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As part of an effort to improve and enhance the performance and capabilities of its product line, EMC from time to time releases revisions of its hardware and software. Therefore, some functions described in this manual may not be supported by all revisions of the software or hardware currently in use. For the most up-to-date information on product features, refer to your product release notes.

If a product does not function properly or does not function as described in this manual, please contact your EMC representative.

About this manual

This manual describes the tasks for setting up, configuring, and managing EMC® MirrorView™ / Asynchronous using EMC Navisphere® Manager. Each major section includes introductory information and a general procedure for completing a task. This manual is not intended for use during the actual setup, configuration, and management of MirrorView / Asynchronous, so the steps in the procedures purposely do not include screen captures of the dialog boxes.

The introductory information and detailed steps for each procedure appear in the Navisphere Manager online help, so you have the complete information available when you actually set up, configure, and manage MirrorView / A, should you require help.

This manual refers to EMC MirrorView / Asynchronous as MirrorView / A.

Audience

This guide is part of the Navisphere Manager documentation set, and is intended for use by system administrators who set up and administer MirrorView / A operations, and in failure or disaster situations recover data on primary or secondary storage systems.
Preface

Readers of this guide are expected to be familiar with the following topics:

- EMC Navisphere Manager operation
- Microsoft Windows operating environments

Organization

This manual contains five chapters, as follows.

Chapter 1 Introduces the EMC MirrorView/A product.
Chapter 2 Explains how to set up MirrorView/A and manage MirrorView/A connections.
Chapter 3 Explains how to create a remote mirror and use the MirrorView/A features.
Chapter 4 Explains how to create consistency groups.
Chapter 5 Explains how MirrorView/A handles failures.

Related documents

Related documents include:

EMC MirrorView/Asynchronous Command Line Interface (CLI) Reference (P/N 300-001-335)

For the most current management and security content for CX3-series and CX-series storage systems, refer to EMC Navisphere Manager Administrator’s Guide (P/N 300-003-511).

Conventions used in this guide

EMC uses the following conventions for notes, cautions, warnings, and danger notices.

Note: A note presents information that is important, but not hazard-related.

CAUTION

A caution contains information essential to avoid data loss or damage to the system or equipment. The caution may apply to hardware or software.

WARNING

A warning contains information essential to avoid a hazard that can cause severe personal injury, death, or substantial property damage if you ignore the warning.
DANGER

A danger notice contains information essential to avoid a hazard that will cause severe personal injury, death, or substantial property damage if you ignore the message.

Typographical conventions

This manual uses the following format conventions:

This typeface Indicates text (including punctuation) that you type verbatim, all commands, pathnames, filenames, and directory names. It indicates the name of a dialog box, field in a dialog box, menu, menu option, or button.

This typeface Represents variables for which you supply the values; for example, the name of a directory or file, your username or password, and explicit arguments to commands.

This typeface Represents a system response (such as a message or prompt), a file or program listing.

x > y Represents a menu path. For example, Operations > Poll All Storage Systems tells you to select Poll All Storage Systems on the Operations menu.

[ ] Encloses optional entries.

| Separates alternative parameter values; for example:

LUN-name | LUN-number means you can use either the LUN-name or the LUN-number.

Finding current information

The most up-to-date information about the EMC Navisphere MirrorView/A software is posted on the EMC Powerlink™ website. We recommend that you download the latest information before you start the MirrorView/A software. If you purchased this product from an EMC reseller and you cannot access Powerlink, the latest product information should be available from your reseller.

To access EMC Powerlink, use the following link:

http://Powerlink.EMC.com
After you log in, select **Support > Document Library** and find the following:

- *EMC MirrorView/Asynchronous Release Notes*
- The latest version of this manual that is applicable to your software revision
- *EMC Installation Roadmap for CX3-Series, CX-Series, AX-Series, and FC-Series Storage Systems*, which provides a checklist of the tasks that you must complete to install your storage system in a storage area network (SAN) or direct attach configuration.

**Where to get help**

EMC support, product, and licensing information can be obtained as follows.

**Product information** — For documentation, release notes, software updates, or for information about EMC products, licensing, and service, go to the EMC Powerlink website (registration required) at:

http://Powerlink.EMC.com

**Technical support** — For technical support, go to EMC WebSupport on Powerlink. To open a case on EMC WebSupport, you must be a WebSupport customer. Information about your site configuration and the circumstances under which the problem occurred is required.

**Your comments**

Your suggestions will help us continue to improve the accuracy, organization, and overall quality of the user publications. Please send a message to techpub_comments@EMC.com with your opinions of this guide.
This chapter introduces the EMC® MirrorView™ Asynchronous product, which lets you maintain a periodic mirrored copy of current information on another storage system. Using remote mirroring can assist in recovery in the event of a failure affecting a server or the primary storage system.

This manual refers to the EMC MirrorView/Asynchronous product as MirrorView/A.

Note: The features in this chapter function only with a storage system that has the optional MirrorView/A software installed.

This chapter describes the following:

- MirrorView/A overview .................................................................1-2
- Prerequisites ..............................................................................1-3
- Configuration guidelines ...............................................................1-4
- MirrorView/A connection requirements ......................................1-7
- MirrorView/A terminology ..........................................................1-11
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- Using online help ......................................................................1-22
About EMC MirrorView/ Asynchronous software

MirrorView/A overview

MirrorView/ A lets you periodically update a remote copy of production data. It is a software application that keeps a point-in-time copy of a logical unit (LUN) and periodically replicates the copy to a separate location in order to provide disaster recovery, that is, to let one image continue to be active if a serious accident or natural disaster disables the other. It provides data replication over long distances (hundreds to thousands of miles).

The production image (the one mirrored) is called the primary image; the copy image is called the secondary image. MirrorView/ A supports one remote image per primary. The primary image receives I/O from a server called the production server; a separate storage system maintains the secondary image. This storage system can optionally have a failover/standby computer connected to it or can be connected to its own computer system. Both storage systems can be in different domains, which you manage with the user interface (UI). The client that is managing the storage system can promote the secondary image if the primary image becomes inaccessible. After initial synchronization, the remote site always has a consistent point-in-time copy of the primary data.

Note: As a storage-system-based mirroring product, MirrorView/ A does not flush server buffers before replicating the primary data. Therefore, the copy is a crash-consistent image of the primary data. You must verify data integrity of the secondary image before using it for disaster recovery. (The verification process varies by application type.)

MirrorView/ A supports MirrorView/ A consistency groups, which this manual refers to as consistency groups. A consistency group is a set of asynchronous mirrors whose secondary images need to be kept consistent with each other in order to be useful; that is, the data on the set of secondary images must have existed on the set of primary images previously. This allows an application to use the secondary images if the primary storage system fails.

Note: The primary images of mirrors in a MirrorView/ A consistency group must reside on a single storage system, and the secondary images of the mirrors must reside on a single (but different) storage system. This contrasts with volumes in a Symmetrix® consistency group, which can reside on multiple storage systems.
Prerequisites

- You must have the MirrorView/A and Access Logix™ software installed and enabled on all CX3-series and CX-series storage systems you want to participate in a mirror. See the chapter on installing software on these storage systems in the EMC Navisphere Manager Administrator’s Guide.
- You must have Navisphere Manager installed and enabled.
- SAN configurations must have qualified switches.
- WAN configurations must have qualified FC-to-IP devices.
Configuration guidelines

The following are configuration rules for MirrorView/A:

- Each mirror must have one primary image and zero or one secondary images. Any single storage system can have only one image of a mirror.

- A storage system can have concurrent mirroring connections to a maximum of four other storage systems. (Mirroring connections are common between synchronous and asynchronous mirrors.)

- You can configure a maximum of 50 primary and secondary images on CX400, CX500, and CX3-20 storage systems and a maximum of 100 primary and secondary images on CX600, CX700, CX3-40, and CX3-80 storage systems. The total number of primary and secondary images on the storage system make up this maximum number.

Note: A metaLUN is a single entity; therefore, it is counted as one of your images. For example, if a mirrored metaLUN is composed of five components, it is counted as one of your images, not five.

These limits are independent of the limits for synchronous mirrors. (See the EMC MirrorView/Synchronous for Navisphere Administrator’s Guide).

- To manage remote mirror configurations, the Navisphere management workstation must have an IP connection to both the local and remote storage systems. The connection to the remote storage system should have an effective bandwidth of at least 128 Kb/second. The storage systems can be in different Navisphere domains, which you manage with the UI (see the EMC Navisphere Manager Administrator’s Guide).

- MirrorView/A supports the new, larger LUNs that the FLARE™ operating environment supports. (See the FLARE release notes.)
Figure 1-1 shows a sample remote mirror configuration with two sites and a primary and secondary image that includes the database of four LUNs.

In Figure 1-1, database server 1, the production server, executes customer applications. These applications access data on storage system 1, in the database server storage group; storage system 2 mirrors the data on the database server storage group.
Note: Storage groups are different than consistency groups, which are described in Chapter 4. For more information about storage groups, see the *EMC Navisphere Manager Administrator’s Guide.*

We recommend that you attach a secondary server to storage system 2, so that if a complete site failure occurs where storage system 1 and database server 1 are located, you can completely fail over to the secondary site, and thus minimize the outage window. The server at the standby site is not required; but because it is recommended, this example includes it in the overall configuration.

