was invalid and stating the minimum or maximum retention period allowed.
```

a. Configure the system to use DD Retention Lock Compliance.

```
system retention-lock compliance configure
```

The system automatically reboots.

b. After the restart process is complete, enable DD Retention Lock Compliance on the system.

```
system retention-lock compliance enable
```

4. Enable compliance on an MTree that will contain retention-locked files.

```
mtree retention-lock enable mode compliance mtree mtree-path
```

```
Note: Compliance cannot be enabled on /backup or pool MTrees.
```

5. To change the default minimum and maximum retention lock periods for a compliance-enabled MTree, type the following commands with security officer authorization.

```
• mtree retention-lock set min-retention-period period mtree mtree-path
• mtree retention-lock set max-retention-period period mtree mtree-path
```

```
Note: The retention period is specified in the format [number] [unit]. For example: 1 min, 1 hr, 1 day, 1 mo, or 1 year. Specifying a minimum retention period of less than 12 hours, or a maximum retention period longer than 70 years, results in an error.
```

6. To change the automatic retention period and automatic lock delay for a compliance-enabled MTree, type the following commands with security officer authorization.

```
• mtree retention-lock set automatic-retention-period period mtree mtree-path
```

```
Note: The automatic retention period is specified in the format [number] [unit]. For example: 1 min, 1 hr, 1 day, 1 mo, or 1 year. The value must be between the minimum and maximum retention periods.
```
Client-Side Retention Lock file control

This section describes the DD Retention Lock client command interface for locking files stored on the protection system. Client commands are the same for DD Retention Lock Governance and Compliance. Linux, Unix, and Windows client environments are supported; however, Windows clients may need to download utility programs with commands to lock files.

Note: If your application already supports industry-standard WORM, writing a WORM file to a DD Retention Lock Governance or Compliance enabled MTree will lock the file on the system. The retention time in the application should agree with the DD Retention Lock settings. You do not need to use the commands described in this section. To check whether an application is tested and certified for the DD Retention Lock, refer to the Data Domain Archive Application Compatibility Guide.

Note: Some client machines using NFS, but running a legacy OS, cannot set retention time later than 2038. The NFS protocol doesn’t impose the 2038 limit and allows to specifying times until 2106. Further, DD OS doesn’t impose the 2038 limit.

Client-side commands are used to manage the retention locking of individual files. These commands apply to all retention-lock-capable systems and must be issued in addition to the setup and configuration of DD Retention Lock on the system.

Required Tools for Windows Clients

You need the touch.exe command to perform retention-locking from a Windows-based client.

To obtain this command, download and install utilities for Linux/Unix-based applications according to your Windows version. These utilities are best recommendations from Dell EMC and should be used per customer environment.

- For Windows Server 2003 SP1 and Windows Server 2003 R2: 

Note: The touch command for Windows may have a different format than the Linux examples in this chapter.

Follow the installation instructions provided and set the search path as needed on the client machine.
Client Access to System Files

After an MTree is enabled for DD Retention Lock Governance or Compliance, you can:

- Create a CIFS share based on the MTree. This CIFS share can be used on a client machine.
- Create an NFS mount for the MTree and access its files from the NFS mount point on a client machine.

**Note:** The commands listed in this section are to be used only on the client. They cannot be issued through the DD System Manager or CLI. Command syntax may vary slightly, depending on the utility you are using.

The topics that follow describe how to manage client-side retention lock file control.

Setting Retention Locking on a file

To perform retention locking on a file, change the last access time (`atime`) of the file to the desired retention time of the file, that is, the time when the file can be deleted.

This action is usually performed using the archive application, and all the archive applications that are qualified on the protection system today (per the *Data Domain Archive Application Compatibility Guide*) follow the basic locking protocol outlined here.

The future `atime` you specify must respect the minimum and maximum retention periods of the file’s MTree (as offsets from the current time), as shown in the next figure.

**Figure 17** Valid and invalid `atimes` for retention locking files

For DD Retention Lock Governance and Compliance

![Retention Lock Diagram](image-url)
Note: Some client machines using NFS, but running a legacy OS, cannot set retention time later than 2038. The NFS protocol doesn’t impose the 2038 limit and allows to specifying times until 2106. Further, DD OS doesn’t impose the 2038 limit.

Errors are permission-denied errors (referred to as EACCESS, a standard POSIX error). These are returned to the script or archive application setting the atime.

Note: A file must be completely written to the system before it is committed to be a retention-locked file.

The following command can be used on clients to set the atime:

touch -a -t \[atime\] \[filename\]

The format of atime is:

\[[YY YY MMDDhhmm[.ss]\]

For example, suppose the current date and time is 1 p.m. on January 18, 2012 (that is, 201201181300), and the minimum retention period is 12 hours. Adding the minimum retention period of 12 hours to that date and time results in a value of 201201190100. Therefore, if the atime for a file is set to a value greater than 201201190100, that file becomes retention locked.

The following command:

ClientOS# touch -a -t 201412312230 SavedData.dat

will lock file SavedData.dat until 10:30 p.m. December 31, 2014.
Extending Retention Locking on a file

To extend the retention time of a retention-locked file, set the file’s atime to a value greater than the file’s current atime but less than the maximum retention period of the file’s MTree (as an offset from the current time), as shown in the next figure.

**Figure 18** Valid and invalid atimes for extending retention locking on files

- **For DD Retention Lock Governance and Compliance:**
  - If extended atime < current atime and minimum retention period
    - Retention time is not extended
    - An error message is generated

- **For DD Retention Lock Governance:**
  - If extended atime > maximum retention period
    - Retention time is not extended
    - An error is generated

- **For DD Retention Lock Compliance:**
  - If extended atime > 70 years
    - Retention time is not extended
    - An error message is generated

**Extended file retention specification:**

- **Current time**
- **Retention Lock Governance**
- **Retention Lock Compliance**
- **MTree retention specification:**
  - Greater of current atime or minimum retention period
  - Maximum retention period

For example, changing the atime from 201412312230 to 202012121230 using the following command:

```
ClientOS# touch -a -t 202012121230 SavedData.dat
```

will cause the file to be locked until 12:30 p.m. December 12, 2020.

**Note:** Some client machines using NFS, but running a very old OS, cannot set retention time later than 2038. The NFS protocol doesn’t impose the 2038 limit and allows to specifying times until 2106. Further, DD OS doesn’t impose the 2038 limit.
Errors are permission-denied errors (referred to as EACCESS, a standard POSIX error). These are returned to the script or archive application setting the atime.

**Identifying a Retention-Locked file**

The atime value for a retention-locked file is its retention time. To determine whether a file is retention locked, try to set the atime of the file to a value earlier than its current atime. This action will fail with a permission-denied error if and only if the file is a retention-locked file.

First, list the current atime value, and then execute the `touch` command with an earlier atime using these commands:

```
l -l --time=atime [filename]
t -a -t [atime] [filename]
```

The following example shows the command sequence:

```
ClientOS# ls -l --time=atime SavedData.dat
202012121230
ClientOS# touch -a -t 202012111230 SavedData.dat
```

If the atime of SavedData.dat is 202012121230 (12:30 p.m. December 12, 2020) and the touch command specifies an earlier atime, 202012111230 (12:30 p.m. December 11, 2020), the touch command fails, indicating that SavedData.dat is retention-locked.

**Note:** The --time=atime option is not supported in all versions of Unix.

**Specifying a directory and touching only those files**

Use the command line to create a root directory containing the files for which access times will change.

In this routine, root directory to start from contains the files on which you want to change access times using this client system command:

```
find [root directory to start from] -exec touch -a -t [expiration time] {} \;
```

For example:

```
ClientOS# find [/backup/data1/] -exec touch -a -t 202012121230 {} \;
```

**Reading a list of files and touching only those files**

In this routine, name of file list is the name of a text file that contains the names of the files on which you want to change access times. Each line contains the name of one file.

Here is the client system command syntax:

```
t -a -t [expiration time] 'cat [name of file list]'
```

For example:

```
ClientOS# touch -a -t 202012121230 'cat /backup/data1/filelist.txt'
```

**Deleting or expiring a file**

Delete or expire a file with an expired retention lock using a client application, or delete a file using a standard file-delete command.

Expiring a file using an application makes the file inaccessible to the application. The file may or may not actually be removed from the protection system by the expiration operation. If it is not removed, the application often provides a separate delete operation. You must have the appropriate access rights to delete the file, independent of DD Retention Lock.
Note: If the retention period of the retention-locked file has not expired, the delete operation results in a permission-denied error.

Note: For more information, refer to KB article 516962 Data Domain: How to delete data.

Privileged delete

For DD Retention Lock Governance (only), you can delete retention locked files using this two step process.

Procedure

1. Use the mtree retention-lock revert path command to revert the retention locked file.
2. Delete the file on the client system using the rm filename command.

Using ctime or mtime on Retention-Locked files

ctime is the last-metadata-change time of a file.

ctime

ctime gets set to the current time when any of the follow events occur:

- A non-retention-locked file is retention locked.
- The retention time of a retention-locked file is extended.
- A retention-locked file is reverted.

Note: User access permissions for a retention-locked file are updated using the Linux command line tool chmod.

mtime

mtime is the last-modified time of a file. It changes only when the contents of the file change. So, the mtime of a retention-locked file cannot change.

System behavior with DD Retention Lock

System behavior topics are discussed separately for DD Retention Lock Governance and DD Retention Lock Compliance in the sections that follow.

DD Retention Lock governance

Certain DD OS commands behave differently when using DD Retention Lock Governance. The following sections describe the differences for each.

Replication

Collection replication, MTTree replication, and directory replication replicate the locked or unlocked state of files.

Files that are governance retention locked on the source are governance retention locked on the destination and have the same level of protection. For replication, the source system must have a DD Retention Lock Governance license installed—a license is not required on the destination system.

Replication is supported between systems that are:

- Running the same major DD OS version (for example, both systems are running DD OS 5.5.x.x).
• Running DD OS versions within the next two consecutive higher or lower major releases (for example, 5.3.x.x to 5.5.x.x or 5.5.x.x to 5.3.x.x). Cross-release replication is supported only for directory and MTree replication.

**Note**: MTree replication is not supported for DD OS 5.0 and earlier.

Be aware that:

• Collection replication and MTree replication replicate the minimum and maximum retention periods configured on MTrees to the destination system.

• Directory replication does not replicate the minimum and maximum retention periods to the destination system.

The procedure for configuring and using collection, MTree, and directory replication is the same as for protection systems that do not have a DD Retention Lock Governance license.

**Replication Resync**

The `replication resync destination` command tries to bring the destination into sync with the source when the MTree or directory replication context is broken between destination and source systems. This command cannot be used with collection replication. Note that:

• If files are migrated to the cloud tier before the context is broken, the MTree replication resync overwrites all the data on the destination, so you will need to migrate the files to the cloud tier again.

• If the destination directory has DD Retention Lock enabled, but the source directory does not have DD Retention Lock enabled, then a resync of a directory replication will fail.

• With Mtree replication, resync will fail if the source MTree does not have retention lock enabled and the destination MTree has retention lock enabled.

• With MTree replication, resync will fail if the source and destination MTrees are retention lock enabled but the propagate retention lock option is set to FALSE.

**Fastcopy**

When the `filesys fastcopy [retention-lock] source src destination dest` command is run on a system with a DD Retention Lock Governance enabled MTree, the command preserves the retention lock attribute during the fastcopy operation.

**Note**: If the destination MTree is not retention lock enabled, the retention-lock file attribute is not preserved.

**Filesys destroy**

Effects of the `filesys destroy` command when it is run on a system with a DD Retention Lock Governance enabled MTree.

• All data is destroyed, including retention-locked data.

• All filesys options are returned to their defaults. This means that retention locking is disabled and the minimum and maximum retention periods are set back to their default values on the newly created file system.

**Note**: This command is not allowed if DD Retention Lock Compliance is enabled on the system.
**MTree delete**

When the `mtree delete mtree-path` command attempts to delete a DD Retention Lock Governance enabled (or previously enabled) MTree that currently contains data, the command returns an error.

**Note:** The behavior of `mtree delete` is similar to a command to delete a directory—an MTree with retention lock enabled (or previously enabled) can be deleted only if the MTree is empty.

**DD Retention Lock compliance**

Certain DD OS commands behave differently when using DD Retention Lock Compliance. The following sections describe the differences for each.

**Replication**

An MTree enabled with DD Retention Lock Compliance can be replicated via MTree and collection replication only. Directory replication is not supported.

MTree and collection replication replicate the locked or unlocked state of files. Files that are compliance retention locked on the source are compliance retention locked on the destination and have the same level of protection. Minimum and maximum retention periods configured on MTrees are replicated to the destination system.

To perform collection replication, the same security officer user must be present on both the source and destination systems before starting replication to the destination system and afterward for the lifetime of the source/replica pair.

**Replication Resync**

The `replication resync destination` command can be used with MTree replication, but not with collection replication.

- If the destination MTree contains retention-locked files that do not exist on the source, then resync will fail.
- Both source and destination MTrees must be enabled for DD Retention Lock Compliance, or resync will fail.

**Replication procedures**

The topics in this section describe MTree and collection replication procedures supported for DD Retention Lock Compliance.

**Replicating an MTree: One-to-one topology**

Replicate a DD Retention Lock Compliance enabled MTree from a source system to a destination system.

**Before you begin**

Enable DD Retention Lock on an MTree and configure client-side retention lock file control before replication.

**Procedure**

1. Until instructed otherwise, perform the following steps on the destination system only.
2. Add the DD Retention Lock Compliance license on the system, if it is not present.
   a. First, check whether the license is already installed.
      ```
      elicense show
      ```
   b. If the RETENTION-LOCK-COMPLIANCE feature is not displayed, install the license.
      ```
      elicense update license-file
      ```