Each server has a path to each SP through each fabric — to each storage system. If a failure occurs in a path, software installed on the server (for example, EMC PowerPath® software) can switch to the path through the other SP and continue accessing the data, transparent to the applications on the server.

The production server sends a write request to an SP in storage system 1, which then writes data to the local LUN. The change to the primary LUN is recorded, and at an interval that you define, all changes are copied to the secondary storage system.

If a failure occurs in storage system 1, an administrator can use the client that is managing the storage system to promote the image on storage system 2 to the role of primary image.

Note: The mirrored data is inaccessible until the secondary image is promoted to a primary image.

Then the appropriate applications can start on any connected server (here, database server 2) with full access to the data. The mirror can be accessible in minutes, although the time needed for applications to recover will vary.
MirrorView/A connection requirements

MirrorView/A requires the following:

- One server, connected to one of the storage systems (a second server, connected to the other storage system, is optional).
- A Fibre Channel connection between the two storage systems (direct, switch, or IP connection, shown on the following pages).

Cable connections between SPs at the MirrorView/A sites

MirrorView/A uses a front-end port on each storage processor (SP) as a communication channel between the storage systems in a remote mirror configuration. This port is called the mirror port in this document. The mirror ports for the different storage systems are:

- Port 5 for a CX3-20c or CX3-40c SP
- Port 3 for a CX600, CX700, or CX3-80 SP
- Port 1 for a CX400, CX500, CX3-20, or CX3-40 SP

Although server I/O can share the front-end port with MirrorView/A, for performance reasons, we strongly recommend that server I/O use the front-end ports that MirrorView/A is not using.

CAUTION

Currently, MirrorView and SAN Copy software cannot share the same SP port. Before installing the MirrorView enabler, you must deselect any MirrorView ports that a SAN Copy session is using. Otherwise, any SAN Copy sessions using the MirrorView port will fail.

For MirrorView/A to work correctly, the SP A mirror port at one site must be connected to the SP A mirror port on the other site and the SP B mirror port at one site must be connected to the SP B mirror port at the other site. The connections can be either direct or through a switch fabric.
Direct remote mirror connections

A direct mirror configuration consists of one primary storage system and one secondary storage system. The remote mirror connections must be between:

- SP A mirror ports on the primary and secondary storage systems
- SP B mirror ports on the primary and secondary storage systems

Figure 1-2 shows a sample direct remote mirror configuration.
Fabric remote mirror connections

A fabric mirror configuration consists of one primary storage system and up to four secondary storage systems. The fabric connections must be as follows:

- SP A mirror port on the primary storage system must be connected to the same switch fabric as the SP A mirror port on the secondary storage system.
- SP B mirror port on the primary storage system must be connected to the same switch fabric as the SP B mirror port on the secondary storage system.

Note: The fabric to which SP A mirror ports are connected can be the same fabric or a different fabric than the one to which the SP B mirror ports are connected.

You must zone the mirror port switch connections as follows:

- A separate zone for the SP A mirror port on the primary storage system and the SP A mirror port on each secondary storage system.
- A separate zone for the SP B mirror port on the primary storage system and the SP B mirror port on each secondary storage system.

For example, if you have primary storage system 1 and secondary storage systems 2 and 3, you need the following two zones:

- Zone 1 - SP A mirror port on storage system 1 and SP A mirror ports on storage systems 2 and 3.
- Zone 2 - SP B mirror port on storage system 1 and SP B mirror ports on storage systems 2 and 3.

You can use the same SP port for server data and MirrorView/A. Be careful when an IP distance connection is used because using the same SP port may cause a degradation in both replication and server application performance.

CAUTION

MirrorView and SAN Copy software cannot share the same SP port. Before installing the MirrorView enabler, you must deselect any MirrorView ports that a SAN Copy session is using. Otherwise, any SAN Copy sessions using the MirrorView port will fail.
Figure 1-3 shows a sample remote mirror fabric configuration.

**Figure 1-3** Sample remote mirror connection through a fabric
### MirrorView/A terminology

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active state</strong></td>
<td>State in which a remote mirror is running normally.</td>
</tr>
<tr>
<td><strong>Attention state</strong></td>
<td>The mirror’s secondary image is fractured, and the mirror is configured to generate an alert in this case. The mirror continues to accept server I/O in this state.</td>
</tr>
<tr>
<td><strong>Auto recovery</strong></td>
<td>Option to have synchronization start as soon as a system-fractured secondary image is determined to be reachable.</td>
</tr>
<tr>
<td><strong>Consistency group</strong></td>
<td>A set of asynchronous mirrors that are managed as a single entity and whose secondary images always remain in a consistent and recoverable state with respect to their primary image and each other.</td>
</tr>
<tr>
<td><strong>Consistency group condition</strong></td>
<td>Displays more detailed information about the consistency group, including whether the group is normal, initializing, updating, admin fractured, system fractured, or waiting on admin.</td>
</tr>
<tr>
<td><strong>Consistency group state</strong></td>
<td>Indicates the current state of the consistency group: synchronized, consistent, quasi-consistent, synchronizing, out-of-sync, scrambled, rolling back, or empty.</td>
</tr>
<tr>
<td><strong>Consistent state (of image)</strong></td>
<td>State in which a secondary image is identical to either the current primary image or to some previous (consistent point-in-time) instance of the primary image.</td>
</tr>
<tr>
<td><strong>Fracture</strong></td>
<td>A condition in which I/O does not propagate to the secondary image and can result when you initiate the fracture (Admin Fracture) or when the system determines that the secondary image is unreachable (System Fracture). An admin fracture may also occur if the MirrorView/A software detects an error condition that requires administrative intervention to correct.</td>
</tr>
<tr>
<td><strong>Image condition</strong></td>
<td>The condition of a secondary image provides additional information about the status of updates for the image. Values include normal, administratively fractured, system fractured, updating, synchronizing, or Waiting on Admin.</td>
</tr>
<tr>
<td><strong>Image state</strong></td>
<td>Indication of the relationship between a secondary image and the primary image of a mirror. The image states are: Synchronized, Consistent, Synchronizing, Out-of-Sync, and Rolling Back. See States.</td>
</tr>
</tbody>
</table>
## About EMC MirrorView/Asynchronous software

### MirrorView/A mirroring
A feature that provides disaster recovery by maintaining mirrors of LUNs on other storage system(s). MirrorView/A can work in conjunction with, but is independent of, the other major CLARiiON® software options such as PowerPath® software. MirrorView/A works with LUNs in SAN storage systems; thus you can use it to mirror one or more LUNs.

### Out-of-sync state
A remote mirror state in which the software does not know how the primary and secondary images differ; therefore a full synchronization is required to make the secondary image(s) usable for recovery. Also see Image state.

### Primary image
The LUN on the production storage system that contains user data and is the source for data copied to the secondary image. There is one primary image and zero or one secondary image. A remote mirror is ineffective for recovery unless it has a secondary image. This manual also refers to primary image as primary.

### Promote (to primary)
The operation by which the administrator changes an image’s role from secondary to primary. As part of this operation, the previous primary image becomes a secondary image. If the previous primary image is unavailable when you promote the secondary image (perhaps because the primary site suffered a disaster), the software does not include it as a secondary image in the new mirror. A secondary image can be promoted if it is in either the Synchronized state or the Consistent state and an update is not currently transferring data.

### Recovery time objective
A time interval you set for MirrorView/A to automatically update the secondary image. You can specify it as the time interval between the start of two consecutive updates or between the end of the last update and the beginning of the next update.

### Remote mirror
A remote mirror is the combination of a LUN on one storage system, called the primary image, and another LUN on a different storage system, called the secondary image. The software maintains the secondary image as an exact copy of the primary image at some (possibly previous) point in time. If the server and/or storage system at the primary site fails, you can promote the secondary image to take over the role of the primary, thus allowing continued access to your production data.
Remote mirror image  The LUN on one storage system that participates in a remote mirror. The image can be either the primary or a secondary image. This manual refers to remote mirror image also as image.

Remote mirror state  Active and Attention. In the active state, the remote mirror is running normally. In the attention state, a site or communications failure has caused several accessible images to fall below the required minimum. Administrator action is required to correct the issue with a secondary image.

Rolling Back state  The state that occurs after a successful promotion where there was an unfinished update to the secondary image. This state persists until the Rollback operation completes.

Secondary image  A LUN that contains a mirror of the primary image LUN. There can be zero or one secondary image. This manual also refers to secondary image as secondary.

States  Remote mirror states and image states. The remote mirror states are: Active and Attention. The image states are: Synchronized, Consistent, Synchronizing, Out-of-Sync, and Rolling Back.

Synchronized state  The state in which the data in the secondary image is identical to that in the primary. On the next write to the primary, the image state will change to Consistent. Also see States.

Synchronizing state  A secondary image in the process of initial synchronization. The data in the secondary image is not usable for recovery until the synchronization operation completes. Thus, you cannot promote an image in the Synchronizing state to the primary image. Once initial synchronization completes, a MirrorView/A mirror should not return to this state, but stay consistent or synchronized. Also, see States.

Unfinished update  Cases when the secondary image is fractured and data is not currently being transferred, as well as when data is being transferred.

Update in progress  Data is currently being transferred to the secondary storage system.
About EMC MirrorView/Asynchronous software

MirrorView/A features and benefits

MirrorView/A mirroring has the following features:

- Provision for disaster recovery with minimal overhead
- CLARiiON environment
- Bidirectional mirroring
- Integration with EMC SnapView™ LUN copy software
- Replication over long distances

You can also script application integration using the Navisphere CLI commands. (See the EMC MirrorView/Asynchronous Command Line Interface (CLI) Reference.)

Provision for disaster recovery with minimal overhead

Provision for disaster recovery is the major benefit of MirrorView/A mirroring. Destruction of the data at the primary site would cripple or ruin many organizations. After a disaster, MirrorView/A lets data processing operations resume with minimal overhead.

MirrorView/A enables a quicker recovery by creating and maintaining a copy of the data on another storage system.

MirrorView/A is transparent to servers and their applications. Server applications do not know that a LUN is mirrored and the effect on performance is minimal.

With MirrorView/A, secondary systems are periodically updated.

MirrorView/A is not server-based; therefore it uses no server I/O or CPU resources. The processing for mirroring is performed on the storage system.

CLARiiON MirrorView/A environment

MirrorView/A operates in a highly available environment, leveraging the dual-SP design of CLARiiON systems. If one SP fails, MirrorView/A running on the other SP will control and maintain the mirrored LUNs. If the server is able to fail over I/O to the remaining SP, then periodic updates will continue. The high-availability features of RAID protect against disk failure, and mirrors are resilient to an SP failure in the primary or secondary storage system.
Bidirectional mirroring

A single storage system may be primary (that is, hold the primary image) for some mirrors and secondary (that is, hold the secondary image) for others. This enables bidirectional mirroring.

**Note:** A storage system can never hold more than one image of a single mirror.

Integration with EMC SnapView snapshot software

SnapView software lets you create a snapshot of an active LUN at any point in time; however, do this only when the mirror is not updating to the secondary image. Since the secondary image is not viewable to any servers, you can use SnapView in conjunction with MirrorView/A to create a snapshot of a secondary image on a secondary storage system to perform data verification and run parallel processes, for example backup.

**Note:** Before starting a SnapView session, make sure that the secondary image is in the synchronized or consistent state. Starting a SnapView session of a secondary LUN when MirrorView/A is updating the secondary will not give consistent data. Also note that data cached on the production server, as well as data written to the primary image but waiting to be transferred to the secondary on the next update, will not be included in the session of the secondary image.

You can create a snapshot of a mirrored LUN, but you cannot create a clone (BCV) of a mirrored LUN.

For more information about SnapView, see the *EMC SnapView for Navisphere Administrator’s Guide*.

Integration with EMC SAN Copy software

SAN Copy™ software lets you create an intra- or inter-storage system copy of a LUN at any point in time; however, do this only when the image state is either Synchronized or Consistent and the mirror is not updating to the secondary image. The copy is a consistent image that can serve for other application purposes while I/O continues to the source LUN. The MirrorView secondary image is not viewable to any servers, but you can use SAN Copy to create a copy of the secondary
image on a secondary storage system to perform data verification and run parallel processes.

Note: Related to the process of making the MirrorView secondary unavailable for server I/O, you cannot run SAN Copy full copy sessions on MirrorView secondary images. You can, however, run SAN Copy incremental sessions on MirrorView secondary images.

For more information about SAN Copy, see the **EMC SAN Copy for Navisphere Administrator’s Guide**.

**Replication over long distances**

MirrorView/A uses FC-to-IP devices to provide replication over long distances (hundreds to thousands of miles).
MirrorView/A operations overview

1. Connect the same Navisphere® client that is managing the storage system to both storage systems and configure this client, so that you can manage both storage systems.

   __Note:__ Optionally, you can perform this step at the secondary site as well.

   You must manage both storage systems, which can be in different domains (see the *EMC Navisphere Manager Administrator’s Guide*).

2. Estimate the size of the reserved LUN pool and the reserved LUNs (see “Estimating a suitable reserved LUN pool size” on page 2-2).

3. Establish a usable, two-way connection between the MirrorView/A storage systems (see “Synchronizing a secondary image” on page 3-15).

4. If the primary LUN does not exist, bind it on its server’s storage system. Wait for the LUN to finish binding and add it to the storage group.

5. If the secondary LUN does not exist, right-click the primary LUN and select **Create Secondary Image LUN**.

   __Note:__ The secondary LUN can be a different RAID type from the primary, as long as the block size matches.

6. Wait for the secondary LUN to finish binding.

7. From the management workstation, create the remote mirror as follows.

   With Manager, use the **Create Remote Mirror** option on the primary storage system. See “Creating a remote mirror” on page 3-2.

   Next add a secondary image. To add a secondary image, see “Add a secondary image” on page 3-7.

   Normally, when you add a secondary image to a mirror, the software synchronizes the secondary image with the primary. The software will initially copy all the data from the primary LUN to the secondary LUN, in order to ensure that the two LUNs are identical.
At any time in the previous sequence of steps, you can get remote mirror status with the Manager **Remote Mirror Property** dialog box.

8. If a primary failure occurs, Navisphere reports the failure.

   If the primary failure is minor, have the primary fixed and resume mirroring.

   If the primary failure is catastrophic, the original client that is managing the storage system may be unusable and thus unable to report the failure. For such a failure, the administrator at the secondary site must set up a client to manage the storage system (if not already done), and then promote the secondary to primary and take other recovery action needed. This includes assigning the newly promoted LUN to a storage group, if it is not already in the appropriate one.

When you use MirrorView/A on a VMware ESX Server, after you promote the secondary image to a primary, perform the following steps:

   a. If not already assigned, assign the newly promoted primary image to a storage group of the same or standby ESX Server.

   b. Rescan the bus at the ESX Server level.

   c. If not already created, create a Virtual Machine (VM) on the same or standby ESX Server. The VM is not powered up when you create it.

   d. Assign the newly promoted primary to the VM.

   e. Power up the VM.

If the VM is created and running and you have not already assigned the newly promoted primary to the VM, perform these steps:

   a. Perform steps a and b above.

   b. If you are running ESX Server 2.5.x, power it down.

   c. To assign the newly promoted primary to the VM, use the Virtual Center interface for ESX Server 3.x and 2.5.x or the Management User Interface for ESX Server 2.5.x.

   **Note:** If you are running ESX Server 3.x, you do not need to power down the VM.
d. If you are running ESX Server 2.5.x, power up the VM.

**Note:** If you are running ESX Server 3.x, you do not need to power up the VM.

The primary image (which is now the secondary image) will not be accessible to the primary ESX Server.

**Note:** For configuration restrictions when using VMFS volumes, go to the E-Lab Interoperability Navigator on the EMC Powerlink website, and under the **PDFs and Guides** tab, open the **VMware ESX server.pdf** file.

9. If access to the secondary storage image fails, the primary storage system will fracture the remote mirror. If the problem with the secondary is minor (for example, replacing a cable), then the administrator can fix it. Mirroring will recover and resynchronize the image, if the image recovery policy is Automatic.

10. Create a consistency group and add the primary image to it (optional). See “Overview of consistency groups” on page 4-2. Whenever you want to stop mirroring, you can first fracture and remove the secondary images, and then destroy the mirror. This does not affect any data on either image LUN, and access to the primary LUN is also unaffected. The LUN that held the secondary image now becomes accessible as a regular LUN.
About EMC MirrorView/ Asynchronous software

Right-click menu options for MirrorView/A

MirrorView/A is an optional software application that provides additional features and capability to the storage management software.

Table 1-1 MirrorView/A tree icons: images and descriptions

<table>
<thead>
<tr>
<th>Image</th>
<th>Description</th>
<th>Menu option</th>
<th>Use to</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Storage system icon" /></td>
<td>Storage system</td>
<td>MirrorView</td>
<td>Select MirrorView options.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MirrorView &gt; Manage MirrorView Connections</td>
<td>Define which storage systems will mirror each other.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MirrorView &gt; Create Remote Mirror</td>
<td>Create a remote mirror.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MirrorView &gt; Create Group</td>
<td>Create a consistency group.</td>
</tr>
<tr>
<td><img src="image" alt="Remote mirrors icon" /></td>
<td>Remote mirrors - This icon appears even when no remote mirror instances are defined on the storage system.</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td><img src="image" alt="Individual remote mirror icon" /></td>
<td>Individual remote mirror</td>
<td>Add Secondary Image</td>
<td>Add a new secondary image for the remote mirror.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Destroy</td>
<td>Destroy the remote mirror.</td>
</tr>
<tr>
<td>Image</td>
<td>Description</td>
<td>Menu option</td>
<td>Use to</td>
</tr>
<tr>
<td>-------</td>
<td>------------------------------------------</td>
<td>------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Remote Mirror Image</td>
<td>Synchronize</td>
<td>Start to synchronize</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• an Out-Of-Sync secondary mirror image</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• a consistent/manual update mirror (asynchronous mirrors</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>are synchronized automatically.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• a mirror that had been admin fractured</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Promote</td>
<td>Promote a secondary image to the primary mirror role.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Remove</td>
<td>Remove the secondary mirror image from the mirror.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fracture</td>
<td>Fracture the secondary mirror image.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Properties</td>
<td>View or modify the properties of the remote mirror image.</td>
</tr>
<tr>
<td></td>
<td>LUN - Icon displays the LUN type.</td>
<td>MirrorView</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MirrorView &gt; Create Remote Mirror</td>
<td>Creates a remote mirror.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MirrorView &gt; Create Secondary Image LUN</td>
<td>Creates a same-sized LUN owned by the same SP on a storage system with which a MirrorView connection has been established.</td>
</tr>
</tbody>
</table>
Using online help

The following help is available online from the Navisphere Manager interface:

- A set of organized, linked help topics
  To access the online help table of contents, click Help > Help Topics on the Menu bar in the application’s Main window, or click the help icon in the toolbar.