3. Set up one or more security officer users accounts according to Role-Base Access Control (RBAC) rules.
   a. In the system administrator role, add a security officer account.
      ```
      user add user role security
      ```
   b. Enable the security officer authorization.
      ```
      authorization policy set security-officer enabled
      ```
4. Configure and enable the system to use DD Retention Lock Compliance.
   □ Note: Enabling DD Retention Lock Compliance enforces many restrictions on low-level access to system functions used during troubleshooting. Once enabled, the only way to disable DD Retention Lock Compliance is to initialize and reload the system, which results in destroying all data on the system.
   CAUTION When setting the lock period for Retention Lock Compliance MTrees, users cannot set the period to be less than the current minimum or maximum period allowed. Doing so generates a message notifying the user that the entry was invalid and stating the minimum or maximum retention period allowed.
   a. Configure the system to use DD Retention Lock Compliance.
      ```
      system retention-lock compliance configure
      ```
      The system automatically reboots.
   b. After the restart process is complete, enable DD Retention Lock Compliance on the system.
      ```
      system retention-lock compliance enable
      ```
5. Create a replication context.
   ```
   replication add source mtree://source-system-name/data/col1/mtree-name destination mtree://destination-system-name/data/col1/mtree-name
   ```
6. Perform the following steps on the source system only.
7. Create a replication context.
   ```
   replication add source mtree://source-system-name/data/col1/mtree-name destination mtree://destination-system-name/data/col1/mtree-name
   ```
8. Initialize the replication context.
   ```
   replication initialize mtree://destination-system-name/data/col1/mtree-name
   ```
9. Confirm that replication is complete.
   ```
   replication status mtree://destination-system-name/data/col1/mtree-name detailed
   ```
This command reports 0 pre-compressed bytes remaining when replication is finished.

**Replicating an MTree: One-to-many topology**

Replicate a DD Retention Lock Compliance enabled MTree from a source system to multiple destination systems.

**Before you begin**

Enable DD Retention Lock compliance on an MTree and configure client-side retention lock file control before replication.

**Procedure**

1. Until instructed otherwise, perform the following steps on the destination system only.
2. Add the DD Retention Lock Compliance license on the system, if it is not present.
   a. First, check whether the license is already installed.
      
      ```
      elicense show
      ```
   b. If the RETENTION-LOCK-COMPLIANCE feature is not displayed, install the license.
      
      ```
      elicense update license-file
      ```
3. Set up one or more security officer users accounts according to Role-Base Access Control (RBAC) rules.
   a. In the system administrator role, add a security officer account.
      
      ```
      user add user role security
      ```
   b. Enable the security officer authorization.
      
      ```
      authorization policy set security-officer enabled
      ```
4. Configure and enable the system to use DD Retention Lock Compliance.

   ![Note](image)
   
   **Note:** Enabling DD Retention Lock Compliance enforces many restrictions on low-level access to system functions used during troubleshooting. Once enabled, the only way to disable DD Retention Lock Compliance is to initialize and reload the system, which results in destroying all data on the system.

   ![Caution](image)
   
   **CAUTION** When setting the lock period for Retention Lock Compliance MTrees, users cannot set the period to be less than the current minimum or maximum period allowed. Doing so generates a message notifying the user that the entry was invalid and stating the minimum or maximum retention period allowed.

   a. Configure the system to use DD Retention Lock Compliance.
      
      ```
      system retention-lock compliance configure
      ```
      The system automatically reboots.
   b. After the restart process is complete, enable DD Retention Lock Compliance on the system.
      
      ```
      system retention-lock compliance enable
      ```
5. Create a replication context.

   ```
   replication add source mtree://source-system-name/data/coll/mtree-name destination mtree://destination-system-name/data/coll/mtree-name
   ```
6. Perform the following steps on the source system only.
7. Create a replication context for each destination system.
   
   ```
   replication add source mtree://source-system-name/data/coll/mtree-name destination mtree://destination-system-name/data/coll/mtree-name
   ```

8. Initialize the replication context for each destination system MTree.
   
   ```
   replication initialize mtree://destination-system-name/data/coll/mtree-name
   ```

9. Confirm that replication is complete for each destination system.
   
   ```
   replication status mtree://destination-system-name/data/coll/mtree-name detailed
   ```
   
   This command reports 0 pre-compressed bytes remaining when replication is finished.

Adding DD Retention Lock Compliance protection to an existing MTree replication pair

Add DD Retention Lock Compliance protection to an existing MTree replication pair that is not enabled for retention locking.

**Procedure**

1. Until instructed otherwise, perform the following steps on both the source and destination systems.

2. Log in to the DD System Manager.
   
   The DD System Manager window appears with **DD Network** in the Navigation panel.

3. Select a protection system.
   
   In the Navigation panel, expand **DD Network** and select a system

4. Add the DD Retention Lock Governance license, if it is not listed under Feature Licenses.
   
   a. Select **Administration > Licenses**
   
   b. In the Licenses area click **Add Licenses**.
   
   c. In the License Key text box, type the license key.
   
      - **Note:** License keys are case-insensitive. Include the hyphens when typing keys.

      d. Click **Add**.

5. Break the current MTree context on the replication pair.
   
   ```
   replication break mtree://destination-system-name/data/coll/mtree-name
   ```

6. Create the new replication context.
   
   ```
   replication add source mtree://source-system-name/data/coll/mtree-name destination mtree://destination-system-name/data/coll/mtree-name
   ```

7. Perform the following steps on the source system only.

8. Select an MTree for retention locking.
   
   Click the **Data Management > MTree** tab, then the checkbox for the MTree you want to use for retention locking. (You can also create an empty MTree and add files to it later.)

9. Click the MTree Summary tab to display information for the selected MTree.
10. Lock files in the compliance-enabled MTree.

11. Ensure that both source and destination (replica) MTrees are the same.
   
   ```
   replication resync mtree://destination-system-name/data/coll/mtree-name
   ```

12. Check the progress of resync.
   
   ```
   replication watch mtree://destination-system-name/data/coll/mtree-name
   ```

13. Confirm that replication is complete.
   
   ```
   replication status mtree://destination-system-name/data/coll/mtree-name detailed
   ```
   
   This command reports 0 pre-compressed bytes remaining when replication is finished.

---

### Converting a collection replication pair to MTree replication pairs

A procedure for customers who used collection replication under DD Retention Lock Compliance in DD OS 5.2 and want to convert compliance-enabled MTrees in the collection replication pair to MTree replication pairs.

**Procedure**

1. On the source system only:
   a. Create a snapshot for each DD Retention Lock Compliance enabled MTree.
      