- Context-sensitive help topics
  To display context-sensitive help, click the Help button displayed in each dialog box.
This chapter describes the following:

- Estimating a suitable reserved LUN pool size...............................2-2
- Managing MirrorView connections.................................................2-3

Note: This chapter gives a general overview of the topics discussed. For detailed information on these topics, refer to the online help.
Estimating a suitable reserved LUN pool size

The reserved LUN pool works with MirrorView/A to perform asynchronous MirrorView operations. It consists of one or more private LUNs. You cannot assign a private LUN to a storage group; therefore, a server cannot perform I/O to it. A LUN becomes private when you add it to the reserved LUN pool.

Each SP has its own reserved LUN pool, and before starting a MirrorView/A session, the pool for each SP must contain at least one LUN for each source LUN owned by that SP that will participate in a mirror session.

The LUN resources of the reserved LUN pool are shared across Navisphere applications, such as SnapView and MirrorView/A. The LUN pool must contain at least one LUN for each source LUN that will participate in a SnapView or MirrorView/A session. For example, if you run a MirrorView/A session on one LUN and a snapshot session on another LUN and both source LUNs belong to the same SP, the reserved LUN pool for that SP must contain at least two LUNs - one for each source LUN.

You must configure the reserved LUN pool before you add a secondary image to any MirrorView/A mirror.

Note: You must configure the LUN pool size on both the primary and the secondary storage systems.

The following are guidelines for estimating the reserved LUN pool size to use with MirrorView/A:

- We recommend a minimum of 10-20% of the source LUN size for copy-on-first-write (COFW) data (including an overhead of approximately 2%).
- Every LUN in the LUN pool must be large enough to handle any source LUN.
- In a failover situation you must have additional LUNs available in the pool for the surviving SP; otherwise, updates may fail to start.

Note: In large configurations this may require manual reconfiguration of the reserved LUN pool due to the limit on the maximum number of reserved LUNs.
Managing MirrorView connections

You must establish a connection between storage systems in order for the remote mirror to work and in order to add a secondary image to an existing remote mirror. You must be managing at least one SP Agent in each storage system to establish a logical connection.

**Note:** The connection between MirrorView/S and MirrorView/A is common. You do not need to repeat this process if you have already configured it for MirrorView/S.

To establish connections:

1. From the Storage tab of the Enterprise Storage dialog box, select the storage system icon for which you want to manage MirrorView connections, and select Manage MirrorView Connections from the MirrorView menu options.

   The dialog box displays the name of the storage system and other storage systems that are connected or have a MirrorView connection enabled.

   **Note:** The Storage System list includes only those storage systems that have MirrorView/A or MirrorView/S enabled.

2. Establish or remove logical connections between storage systems.

   a. Select and enable the connection to the storage system to which you want to establish a mirror connection, and verify that the connection is enabled for both SPs.

   **Note:** MirrorView Enabled Systems lists storage systems that have at least one logical connection to the selected storage system. If you change connections between SPs after defining MirrorView connections between storage systems, disable the connection and re-enable it to ensure proper connectivity.

For better performance use a different RAID group for the reserved LUN pool than the mirrored LUNs.

For information about estimating the reserved LUN pool size, see the EMC Navisphere Manager Administrator’s Guide.
The **MirrorView Enabled Systems** window displays the status of each storage-system connection to the selected storage system. Table 2-1 describes each status. It also displays the **Logged-in Status**, which indicates the physical connection between two storage systems. If the status is **logged-in**, a connection exists between the two storage systems that you can use for mirroring.

### Table 2-1 Connection status in MirrorView/A enabled systems

<table>
<thead>
<tr>
<th>Status</th>
<th>Description</th>
<th>Action to take</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enabled</td>
<td>Connection is usable and fully established. (SP A &lt;-&gt; SP A and SP B &lt;-&gt; SP B)</td>
<td>None needed, unless you want to remove a logical connection.</td>
</tr>
<tr>
<td>Partially Enabled</td>
<td>Connection is usable, but not fully established. (SP A &lt;-&gt; SP A, but SP B &lt;-&gt; SP B does not exist or vice versa)</td>
<td>Check the physical connections between both pairs of SPs, as well as zoning of any switches. Once everything is correct, disable the connection and re-enable it.</td>
</tr>
<tr>
<td>Unusable (one-way)</td>
<td>Connection is unusable since the connection is a one-way connection. (SP A &gt; SP A, or SP B &gt; SP B)</td>
<td>Correct this degraded state of operation. Try to establish a two-way connection between one or both SPs (Enabled), or remove any unusable connections.</td>
</tr>
<tr>
<td>Not Enabled</td>
<td>Connection is not verifiable since the storage system is unmanaged.</td>
<td>Manage the storage system and then try to establish logical connections, or remove any connections.</td>
</tr>
</tbody>
</table>

b. To remove connections, in the **Mirror Enabled Systems** list, select a storage system from which you want to remove a logical connection, and click **Disable**.

The **Unconnected/Unknown Systems** pane lists the storage systems that have a physical connection but no logical connection to the primary storage system, or the connection status is unknown. This includes storage systems that are unmanaged or unavailable (the worldwide name is displayed instead of the storage-system name). The **Status** column displays the status of each storage system connection. Table 2-2 describes each status. The **Logged-In Status** indicates if a physical connection exists between two storage systems. If the status is **logged-in**, a connection exists between the two storage systems that you can use for mirroring.
Table 2-2  Connection status in unconnected/unknown storage systems

<table>
<thead>
<tr>
<th>Status</th>
<th>Description</th>
<th>Action to take</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Enabled</td>
<td>No connections are established.</td>
<td>For mirroring to be possible, establish at least one usable connection.</td>
</tr>
<tr>
<td>Unknown</td>
<td>The connection status cannot be determined because either the storage system is unmanaged or inaccessible.</td>
<td>Manage the storage system or determine why the storage system is inaccessible.</td>
</tr>
</tbody>
</table>

3. Confirm and close the dialog box.
This chapter describes the following:

- Creating a remote mirror .............................................................. 3-2
- Identifying remote mirrors on a storage system ......................... 3-4
- Adding a secondary image to a remote mirror ......................... 3-5
- Viewing or modifying remote mirrors or images ....................... 3-9
- Synchronizing a secondary image ............................................. 3-15
- Fracturing a secondary image ..................................................... 3-16
- Promoting a remote mirror ......................................................... 3-17
- Removing a secondary image from a remote mirror ................... 3-18
- Destroying a remote mirror ....................................................... 3-19

Note: This chapter gives a general overview of the topics discussed. For detailed information on these topics, refer to the online help.
Creating a remote mirror

You can create a remote mirror on a storage system if all of the following are true:

- The storage system has MirrorView/A installed.
- Some LUNs bound on the storage system are not already participating in an asynchronous mirror, a synchronous mirror, or a clone group.
- The maximum number of remote mirrors for the storage system has not been reached. See “MirrorView/A terminology” on page 1-11.

Creating a remote mirror

The Create Remote Mirror dialog box lets you create a remote mirror and customize its parameters.

Note: You cannot expand the capacity of a LUN or metaLUN that is participating in a MirrorView/A session until you destroy the mirror relationship. Neither the production or secondary server can access this added capacity until the expansion is complete and you perform a full resynchronization. If possible, consider expanding the LUN before making it a mirror.

For detailed information on expanding a LUN or metaLUN, see the Manager online help or the EMC Navisphere Manager Administrator’s Guide. The primary LUN and secondary LUN must have the same number of user blocks. You set the block count when you bind the LUN.

1. From the Storage tab of the Enterprise Storage dialog box, navigate to the storage system icon for which you want to create a remote mirror, and select Create Remote Mirror from the MirrorView menu option.

In the Create Remote Mirror dialog box, you can change the following mirror parameters:

- Mirror Type
  To create a MirrorView/A mirror, select asynchronous. Unless you also have MirrorView/S installed on the storage system, this is the only choice available.
• Name

Note: Once you create an asynchronous mirror, you cannot change its name.

• Description
Free-form text that describes the use of the mirror. This field is for your use only; the software does not use it.

• Minimum Required Images
Specify the number of secondary images required for the mirror to remain in the Active state. If the number of secondary images is not met, the mirror will go into the Attention state (the mirror continues to operate). This state indicates that the secondary image has an issue that requires attention.

• Primary Storage System LUN to be Mirrored
You can select the eligible LUN on the selected primary storage system to mirror.

2. Save the changes.
Identifying remote mirrors on a storage system

From the Storage tab of the Enterprise Storage dialog box, double-click the icon for the Remote Mirrors container node.

The possible states of a remote mirror are Active and Attention.

- **Active** – The remote mirror is running normally.
- **Attention** – The mirror’s secondary image is fractured, and the mirror is configured to generate an alert in this case. The mirror continues to accept server I/O in this state.
Adding a secondary image to a remote mirror

Before adding a secondary image to a remote mirror, you must first create a secondary image LUN. Then, to add a secondary image to a remote mirror, you can use the Add Secondary Image dialog box.

Adding a secondary image to a remote mirror requires the following:

- A working connection between the primary and secondary storage systems must exist.
- The intended secondary image LUN must not be part of another MirrorView/A mirror, a synchronous mirror, or a clone group.
- The intended secondary image LUN must not be part of a storage group.
- The secondary LUN must be precisely the same size as the primary LUN.
- A reserved LUN pool must be allocated on both the primary and secondary storage systems.

**Note:** Once you designate a LUN as secondary image, you can add it to a storage group to expedite failover to the secondary site. When adding secondary LUNs to a storage group on the secondary storage system, make sure that they have the same host LUN ID (HLU) as their corresponding primary images to ensure a cleaner failover, especially with clusters.

The intended secondary LUN must not be the target of a SAN Copy session.
Create a secondary image LUN

The **Create Secondary Image LUN** dialog box lets you create a LUN that you can use as a secondary image if you do not want to use an existing LUN on the secondary storage system. This LUN will be the same LUN size as the primary image. You must still use the **Add Image** dialog box to assign the new LUN.

To create a secondary image LUN, a RAID group must exist on the secondary storage system. If one does not exist, you must create one.

1. From the **Storage** tab of the **Enterprise Storage** dialog box, navigate to the icon for the LUN for which you want to create a secondary image LUN, and select **Create Secondary Image LUN** from the **MirrorView** menu option.

   In the dialog box, you can do the following:
   - Verify that the primary storage system and primary LUN are correct.
   - Select a storage system on which to create the secondary image LUN.
   - Select the RAID group for the secondary image LUN.

2. Save the changes and close the dialog box.

   **Note:** If the RAID group you select for the secondary image has no LUNs (it is **Unbound**), click **Select RAID Type**. In the dialog box, assign a RAID type for the secondary mirror image LUN.

   The application creates a LUN in the selected or new RAID group on the secondary storage system.
Add a secondary image

The Add Secondary Image dialog box specifies a secondary mirror image for a remote mirror with a minimum of user input.

1. From the Storage tab of the Enterprise Storage dialog box, right-click the icon for a remote mirror, and select Add Secondary Image.

In the dialog box, you can do the following:

- Select the secondary storage system on which the secondary mirror image is to reside.
- Select the LUN on the specified secondary storage system that will compose the secondary mirror image. (The application’s choice will be checked in the Select Secondary Mirror Image LUN list.)

To choose the LUN yourself, clear Auto Select. In the Select Secondary Mirror Image LUN list, select the LUN that will compose the secondary mirror image.

You can also view or modify the following advanced parameters:

- **Initial Sync Required** lets you perform a full synchronization on the newly added secondary mirror image.

  Note: If both the primary and secondary LUNs have just been bound and not accessed by any server (and thus contain no pre-existing data, including disk formatting and signature data), you do not need to synchronize the secondary when you add it. In all other cases, we strongly recommend performing the initial synchronization to ensure that the secondary image LUN is identical to the primary.

- **Recovery Policy** specifies the policy for recovering the secondary mirror image after a system fracture.
  - **Automatic** specifies that recovery automatically resumes as soon as the primary image determines that the secondary mirror image is once again accessible.
  - **Manual** specifies that the administrator must explicitly start a synchronization operation to recover the secondary mirror image.

- **Synchronization Rate** specifies a relative value (low, medium, or high) for the priority of completing updates. **High** completes updates faster, but may significantly affect storage
system performance for server I/O requests, particularly where there are multiple concurrent synchronizations occurring. Low completes updates much slower, but also minimizes impact on other storage system operations.

- **Update Type** specifies how frequently you want the update of the secondary image to occur.
  - **Manual Update** specifies that you must explicitly update the image.
  - **Start of Last Update** specifies the time (in minutes) from the beginning of the previous update to the start of the next update. The current update must complete before the next one can start. If the update is still in process when the time period expires, the next update will start immediately once the current update completes.
  - **End of Last Update** specifies the time (in minutes) from the end of the previous update to the next update. A value of 0 causes updates to occur as fast as possible.

2. Click **OK** to add the secondary image and close the dialog box. The application places an icon for the secondary image under the remote mirror image icon in the **Storage** tree.

After adding a secondary image, an initial synchronization automatically starts unless you cleared the **Initial Sync Required** checkbox. The entire LUN is copied in the initial synchronization to ensure that you have a complete copy of the primary image.
Viewing or modifying remote mirrors or images

**Note:** Always view and modify remote mirror properties from the primary storage system. Information displayed from the secondary storage system may not be up to date, especially if the primary storage system has fractured the secondary image or has lost contact with the secondary storage system.

The following example shows a mirror with the primary image on one storage system and the secondary on the other storage system. The primary shows that the image is system-fractured and consistent, while the secondary image still displays the image state as synchronized (and the condition as normal). The secondary storage system displays the status from the last time it was updated (before the fracture).
To view or modify a remote mirror’s general properties

The Remote Mirror Properties - General tab lets you view and modify the general properties of a remote mirror, including the state and description.

Note: Unique ID and Name are read only.

1. From the Storage tab of the Enterprise Storage dialog box, navigate to the icon for the remote mirrors you want to view or modify, and select Properties.

2. Select the General tab.

This tab displays the following read-only information:

- Name
- Mirror type, either synchronous or asynchronous.
- Unique ID (World Wide Name) for the remote mirror.
- Current state of the remote mirror, as shown in Table 3-1.

### Table 3-1 Current states of the remote mirror

<table>
<thead>
<tr>
<th>State</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>The remote mirror is running normally.</td>
</tr>
<tr>
<td>Attention</td>
<td>The mirror’s secondary image is fractured, and the mirror is configured to generate an alert in this case. The mirror continues to accept server I/O in this state.</td>
</tr>
</tbody>
</table>

You can view or modify the following:

- Description
- Minimum number of secondary images that must be defined and operational for the mirror

Note: If the actual number of operational images falls below this limit, an alert to the administrator will be triggered. I/O can continue to be mirrored as normal.

3. Apply the changes.
To view or modify a primary remote mirror image

The Remote Mirror Properties - Primary Image tab lets you view information about the LUN copied on the remote mirror.

1. From the Storage tab of the Enterprise Storage dialog box, navigate to the icon for the remote mirrors you want to view or modify, and select Properties.

2. Click the Primary Image tab.

This tab displays the following read-only information:

- **Storage System**, which displays the current name of the storage system on which the LUN being mirrored is bound. (This is the storage system that holds the primary image for the remote mirror.)
- **Image LUNs**, which displays details of the primary image LUN, including the user-specified LUN name, the LUN ID, the LUN’s capacity in gigabytes, and the drive type.

3. Apply the changes.

**Note:** Use the Force Destroy tab only in failure recovery situations. For information on using Force Destroy, see page 3-19.

To view or modify a secondary remote mirror image

The Remote Mirror Properties - Secondary Image tab lets you view and modify parameters for a secondary mirror image LUN.

1. From the Storage tab of the Enterprise Storage dialog box, navigate to the icon for the remote mirror you want to view or modify, and select Properties.
2. Click the **Secondary Image** tab.

The **Secondary Image** tab displays the following read-only information for the image:

- **Storage System**, which displays the name of the storage system that currently holds the secondary image for the remote mirror.
- **State**, which displays the current state of the secondary mirror image, as shown in Table 3-2.

### Table 3-2 Current state of the secondary mirror image

<table>
<thead>
<tr>
<th>State</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synchronizing</td>
<td>Initial synchronization of the mirror is in progress.</td>
</tr>
<tr>
<td>Consistent</td>
<td>The secondary image is identical to either the current primary image or to some previous instance of the primary image. This means that the secondary image is recoverable when it is promoted.</td>
</tr>
<tr>
<td>Synchronized</td>
<td>The secondary image is identical to the primary image. This state persists only until the next write to the primary image, at which time the image state becomes Consistent.</td>
</tr>
<tr>
<td>Out-of-Sync</td>
<td>Initial synchronization failed (for example, fractured).</td>
</tr>
<tr>
<td>Rolling back</td>
<td>A successful promotion occurred where there was an unfinished update to the secondary image. This state persists until the Rollback operation completes.</td>
</tr>
</tbody>
</table>

- **Image Condition**, which displays more detailed information about the condition of the secondary image, for example, whether the image condition is normal, administratively fractured, system fractured, is in the process of being synchronized, or Waiting on Admin.
- **Image LUNs**, which displays details of the secondary image LUN. The details displayed are the user-specified LUN name, the LUN ID, the LUN’s capacity in gigabytes, and the drive type.
- **Last Image Error**, which appears only if the image is fractured due to some fault that the storage system software detects. When displayed, this field describes the error that caused the secondary image to fracture.
• **% Synchronized**, which displays the percentage completion of the current update and a progress bar showing the current update. If no update is in progress or the secondary image is fractured, the value is 0 and the progress bar does not appear. If the value is 100%, the progress bar does not appear.

• **Duration**, which displays the duration of the last completed update.

• **Last Started**, which displays the start time of the most recent update. This time may be more recent than the time displayed in the **Last Ended** field since that field refers to the last completed update; whereas, this field refers to the most recent (possibly not completed) update.

• **Last Ended**, which displays the end time of the last completed update.

You can view or modify the following:

• **Recovery Policy**
  – **Automatic** specifies that recovery from a system fracture is automatic as soon as the primary image determines that the secondary mirror image is once again accessible.
  – **Manual** specifies that the administrator must explicitly start a synchronization operation to recover the secondary mirror image after a fracture.