      ```
      snapshot create snapshot-name /data/coll/mtree-name
      ```
   b. Synchronize the collection replication pair.
      
      ```
      replication sync col://destination-system-name
      ```
   c. Confirm that replication is complete.
      
      ```
      replication status col://destination-system-name detailed
      ```
      
      This command reports 0 pre-compressed bytes remaining when replication is finished.
   d. View snapshot information for each DD Retention Lock Compliance enabled MTree.
      
      ```
      snapshot list mtree /data/coll/mtree-name
      ```
      
      Note the snapshot names for use later.

2. On the destination system only:
   a. Confirm that the replication is complete.
      
      ```
      replication status mtree://destination-system-name/data/coll/mtree-name detailed
      ```
      
      This command reports 0 pre-compressed bytes remaining when replication is finished.
   b. View each MTree snapshot replicated to the destination system.
      
      ```
      snapshot list mtree /data/coll/mtree-name
      ```
   c. Ensure that all DD Retention Lock Compliance MTree snapshots have been replicated by comparing the snapshot names generated here with those generated on the source system.
      
      ```
      snapshot list mtree /data/coll/mtree-name
      ```

3. On the both the source and destinations systems:
   a. Disable the file system.
      
      ```
      filesys disable
      ```
b. Break the collection replication context.
   replication break col://destination-system-name

c. Enable the file system. (Security officer authorization may be required.)
   filesys enable

d. Add a replication context for each DD Retention Lock Compliance enabled MTree.
   replication add source mtree://source-system-name/data/coll/mtree-name destination mtree://destination-system-name/data/coll/mtree-name

   **Note:** Source and destination MTree names must be the same.

4. On the source system only:
   a. Ensure that both source and destination MTrees are the same.
      replication resync mtree://destination-system-name
    
   b. Check the progress of resync.
      replication watch destination
    
   c. Confirm that replication is complete.
      replication status mtree://destination-system-name/data/coll/mtree-name detailed
      This command reports 0 pre-compressed bytes remaining when replication is finished.

**Performing collection replication**

Replicate /data/coll1 from a compliance-enabled source system to a compliance-enabled destination system.

**About this task**

   **Note:** For collection replication the same security officer account must be used on both the source and destination systems.

**Procedure**

1. Until instructed to do differently, perform the following steps on the source system only.
2. Log in to the DD System Manager.
   The DD System Manager window appears with DD Network in the Navigation Panel.
3. Select a protection system.
   In the Navigation Panel, expand DD Network and select a system.
4. Add the DD Retention Lock Governance license, if it is not listed under Feature Licenses.
   a. Select Administration > Licenses
   b. In the Licenses area click Add Licenses.
   c. In the License Key text box, type the license key.

   **Note:** License keys are case-insensitive. Include the hyphens when typing keys.
    
   d. Click Add.
5. Create the replication context.
6. Until instructed to do differently, perform the following steps on the destination system only.

7. Destroy the file system.
   ```
   filesys destroy
   ```

8. Log in to the DD System Manager.
   The DD System Manager window appears with DD Network in the Navigation Panel.

9. Select a protection system.
   In the Navigation Panel, expand DD Network and select a system.

10. Create a file system, but do not enable it.
    ```
    filesys create
    ```

11. Create the replication context.
    ```
    replication add source col://source-system-name destination col://destination-system-name
    ```

12. Configure and enable the system to use DD Retention Lock Compliance.
    ```
    system retention-lock compliance configure
    ```
    (The system automatically reboots and executes the system retention-lock compliance enable command.)

13. Perform the following steps on the source system only.

14. Initialize the replication context.
    ```
    replication initialize source col://source-system-name destination col://destination-system-name
    ```

15. Confirm that replication is complete.
    ```
    replication status col://destination-system-name detailed
    ```
    This command reports 0 pre-compressed bytes remaining when replication is finished.

Adding DD Retention Lock Compliance protection to an existing collection replication pair

Add DD Retention Lock Compliance protection to a collection replication pair that was created without DD Retention Lock Compliance enabled on the source and destination systems.

**Procedure**

1. Until instructed otherwise, perform the following steps on both the source and destination systems.

2. Disable the replication.
   ```
   replication disable col://destination-system-name
   ```

3. Log in to the DD System Manager.
   The DD System Manager window appears with DD Network in the Navigation Panel.

4. Select a protection system.
   In the Navigation Panel, expand DD Network and select a system.

5. Until instructed otherwise, perform the following steps on the source system.
6. Configure and enable the system to use DD Retention Lock Compliance.
   system retention-lock compliance configure
   (The system automatically reboots by executing the system retention-lock compliance enable command.)

7. Enable the replication context.
   replication enable col://destination-system-name

8. Until instructed otherwise, perform the following steps on the destination system.

9. Configure and enable the system to use DD Retention Lock Compliance.
   system retention-lock compliance configure
   (The system automatically reboots by executing the system retention-lock compliance enable command.)

10. Enable the replication context.
    replication enable col://destination-system-name

Fastcopy

When the filesys fastcopy [retention-lock] source src destination dest command is run on a system with a DD Retention Lock Compliance enabled MTree, the command preserves the retention lock attribute during the fastcopy operation.

Note: If the destination MTree is not retention lock enabled, the retention-lock file attribute is not preserved.

CLI usage

Considerations for a protection system with DD Retention Lock Compliance.

- Commands that break compliance cannot be run. The following commands are disallowed:
  - filesys destroy
  - mtree delete mtree-path
  - mtree retention-lock reset {min-retention-period period | max-retention-period period} mtree mtree-path
  - mtree retention-lock disable mtree mtree-path
  - mtree retention-lock revert
  - user reset

- The following command requires security officer authorization if the license being deleted is for DD Retention Lock Compliance:
  - elicense reset
  - elicense update

- The following commands require security officer authorization if DD Retention Lock Compliance is enabled on an MTree specified in the command:
  - mtree retention-lock set {min-retention-period period | max-retention-period period} mtree mtree-path
  - mtree rename mtree-path new-mtree-path

- The following commands require security officer authorization if DD Retention Lock Compliance is enabled on the system:
System clock

DD Retention Lock Compliance implements an internal security clock to prevent malicious tampering with the system clock.

The security clock closely monitors and records the system clock. If there is an accumulated two-week skew within a year between the security clock and the system clock, the file system is disabled and can be resumed only by a security officer.