• **Synchronization Rate**, which specifies a relative value (low, medium, or high) for the priority of completing updates. **High** completes updates faster, but may significantly affect storage system performance for server I/O requests, particularly where there are multiple concurrent synchronizations occurring. **Low** completes updates much slower, but also minimizes impact on other storage system operations.

**Note:** If you are running concurrent synchronizations on more than one secondary image, we recommend that you set the **Synchronization Rate** to **Medium**. Mirror synchronizations can significantly reduce the storage-system performance, especially on the LUNs being synchronized.
• **Update Type**, which specifies how frequently you want the update of the secondary image to occur.
  
  – **Manual Update** specifies that you must explicitly update the image.

  – **Start of Last Update** specifies the time (in minutes) from the beginning of the previous update to the start of the next update. The current update must complete before the next one can start. If the update is still in process when the time period expires, the next update will start immediately once the current update completes.

  – **End of Last Update** specifies the time (in minutes) from the end of the previous update to the next update. A value of 0, causes updates to occur as fast as possible.

3. Apply the changes. You can close the dialog box or leave it open.

*Note:* Use **Force Destroy** only in failure recovery situations. For information on using **Force Destroy**, see page 3-19.
Synchronizing a secondary image

If the primary image loses contact with the secondary image, the secondary image will be system fractured. If the recovery policy for the secondary image is automatic, then MirrorView/A will automatically synchronize the secondary image when the connection is restored. If the recovery policy is set to manual, then MirrorView/A will administratively fracture the image after the connection is restored, and an administrator must start the synchronization. Manager displays text at the end of the image data in the display to show the type of fracture.

Synchronization is possible only when:

- Manager currently manages the storage system hosting the primary mirror image.
- The secondary image state is administratively fractured or the mirror image condition is normal.
- The mirror is not part of a consistency group.

When an update starts, the software on the secondary storage system automatically preserves a copy of the secondary image as it existed at the start of the update. If the secondary image is promoted before the update is complete, this saved last-consistent copy (which is the last successful update) is restored to the secondary image LUN, so that the data is usable.

To synchronize a secondary image

From the Storage tab of the Enterprise Storage dialog box, navigate to a secondary mirror image, and select Synchronize.

Upon confirming the operation, the application attempts to start the synchronization process and reports whether the operation was successful.
Fracturing a secondary image

A fracture stops a current update from the primary image to the secondary mirror image. The current update (if any) stops, and no further updates start until you issue a synchronization request. The last consistent copy remains in place on the secondary image if the mirror was updating.

A fracture can occur either automatically, because of a failure in the path to the secondary image’s SPs, or manually, by an administrative action.

In some cases, you may want to fracture the secondary mirror image from the remote mirror. You might administratively fracture an image to perform preventive maintenance. You can then perform the maintenance without having the primary begin updating the secondary image each time the secondary becomes available. After the maintenance, you can then start synchronization.

Administrative fracture is possible only when:

- Manager is currently managing the storage system hosting the primary mirror image.
- The secondary mirror image is not already administratively fractured.

Fracturing a member of a consistency group will cause all members of the group to fracture.

To fracture a secondary image

From the Storage tab of the Enterprise Storage dialog box, navigate to a secondary mirror image, and select Fracture.

After you confirm the fracture, the application will fracture the secondary image from the remote mirror.
Promoting a remote mirror

In situations where you must replace the primary storage system due to a catastrophic failure, you can use a promotion to access data on the secondary storage system. To recover and restore I/O access, you must promote a secondary mirror image to the role of primary mirror image, so that a server can access it.

To promote a secondary image, the storage system hosting the secondary image must be currently managed by the application, and the state of the secondary image to be promoted must be either consistent or synchronized.

For more information about promoting a secondary image, see page 5-3.
Removing a secondary image from a remote mirror

To remove a secondary image, from the Storage tab of the Enterprise Storage dialog box, navigate to a secondary mirror image, and select Remove.

If the action is successful, MirrorView/A confirms that the image was removed and removes the icon for the secondary image from the Storage tree. Otherwise, the application displays an error message.

You cannot remove the secondary image if one or more of the following conditions is true:

- Manager is not currently managing the storage system hosting the primary mirror image.
- The storage system hosting the secondary image is inaccessible.
- The secondary image is updating. You must first administratively fracture the secondary image.
- The secondary image is part of a consistency group.
Destroying a remote mirror

At some point, you may want to stop mirroring a LUN. To do this, you must first remove the secondary image, and then destroy the remote mirror for the LUN. When you destroy a remote mirror, you destroy the mirror’s data structure, thus eliminating its mirroring capabilities. You do not destroy any data stored on the LUN. Destroying a mirror makes the LUN available for non-MirrorView/A uses, such as being a clone source.

**Note:** You cannot destroy a mirror that is part of a consistency group; you must first remove it from the group.

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To destroy a remote mirror using destroy

To use **Destroy**, Manager must manage the storage system hosting the primary image, and you must remove the secondary image from the remote mirror. See “Removing a secondary image from a remote mirror” on page 3-18.

From the **Storage** tab of the **Enterprise Storage** dialog box, navigate to a remote mirror node, right-click, and then select **Destroy**.

Upon confirmation, the application removes the icon for the remote mirror from the **Storage** tree, and reports whether the operation was successful.

---

To destroy a remote mirror using Force Destroy

Use **Force Destroy** only to recover following a disaster situation, or where a storage system hosting one of the mirror’s images has become unavailable.
CAUTION

Since the Force Destroy operation bypasses the normal safety checks of the Destroy operation, using it incorrectly can have serious consequences, including SP failure. Stop all I/O to the mirror before using the force destroy. Clicking Force Destroy is both immediate and also will only destroy the mirror on the storage system hosting the image forced destroyed. From the perspective of the storage system hosting the other image in the mirror, the mirror still exists.

To use Force Destroy, remove the primary image from any storage groups. See the EMC Navisphere Manager Administrator’s Guide.

Note: Force Destroy destroys a remote mirror regardless of whether it has any secondary images. Force Destroy affects only the storage system to which you send it. Any records of the mirror on other storage systems are unaffected; you must force destroy these separately.

1. Ensure that no I/O is occurring in the mirror.
   This includes I/O from an attached server, as well as I/O from an in-progress update.

2. From the Storage tab of the Enterprise Storage dialog box, select the storage system on which you want to destroy the remote mirror.

3. Right-click the remote mirror you want to destroy.

4. Select Properties, select the Primary Image tab (if the storage system hosts the primary image of the mirror) or the Secondary Image tab (if the storage system hosts the secondary image), and click Force Destroy.

   If the Force Destroy button is disabled, you have not selected the mirror on the storage system where you want to destroy the mirror.

Note: You cannot destroy or force destroy if the primary image is rolling back, or an update is currently transferring data.
This chapter explains how to create MirrorView/A consistency groups, view and modify their properties, and perform administrative operations on them. It also describes some recommended practices for using them. This manual refers to MirrorView/A consistency groups as *consistency groups*.

Topics include:
- Overview of consistency groups
- Creating a consistency group
- Viewing or modifying consistency group properties
- Adding a member to a consistency group
- Synchronizing a consistency group
- Fracturing a consistency group
- Promoting a consistency group
- Removing a member from a consistency group
- Destroying a consistency group
- Best practices for using MirrorView/A consistency groups
Using consistency groups

Overview of consistency groups

This section defines a consistency group and explains why you would use it.

The LUNs in a MirrorView/A consistency group must reside on the same storage system, unlike the volumes in a Symmetrix consistency group, which can reside on multiple storage systems.

What is a consistency group?

A consistency group is a set of asynchronous mirrors that must remain consistent with respect to each other at all times. This means that they perform all their administrative functions together, such as updating, fracturing, synchronizing, and promoting. All members of a group must have a secondary image.

Once mirrors are in a consistency group, you cannot fracture, synchronize, promote, or destroy individual mirrors that are in the consistency group. Once you create a consistency group and all its members are consistent, the group will remain consistent. A consistency group ensures that the last consistent copy of the set of LUNs on the secondary storage system is always available for disaster recovery.

Note: All secondary images in a consistency group must be on the same remote storage system. Consistency group information, such as name and membership, automatically propagates to the remote storage system to match the primary side. Thus, when you create a consistency group on a primary and add a mirror to it, the software automatically creates a consistency group with the same name on the secondary, and adds the mirror to it.

You cannot mix asynchronous and synchronous mirrors in a single group.
Why use consistency groups?

Some applications organize their data across several LUNs. For example, an RDBMS may have the database files on one LUN and the transaction logs on another. It is critical that the mirrored copies of these LUNs on the secondary storage system are consistent relative to one another. That is, the contents of the LUNs on the secondary at any time (viewed as a whole) must have existed on the primary at some point in time. Given this, the application can use the data on the secondary storage systems if they are needed following a disaster. The consistency group feature of MirrorView/A supports this requirement.

When you put a set of LUNs in a consistency group (regardless of SP ownership of the individual LUNs), updates are controlled at the group level. That is, the update is not considered complete until all the individual members of the group have completed their update. The last consistent copy of the group, taken at the start of the update, is retained until the end of the update, so that if a failure occurs prior to the last mirror update completing, all members of the group can be rolled back to their contents as they were at the start of the update.

If the mirroring path between the SP As of the two storage systems is interrupted during an update, all the mirrors in the consistency group, including those owned by SP B, fracture. MirrorView/A maintains a recoverable copy of data from the start of the update on the remote storage system in case of an emergency. While fractured, the members of the consistency group continue to track changes made to the primary, so as to minimize resynchronization time once the fault is corrected. When the fault is corrected, you can restart the update, and the secondary images of each mirror in the consistency group are refreshed with any updated data from the primary image. Once all members of the consistency group have copied the necessary data to the remote storage system, the update completes and the group can start the next update at the appropriate time.
Using consistency groups

Creating a consistency group

The Create Group dialog box lets you create a consistency group and customize parameters for it.

**Note:** On a CX400, CX500, and CX3-20 storage system, you can have 8 consistency groups, and each consistency group can have up to 8 mirrors. On a CX600, CX700, CX3-40, and CX3-80 storage system, you can have 16 consistency groups, and each consistency group can have up to 16 mirrors.

To create a consistency group:

1. From the Storage tab of the Enterprise Storage dialog box, navigate to the icon for the storage system for which you want to create a consistency group, and select Create Group from the MirrorView menu option.

   In the Create Group dialog box, specify the following consistency group parameters:

   - **Name**
     Specifies user-defined name for the consistency group. Once you specify the name, you cannot change it.

   - **Description**
     Specifies a user-defined detailed description about the consistency group being created.

   - **Available Remote Mirrors**
     Lists available asynchronous mirrors that have one secondary image and that are not currently part of any other consistency group. The Mirrors column lists the name of each mirror. The Remote Subsystem column lists the name of the remote storage system to which this mirror is connected.

   - **Selected Remote Mirrors**
     Lists the mirrors that you selected from the Available Remote Mirrors list and moved to the Selected Remote Mirrors list using the arrow button.
You can also view or modify the following advanced parameters:

- **Recovery Policy**
  Specifies the policy for recovering the mirrors in a group after a failure causes a system fracture.
  - **Automatic** - Update of the secondary image automatically begins as soon as the connection between the two storage systems is again operational.
  - **Manual** - Update of the secondary image does not begin until you explicitly issue a Synchronize command.

- **Synchronization Rate**
  Specifies a relative value (low, medium, or high) for the priority of completing updates. **High** completes updates faster, but may significantly affect storage system performance for server I/O requests. **Low** completes updates slower, but also minimizes the impact on other storage system operations.

- **Update Type**
  Specifies how frequently updates occur for the group.
  - **Manual Update** - You must explicitly start each update of the group.
  - **Start of Last Update** - Specifies the time (in minutes) from the start of the previous update until the start of the next one. If the previous update has not completed, the next update is delayed until the update in progress has completed.
  - **End of Last Update** - Specifies the time (in minutes) from the end of the previous update until the start of the next one. Specifying a value of 0 results in the group being updated as fast as possible.

---

**Note:** When a consistency group begins an update, the mirrors within the group begin updating and end whenever each individual update finishes. The consistency group update completes when the last mirror completes.

If an update is not running, you can manually start an update even if an automatic update interval is set.

2. Apply the changes.
Viewing or modifying consistency group properties

The **Group Properties** dialog box lets you view the attributes of a consistency group and modify some of them.

To view or modify consistency group properties:

1. From the **Storage** tab of the **Enterprise Storage** dialog box, right-click the icon for the consistency group whose properties you want to view, and select **Properties**.

In the **Group Properties** dialog box, you can view the following consistency group parameters:

- **Name**
  Displays the user-defined name for the consistency group, which you cannot change.

- **Description**
  Displays a user-defined detailed description about the consistency group being created.

- **ID**
  Displays the identifier that the driver assigned to the consistency group. You cannot change the ID.

- **State**
  Displays the current state of the consistency group. The states are as follows:
  - **Synchronized** - All the secondary images are in the Synchronized state.
  - **Consistent** - All the secondary images are either in the Synchronized or Consistent state.
  - **Quasi-Consistent** - A new member that is not consistent with existing members is added to the consistency group, which automatically starts an update. After the update completes, the consistency group is again consistent.
  - **Synchronizing** - At least one mirror in the group is in the Synchronizing state, and no member is in the Out-of-Sync state.
  - **Out-of-Sync** - At least one member of the group is Out-of-Sync.
- **Scrambled** - If you attempt to promote a consistency group, the operation attempts to promote every member of the consistency group. However, a failure (for example, an SP reboot) in the middle of this can leave a consistency group in an inconsistent or scrambled state. A consistency group is in the scrambled state if at least one of its primary images is missing its corresponding secondary image. For more information about the configurations in which this state can occur see Table 5-3 on page 5-23.

- **Rolling Back** - The group is in this state if one or more members had an unfinished update when the group was promoted. The group remains in this state until all members of the group complete their respective rollback operations.

- **Incomplete** - Some, but not all of the secondary images are missing, or mirrors are missing. This is usually due to a failure during group promotion.

- **Local Only** - The consistency group contains only primary images.

- **Empty** - The consistency group has no members.

**Condition**
Displays more detailed information about the consistency group, for example, whether the group is normal, initializing, updating, admin fractured, system fractured, or waiting on admin.

**Role**
On the storage system hosting the primary images of the mirrors in the group, the group is considered a **primary group**. On the storage system hosting the secondary images of the mirrors in the group, the group is considered a **secondary group**. If the consistency group became scrambled after a partially successful promote operation, the role retains the value that it had before you attempted the promotion.

**Available Remote Mirrors**
Lists the names of the remote mirrors that are eligible to be added to the group.
Using consistency groups

- **Selected Remote Mirrors**
  Lists the mirrors that are currently members of the group, as well as mirrors you selected to add to the group. You can also select mirrors from this list to remove them from the group.

- **Force Mirror Removal**
  Forces the removal of mirrors from the consistency group when this would not normally be allowed. When the consistency group contains primary mirrors, you can usually remove mirrors without specifying this option; however, clicking this checkbox causes the mirror removals to include the Force parameter.

You can also view or modify the following advanced parameters:

- **Recovery Policy**
  Specifies the policy for recovering the mirrors in a group after a failure causes a system fracture.
  - **Automatic** - Update of the secondary image automatically begins as soon as the connection between the two storage systems is again operational.
  - **Manual** - Update of the secondary image does not begin until you explicitly issue a Synchronize command.

- **Synchronization Rate**
  Specifies a relative value (low, medium, or high) for the priority of completing updates. **High** completes updates faster, but may significantly affect storage system performance for server I/O requests. **Low** completes updates slower, but also minimizes the impact on other storage system operations.

  **Note:** After you remove a mirror from a group, it retains the synchronization rate of the group.

- **Update Type**
  Specifies how frequently updates occur for the group.
  - **Manual Update** - You must explicitly start each update of the group.
  - **Start of Last Update** - Specifies the time (in minutes) from the start of the previous update until the start of the next one. If the previous update has not completed, the next update is delayed until the update in progress has completed.
- **End of Last Update** - Specifies the time (in minutes) from the end of the previous update until the start of the next one. Specifying a value of 0 results in the group being updated as fast as possible.

  **Note:** When a consistency group begins an update, every mirror within the group begins updating simultaneously and ends whenever each individual update finishes.

  If an update is not running, you can manually start an update even if an automatic update interval is set.

- **Force Destroy**

  Destroys a consistency group even if normal checks would prevent it (for example, the group still contains mirrors).

  **Note:** Use **Force Destroy** only in disaster recovery situations, where the normal safety checks cannot be met due, for example, to the remote storage system being unavailable. **Force Destroy** takes effect immediately; you do not need to click **Apply**.

2. Apply the changes.
Adding a member to a consistency group

You can add members to a consistency group from only the primary system. To determine whether a consistency group is a primary or secondary group, see the Role field in the Group Properties dialog box.

To add a mirror to a consistency group, the group must be in the empty, synchronized, or consistent state. The mirror(s) you are adding to the group must be synchronized or consistent and not fractured. The mirror(s) must have only one secondary image, and each secondary image must reside on the same secondary system as other mirrors in the consistency group.

To add a member to a consistency group:

1. From the Storage tab of the Enterprise Storage dialog box, right-click the icon for the consistency group whose membership you want to change, and select Properties.

2. In the Group Properties dialog box, select from Available Remote Mirrors the mirror you want to add, and move it to the Selected Remote Mirrors list.

   **Note:** You can select and move multiple mirrors at the same time.

When you add a mirror to the consistency group, MirrorView/A automatically adds the mirror into the consistency group on the secondary system.
Synchronizing a consistency group

You can synchronize a consistency group only if it is not already synchronizing, meaning that none of its mirrors is synchronizing. Consistency groups have the same synchronization restrictions as do individual mirrors.

The consistency group Synchronize operation is available from the consistency group itself, not from any of its images. It is accessible on only the storage system that maintains the primary image of the mirrors in the group.

From the Storage tab of the Enterprise Storage dialog box, navigate to a consistency group, and select Synchronize.

Upon confirming the operation, the application attempts to start the synchronization process and reports whether the operation was successful.
Fracturing a consistency group

The consistency group fracture operation is available from the consistency group itself, not from any of its images. It is accessible on only the storage system that maintains the primary image of the mirrors in the group.

1. From the Storage tab of the Enterprise Storage dialog box, right-click the icon for the consistency group you want to fracture, and select Fracture.