Finding the System Clock Skew

You can run the DD OS command `system retention-lock compliance status` (security officer authorization required) to get system and security clock information, including the last recorded security clock value, and the accumulated system clock variance. This value is updated every 10 minutes.

Removing the system clock skew

Clock skew is updated every time the security clock records a new value for the system clock. After 1 year, it is reset to 0.

About this task

At any time, you can run the DD OS command `system set date MMDDhhmm[CC]YY` to set the time of the system clock (security officer authorization required). If the clock skew becomes larger than the preset value (2 weeks), the file system is disabled. Complete these steps to restart the file system and remove the skew between security and system clocks.

Procedure

1. At the system console, enable the file system.
   
   `filesys enable`

2. At the prompt, confirm that you want to quit the `filesys enable` command and check whether the system date is right.

3. Display the system date.
   
   `system show date`

4. If the system date is not correct, set the correct date (security officer authorization is required) and confirm it.
system set date MMDDhhmm[[CC]YY]

5. Enable the file system again.
   
   fileys enable

6. At the prompt, continue to the enabling procedure.

7. A security officer prompt appears. Complete the security officer authorization to start the file system. The security clock will automatically be updated to the current system date.
CHAPTER 27

DD Encryption

This chapter includes:

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DD Encryption overview

Data encryption protects user data if the protection system is stolen or if the physical storage media is lost during transit, and it eliminates accidental exposure of a failed drive if it is replaced.

When data enters the protection system using any of the supported protocols (NFS, CIFS, DD VTL, DD Boost, and NDMP Tape Server), the stream is segmented, fingerprinted, and de-duplicated (global compression). It is then grouped into multi-segment compression regions, locally compressed, and encrypted before being stored to disk.

Once enabled, the DD Encryption feature encrypts all data entering the system. You cannot enable encryption at a more granular level.

⚠️ CAUTION Data that has been stored before the DD Encryption feature is enabled does not automatically get encrypted. To protect all of the data on the system, be sure to enable the option to encrypt existing data when you configure encryption.

Additional Notes:

The `filesys encryption apply-changes` command applies any encryption configuration changes to all data present in the file system during the next cleaning cycle. For more information about this command, see the `DD OS Command Reference Guide`.

DD Encryption supports all of the currently supported backup applications described in the Backup Compatibility Guides available through Online Support at `http://support.emc.com`.

DD Replicator can be used with encryption, enabling encrypted data to be replicated using collection, directory, MTtree, or application-specific managed file replication with the various topologies. Each replication form works uniquely with encryption and offers the same level of security. For more information, see the section on using DD Encryption with replication.

Files locked using DD Retention Lock can be stored, encrypted, and replicated.

The autosupport feature includes information about the state of encryption on the system:

- Whether or not encryption is enabled
- The Key Manager in effect and which keys are used
- The encryption algorithm that is configured
- The state of the file system

Configuring encryption

This procedure includes configuring a key manager.

If the Encryption Status on the Data Management > File System > Encryption tab shows Not Configured, click Configure to set up encryption on the protection system.

⚠️ Note: The system passphrase must be set to enable encryption.

Provide the following information:

- Algorithm
  - Select an encryption algorithm from the drop-down list or accept the default AES 256-bit (CBC).
    - The AES 256-bit Galois/Counter Mode (GCM) is the most secure algorithm but it is slower than the Cipher Block Chaining (CBC) mode.
  - Determine what data is to be encrypted: existing and new or only new. Existing data will be encrypted during the first cleaning cycle after the file system is restarted. Encryption of existing data can take longer than a standard file system cleaning operation.
• Key Manager (select one of the three)
  
  ▪ Embedded Key Manager
    By default, the protection system Embedded Key Manager is in effect after you restart the file system.
    You can enable or disable key rotation. If enabled, type a rotation interval between 1 to 12 months.
  
  ▪ SafeNet KeySecure Key Manager
    
    Note: See the section about key management for an explanation about how the Embedded Key Manager and SafeNet KeySecure Key Manager work.

  The Summary shows the selected configuration values. Review them for correctness. To change a value, click Back to browse to the page where it was entered and modify it.
    
    Note: Applications may experience an interruption while the file system is restarted.

About key management

Encryption keys determine the output of the cryptographic algorithm. They are protected by a passphrase, which encrypts the encryption key before it is stored in multiple locations on disk. The passphrase is generated by the user and requires both an administrator and a security officer to change it.

A key manager controls the generation, distribution, and life cycle management of multiple encryption keys. A protection system can use either the Embedded Key Manager or SafeNet KeySecure Key Manager.

Only one can be in effect at a time. When encryption is enabled on a protection system, the Embedded Key Manager is in effect by default. If you configure the SafeNet KeySecure Key Manager, it replaces the Embedded Key Manager and remains in effect until you disable it.

The Embedded Key Manager provides and generates multiple keys internally, although the system uses only one key at a time to encrypt data coming into the system.

The Embedded Key Manager rotates keys and supports a maximum of 254 keys, and allows you to specify how many months a key is in effect before being replaced. The Embedded Key Manager key rotation is managed on the protection system.

KeySecure

KeySecure 8.5 and 8.9 supported, which is a KMIP-compliant key manager product from Safenet Inc/Gemalto Keysecure. To be able to use KMIP key manager, users have to configure both the key manager and the protection system/DDVE, to trust each other. Users have to pre-create keys on the key manager. A protection system will retrieve these keys and their states from KeySecure after establishing a secure TLS connection. See the DD OS and Gemalto KeySecure Integration Guide for more information about how to create keys and use them on a protection system.

Rectifying lost or corrupted keys

Create a file that contains all of your system’s current encryption keys. Your support provider can use this file to import keys back to your system should they become lost or corrupted. It is recommended that you create an export file on a regular basis.

You are prompted for the Security Officer's credential to export the keys. For additional key file protection, you can use a passphrase that differs from the one used in a protection system. After exporting, it is recommended that you save the key file in a secure file server accessible only by authorized users. You must remember the passphrase used for the key file. If the passphrase is lost or forgotten, the protection system cannot import and restore the keys. Enter:
Key manager support

All Key Managers support all DD OS file system protocols.

Replication

When configuring protection systems for directory or MTree replication, configure each system separately. The two systems can use either the same or a different key class, and the same or different key managers.

For collection replication configuration, the protection system must be configured on the source. All replicated data is encrypted with the key set on the source. New data written to the destination after a replication break will either use the last active key set on the source, or a new key if the key manager is configured.

Working with the Embedded Key Manager

When the Embedded Key Manager is selected, the protection system creates its own keys.

After the key rotation policy is configured, a new key is automatically created at the next rotation. You can disable the key rotation policy by clicking the disable button that is associated with the Embedded Key Manager Key’s rotation status.

Creating a key (Embedded Key Manager)

Create an encryption key for the Embedded Key Manager.

Procedure

2. In the Encryption Keys section, click Create...
3. Type your security officer user name and password.
   A new protection system key is created and activated immediately.
4. Click Create.

Destroying a key (Embedded Key Manager)

Destroy an encryption key for the Embedded Key Manager.

Procedure

2. In the Encryption Keys section, select the key in the list to be destroyed.
3. Click Destroy....
   The system displays the Destroy dialog that includes the tier and state for the key.
4. Type your security officer user name and password.
5. Confirm that you want to destroy the key by clicking Destroy.

Note: After a file system clean has run, the key state changes to Destroyed.
Deleting a key

You can delete Key Manager keys that are in the Destroyed or Compromised-Destroyed states. However, you only need to delete a key when the number of keys has reached the maximum 254 limit. This procedure requires security officer credentials.

About this task

Note: To reach the Destroyed state, the Destroying a Key procedure must be performed on the key and a system cleaning must be run.

Procedure

2. In the Encryption Keys section, select the key or keys in the list to be deleted.
3. Click Delete....
   The system displays the key to be deleted, and the tier and state for the key.
4. Type your security officer user name and password.
5. Confirm that you want to delete the key or keys by clicking Delete.

Working with KeySecure Key Manager

KeySecure Key Manager supports external key managers by using Key Management Interoperability Protocol (KMIP) and centrally manages encryption keys in a single, centralized platform.

- Keys will be pre-created on the Key Manager.
- KMIP Key Manager cannot be enabled on systems that have encryption enabled on one or more cloud units.

Using DD System Manager to set up and manage the KeySecure Key Manager

This section describes how to use DD System Manager to manage the KeySecure Key Manager.

Creating a key for the KeySecure Key Manager

Create an encryption key for the KeySecure Key Manager (KMIP).

About this task

Procedure

1. Scroll down to the Key Manager Encryption Keys table.
2. Click Add to create a new Key Manager encryption key.
   a. Enter the Security Officer username and password.
   b. Click Create.
A new KIIMP key is created and activated immediately.
Modifying the state of an existing key in KeySecure Key Manager

Use DD System Manager to modify the state of an existing KIMP encryption key.

**Before you begin**

Review the conditions for changing a key state:

- A key in an Activated-RO key requires no conditions. Deactivate at any time.

**Procedure**

1. Select **Data Management** > **File System** > **DD Encryption**.
2. Scroll down to view the **Key Manager Encryption Keys** table.
3. Select the appropriate key from the **Key Manager Encryption Keys** table.
4. To deactivate a key:
   a. Click on any key that shows an Activated state.
   b. Enter the security officer username and password.
   c. Click **DEACTIVATE**.

![Deactivate Key Manager Encryption Key dialog box](image)

**Results**

The state of an existing key is changed.

Configuring the KeySecure Key Manager

Use DD System Manager to set the key rotation policy from the protection system.

**Before you begin**

Confirm the desired Key rotation period (weeks or months), the Key rotation start date, and the Next key rotation date.

**Procedure**

1. Select **Data Management** > **File System** > **DD Encryption**.
2. In the **Key Management** section, click **Configure**. The **Change Key Manager** dialog box opens.
3. Enter your security officer user name and password.
4. Select **KeySecure Key Manager** from the **Key Manager Type** drop down menu. The Change Key Manager information appears.
5. Set the key rotation policy:
Note: The rotation policy is specified in weeks and months. The minimum key rotation policy increment is one week, and the maximum key rotation policy increment is 52 weeks (or 12 months).

a. Enable the Key Rotation policy. Set the Enable Key rotation policy button to enable.
b. Enter the appropriate dates in the Key rotation schedule field.
c. Select the appropriate number of weeks or months from the Weeks or Months drop down menu.
d. Click OK.

Results
The key rotation policy is set or changed.

Using the DD CLI to manage the KeySecure Key Manager
This section describes how to use the CLI to manage the KeySecure Key Manager.

Create a new active key on the KeySecure Key Manager
Use the protection system CLI to create a new active key.

Before you begin
Ensure that you have the appropriate user credentials. The security role is required to run these commands.

Procedure
1. Log into the protection system using the security role:
   Username: <security office user>
   Password: <security officer password>
2. Create a new active key:
   # filesys encryption key-manager keys create
3. Output that is similar to the following appears:
   New encryption key was successfully created.

Results
A new active key is created.
Modify the state of an existing key in the KeySecure Key Manager

Use the protection system CLI to modify the state of an existing key to a deactivated state.

**Before you begin**

Ensure that you have the appropriate user credentials. The security role is required to run these commands.

**Procedure**

1. Log into the protection system using the security role:
   
   **Username:** sec
   
   **Password:** <security officer password>

2. Modify the state of an existing key:

   ```
   # filesys encryption key-manager keys modify muid <key-muid> state deactivated
   ```

   For example:

   ```
   # filesys encryption key-manager keys modify muid 740D711374A8C964A62817B4AD193C8DC44374A6ED534C85642782014F2E9D41 state deactivated
   ```

3. Output that is similar to the following appears:

   ```
   Key state modified.
   ```

**Results**

The state of an existing key is modified.

Set or reset a key rotation policy in the KeySecure Key Manager

Use the Data Domain CLI to set the key rotation policy on the Data Domain system to periodically rotate keys. Note that the rotation policy is specified in weeks and months. The minimum key rotation policy increment is one week, and the maximum key rotation policy increment is 52 weeks (or 12 months).

**Before you begin**

Ensure that you have the appropriate user credentials. The security role is required to run these commands.

**Procedure**

1. Log into the Data Domain system using the security role:
   
   **Username:** sec
   
   **Password:** <security officer password>
2. Set a key rotation policy for the first time. In our example, we will set the rotation policy to **three weeks**:

```
# filesys encryption key-manager set key-rotation-policy
    {every <n> {weeks | months} | none}
```

For example:

```
# filesys encryption key-manager set key-rotation-policy every 3 weeks
```

Output that is similar to the following appears:

```
Key-rotation-policy is set. Encryption key will be rotated every 3 weeks.
```

3. Subsequently, run this command if you choose to change the existing key rotation policy. In our example, we will change the rotation policy from **three weeks** to **four months**:

   **Note:** Log into the Data Domain system using the security role (where Username is `sec`, and the password is the `<security officer password>`).

```
# filesys encryption key-manager reset [key-rotation-policy]
```

For example:

```
filesys encryption key-manager set key-rotation-policy every 4 months
```

Output that is similar to the following appears:

```
Key-rotation-policy is set. Encryption key will be rotated every 4 months.
```

4. Display the current key rotation policy, or verify that the policy is set correctly:

```
# filesys encryption key-manager show
```

Output that is similar to the following appears:

```
The current key-manager configuration is:
Key Manager:                Enabled
Server Type:                KeySecure
Server:                     <IP address of KMIP server>
Port:                       5696
Status:                     Online
```


Results
The key rotation policy is set or changed.

How the cleaning operation works
Encryption affects the performance of cleaning operations when data encrypted with the Compromised or Marked-For-Destroyed keys is re-keyed using the Activated-RW key.

At the end of the cleaning operation, there will be no data that is encrypted with the Compromised or Marked-For-Destroyed keys. Also, any data written by the cleaning operation is encrypted with the Activated-RW key.

Key manager setup
Follow the instructions for the type of key manager you are using.
For more information about SafeNet KeySecure Key Manager setup, see the DD OS and Gemalto KeySecure Integration Guide.

Setting up KMIP key manager
With KMIP support, a protection appliance can retrieve symmetric key objects that are used for data at rest encryption from KMIP key managers.

Procedure
1. Set up a KeySecure instance with IP address <IP1>.
2. Create and install an SSL server certificate on the KeySecure.
3. Enable KMIP by navigating to Device > Key Server.
   Ensure <IP1> is the address that is used and Port is <Port1> and the server certificate from Step 2 is used.
4. Create a certificate signing request (CSR) for the system on the protection system/DD VE or Linux computer.
   a. Log in to the protection system.
   b. Issue the command adminaccess certificate cert-signing-request generate.

      If the command is successful, it generates the file CertificateSigningRequest.csr, which is located in /ddvar/certificates/.

By default, NFS exports do not have permissions to access the certificates folder, even to a root user.
5. Take this CSR and have it issued/signed by the CA on the KeySecure.
   If the command is successful, it generates the file `CertificateSigningRequest.csr`, which is located in `/ddvar/certificates/`.

6. Download that signed certificate (x.509 pem file) on to the protection system and use the private key of the CSR to create a pkcs#12 file.
   Rename `csr` to `pem` in the file name.

7. Download the root CA certificate from the CA of the KeySecure (Security > Local CAs).

8. On the protection system/DD VE, use `adminaccess` CLI to install the pkcs#12 client certificate and the CA certificate. Use application type as `keysecure`.

9. On the KeySecure, create a symmetric key with AES-256 as the algorithm and key length.
   a. Set the owner to the user that will use as KMIP on the protection system/DD VE.
   b. Select the Exportable option.
   c. Under Security > Keys > Attributes for the key, ensure to set Application Namespace to `DD_DARE_KEYS`. Ensure to set Application Data to key-class that you are planning to use on the protection system/DD VE.

10. Use `filesys encryption key-manager set` command to configure ALL the parameters to access the keysecure key manager.

11. Enable the external key-manager by using the command `filesys encryption key-manager enable`.

12. Enable encryption by using the commands `filesys encryption enable`.

13. Keys should be automatically retrieved from the keysecure key-manager should be seen in the local key table.

   Sample output of local key table for `filesys encryption keys show`:

   ```
   # filesys encryption keys show
   Active Tier:
   Key Key    State        Size
   Id MUID               post-comp
   1 d05 Activated-RW 40.50 MiB
   * Post-comp size is based on last cleaning of Tue Nov 5 06:42:54 2019.
   ```

   The current active key is used to encrypt any data being ingested.

14. Sync the key states.
   a. On the keysecure web interface, create a new active key as previously described.
   b. On the keysecure web interface, deactivate the old key by clicking the key and going under the Life Cycle tab. Click Edit State. Set the Cryptographic State to Deactivated. Click Save.

15. On the protection system, sync the local key table by running the `filesys encryption keys sync` command.

   Sample output of local key table for `filesys encryption keys show`:

   ```
   # filesys encryption keys show
   Active Tier:
   Key Key    State
   ```
Changing key managers after setup

Modify settings for the Embedded Key Manager.

Before you begin
To manage certificates for a system, you must start DD System Manager on that system.

Procedure

2. Under Key Management, click Configure.
3. Type your security officer username and password.
4. Select to enable or disable key rotation. If enabled, enter a rotation interval between 1-to-12 months. Click OK.
5. Click Manage Certificates to add certificates.

Deleting certificates

Select a certificate with the correct fingerprint.

Procedure

1. Select a certificate to delete.
2. Click Delete.
   The system displays a Delete Certificate dialog with the fingerprint of the certificate to be deleted.
3. Click OK.

Checking DD Encryption settings

Check the settings for the DD Encryption feature.

Click the Data Management > File System > Encryption tabs. The currently used Key Manager is shown as Enabled. For a description of the DD Encryption settings, see the section about the encryption view.

Enabling and disabling DD Encryption

After configuring DD Encryption, the status is enabled and the Disabled button is active. When DD Encryption is disabled, the Enabled button is active.
Enabling DD Encryption

Use the DD System Manager to enable the DD Encryption feature.

Procedure

1. Using the DD System Manager, select the protection system you are working with in the Navigation panel.
2. In the Encryption view, click the Enable button.
3. Both of the following options are available:
   - Select Apply to existing data and click OK. Encryption of existing data will occur during the first cleaning cycle after the file system is restarted.
   - Select Restart the file system now and click OK. DD Encryption will be enabled after the file system is restarted.

After you finish

Note: Applications may experience an interruption while the file system is restarted.

Disabling DD Encryption

Use the DD System Manager to disable the DD Encryption feature.

Procedure

1. Using the DD System Manager, select the protection system you are working with in the Navigation panel.
2. In the Encryption view, click the Disable button.
   The Disable Encryption dialog box is displayed.
3. In the Security Officer Credentials area, enter the user name and password of a security officer.
4. Select one of the following:
   - Select Apply to existing data and click OK. Decryption of existing data will occur during the first cleaning cycle after the file system is restarted.
   - Select Restart the file system now and click OK. DD Encryption will be disabled after the file system is restarted.

After you finish

Note: Applications may experience an interruption while the file system is restarted.

Locking and unlocking the file system

Use this procedure when an DD Encryption-enabled protection system (and its external storage devices) are being transported, or if you want to lock a disk that is being replaced. The procedure requires two accounts: Security Officer and System Administration roles.

Procedure

   In the File System Lock area, the Status shows whether the file system is Locked or Unlocked.
2. Disable the file system by clicking Disabled in the File System status area.
3. Use the procedure to lock or unlock the file system.

**Locking the file system**

To lock the file system, DD Encryption must be enabled and the file system must be disabled.

**Procedure**

2. In the text fields of the Lock File System dialog box, provide:
   - The username and password of a Security Officer account (an authorized user in the Security User group on that protection system).
   - The current and a new passphrase.
3. Click OK.

This procedure re-encrypts the encryption keys with the new passphrase. This process destroys the cached copy of the current passphrase (both in-memory and on-disk).

| Note: | Changing the passphrase requires two-user authentication to protect against the possibility of a rogue employee’s shredding the data. |

| CAUTION | Be sure to take care of the passphrase. If the passphrase is lost, you will never be able to unlock the file system and access the data. The data will be irrevocably lost. |

4. Shut down the system:

| CAUTION | Do not use the chassis power switch to power off the system. Type the following command at the command prompt instead. |

```
# system poweroff The `system poweroff` command shuts down the system and turns off the power. Continue? (yes|no|?) [no]:
```

5. Transport the system or remove the disk being replaced.
6. Power on the system and use the procedure to unlock the file system.

**Unlocking the file system**

This procedure prepares an encrypted file system for use after it has arrived at its destination.

**Procedure**

1. Select Data Management > File System > Encryption and click Unlock File System.
2. In the text fields, type the passphrase that was used to lock the file system.
3. Click OK.
4. Click Close to exit.

If the passphrase is incorrect, the file system does not start and the system reports the error. Type the correct passphrase, as directed in the previous step.
Changing the encryption algorithm

Reset the encryption algorithm if necessary, or select options to encrypt new and existing data or just new data.

Procedure

1. Select Data Management > File System > Encryption

2. To change the Encryption Algorithm used to encrypt the protection system, click Change Algorithm.
   
   The Change Algorithm dialog box is displayed. Supported encryption algorithms are:
   - AES-128 CBC
   - AES-256 CBC
   - AES-128 GCM
   - AES-256 GCM

3. Select an encryption algorithm from the drop-down list or accept the default AES 256-bit (CBC).
   
   The AES 256-bit Galois/Counter Mode (GCM) is the most secure algorithm but it is significantly slower than the Cipher Block Chaining (CBC) mode.

   | Note: To reset the algorithm to the default AES 256-bit (CBC), click Reset to default.

4. Determine what data will be encrypted:
   - To encrypt existing and new data on the system, select Apply to Existing data, Restart file system now, and click OK.
     
     Existing data will be encrypted during the first cleaning cycle after the file system is restarted.

     | Note: Encryption of existing data can take longer than a standard file system clean operation.
   - To encrypt only new data, select Restart file system now and click OK.

5. The status is displayed. Click Close when the process is complete.

   | Note: Applications may experience an interruption while the file system is restarted.