   A confirmation dialog box lists all the asynchronous mirrors that will be affected.

2. Click OK to fracture the consistency group.
Promoting a consistency group

You can promote a consistency group only if it contains at least one secondary image and if the consistency group is not rolling back. The consistency group promote operation is available from the consistency group icon on the Navisphere tree, not from any of its images. It is accessible on only the storage system that maintains the secondary image of the mirrors in the group.

For information about promoting a consistency group, see “Recovering by promoting the secondary consistency group” on page 5-20.
Removing a member from a consistency group

If you will destroy a consistency group, you must first remove its members. You can remove members from a consistency group from the primary system. To determine whether a consistency group is a primary or secondary group, see the Role field in the Group Properties dialog box.

To remove a mirror from only the consistency group on the secondary system, you must remove it on the secondary system and select force mirror removal from the Group Properties dialog box (see page 4-8.) The mirror will remain in the consistency group on the primary system. This action causes the group membership to be different on the primary and secondary systems. When possible, you must remove the mirror from the consistency group on the primary system. Before synchronizing or promoting the consistency group, be sure to correct the member count.

To remove a member from a consistency group:

1. From the Storage tab of the Enterprise Storage dialog box, right-click the icon for the consistency group whose membership you want to change, and select Properties.

2. In the Group Properties dialog box, select from Selected Remote Mirrors the mirror you want to remove, and move it to the Available Remote Mirrors list.

   Note: You can select and move multiple mirrors at the same time.

If you must force remove a mirror, check the force mirror removal checkbox before moving the mirror(s) to the Available Remote Mirrors list.

When you remove a mirror from the consistency group, MirrorView/A automatically removes the mirror from the consistency group on the secondary system. When it removes the last mirror, the state of the consistency group on the primary system changes to empty, and MirrorView/A automatically destroys the consistency group on the secondary system.
Destroying a consistency group

To destroy a consistency group, it must be empty.

1. Remove all asynchronous mirrors from the consistency group using the Group Properties dialog box (see “Removing a member from a consistency group” on page 4-14).

2. From the Storage tab of the Enterprise Storage dialog box, navigate to a consistency group, and then select Destroy.

Upon confirmation, the application removes the icon for the consistency group from the Storage tree, and reports whether the operation was successful.

Note: When you right-click a consistency group that is a secondary, the Destroy option does not appear. You must clean up and destroy the consistency group from the primary storage system, which will take care of the group on the secondary storage system.

Particularly in failure situations you may use Force Destroy to destroy a group that still has members. Force Destroy destroys only the group on the local system; therefore, you must run Force Destroy on the other system as well.
Best practices for using MirrorView/A consistency groups

Follow these best practices when creating consistency groups.

1. On the primary storage system, create LUNs that will hold the primary images. In defining and selecting these LUNs, either SP can own the LUNs; therefore, you can spread these source LUNs across the SPs in the most beneficial way for the application. For example, in a database environment, one SP may own the database LUNs, but the other SP may own the LUNs containing the log files. These LUNs can still be part of a single consistency group.

2. Create matching LUNs on the remote storage system that will hold the secondary images. These LUNs must be the same size, and should be owned by the same SP, as the source LUNs they will mirror. All secondary images for mirrors in a given consistency group must be on the same storage system. In the example above, these would be the mirror set for the database LUNs and the LUNs containing the log files.

3. Create mirrors, as necessary. See “Creating a remote mirror” on page 3-2. Add secondary images to all the mirrors.

4. Create a consistency group into which you will put the mirror images, so that all images function together as a unit, that is, are fractured and then incrementally resynchronized at given points in time. To create a consistency group, see “Overview of consistency groups” on page 4-2. As noted above, either SP can own members of a consistency group, but they must all reside on the same storage system. For example, you would probably put in a consistency group the database LUNs and LUNs containing the log files, in order to keep these LUNs at a consistent point in time relative to each other.

5. Select the consistency group Recovery Policy and Update Cycle. (These settings will apply to all members of the consistency group.) Once you add all the members you want, synchronization of the consistency group begins automatically. For example, if you add a member that is consistent and the consistency group is synchronized, the state of the consistency group changes to consistent, but an update starts automatically to synchronize the newly added members, so that all members are synchronized.

You can add members to a consistency group at any time (provided they reside on the same storage system as the other members of the
consistency group and are not system fractured). Also, the mirror you add must already have a secondary mirror. Once you add a new member, the consistency group state changes to quasi-consistent and an update starts automatically, so that the updated group has recoverable data on the secondary. Once this update completes, the consistency group is once again consistent.

**Note:** In addition to managing operations on various members, consistency groups maintain consistency relative to each other if the resynchronization/update fails on any of the members.
Using consistency groups
This chapter explains how to monitor and respond to MirrorView/A events and describes how MirrorView/A handles failures. Topics include:

- Monitoring and responding to MirrorView/A events ...............5-2
- How MirrorView/A handles failures .....................................5-3
- How consistency groups handle failures ..................................5-20
Monitoring and responding to MirrorView/A events

Use the Event Monitor to monitor events specific to MirrorView/A. The Event Monitor is an enterprise tool that supports Centralized or Distributed monitoring of storage systems in a heterogeneous environment. The Event Monitor software consists of two distinct parts: the Event Monitor user interface (UI) and the Event Monitor.

The Event Monitor UI is part of Navisphere Manager and runs on the web browser. The user interface provides you with an intuitive tool to set up responses for events and to choose which storage systems to observe. The user interface lets you customize a configuration to use any of the supported notification methods. It can easily be configured to e-mail, page, or send an SNMP trap to an industry standard event-management tool. The user interface need only be used when setting up configurations or viewing the Event History log.

Event Monitor is part of the Navisphere Agent and is available on many operating systems. Once configured, the Event Monitor runs continuously as a service or daemon, observing the state of all specified storage systems and notifying you when selected events occur.

To configure Event Monitor for MirrorView/A, refer to the online help Table of Contents entry, Monitoring and responding to events, or to Chapter 5 in the manual, *EMC Navisphere Manager Administrator’s Guide*. 
How MirrorView/A handles failures

When a failure occurs during normal operations, MirrorView/A lets you perform several actions to recover. In recovering from failures, MirrorView/A achieves two goals:

• Preserves data integrity
• Minimizes the amount of time that data is unavailable to the user

Access to the primary SP fails

If an SP that owns mirrored LUNs on the primary system fails, MirrorView/A on the other SP takes ownership of those mirrored LUNs by trespassing them when something on the server (like PowerPath) initiates the trespass. This allows mirroring to continue, provided the server is set up properly to handle the failover (for example, a Windows® server with PowerPath). When the primary LUN is trespassed, MirrorView/A sends a trespass request to any secondary images when the next update starts. Therefore, you may notice that the mirrored LUNs on the secondary system have moved from SP A to SP B, or vice versa. MirrorView/A keeps the SP ownership the same on the primary and secondary systems during updates. If the primary image is on SP A, then the secondary image will be on SP A. This may not occur until the start of the next update.

Primary image fails

If the storage system controlling the primary image fails, access to the mirror stops until you either repair the storage system or promote a secondary image of the mirror to primary.

Promoting a secondary image to a primary image

In situations where you must replace the primary storage system due to a catastrophic failure, you can use a promotion to access data on the secondary storage system. To recover and restore I/O access, you must promote a secondary mirror image to the role of primary mirror image, so that a server can access it.

Note: You can also promote a secondary image even if there has not been a catastrophic failure.
If the primary image and secondary image can communicate with each other, then when the secondary image is promoted, the former primary image is demoted to a secondary image.

To promote a secondary image, the following conditions must be true:

- Navisphere Manager must currently manage the storage system hosting the secondary mirror image.
- The state of the secondary image you will promote must be either Consistent or Synchronized.
- An update is not currently transferring data for this mirror.

**CAUTION**

Promoting a secondary image will cause loss of data written to the primary after the start of the last completed update. If any updates have been made to the primary image since that time, a full resynchronization of the mirror will be required after the promotion. Also, if an update is currently active (that is, transferring data), the promotion will not be allowed; allow the update to complete and the image to transition into the Synchronized state, then perform the promotion. An alternative to allowing the update to complete is to fracture the image.

In a failure situation, before promoting a secondary image to a primary image

1. If the existing primary image is accessible, remove the primary image from any storage groups before promoting the secondary image to avoid I/O and therefore inconsistent data.
2. Ensure that no I/O, either generated from a server or by an update in progress, is occurring in the asynchronous mirror.
3. If the existing primary is available, make sure that it lists the secondary image that is to be promoted as "synchronized.”
To promote a secondary image to a primary image:

1. From the **Storage** tab of the **Enterprise Storage** dialog box, navigate to a secondary mirror image, and select **Promote**.

   The following warning appears:

   The promote operation is a powerful and unforgiving process! All host and MirrorView synchronization I/O should be stopped on the mirror to be promoted prior to the operation.

   Incorrect use of the promote operation may cause data loss.

   Note that after the Promotion, the Recovery Policy for this image will be set to Manual.

   Promote the secondary mirror image on storage system `storage_system_name` in remote mirror `mirror_name`.

   If the secondary is not synchronized, then continuing with the promotion results in a mirror that will require a full resynchronization. A dialog box appears and asks you how to continue. Choose one of the following:

   - **Force Promote** to perform the promotion even if the new secondary image requires a full resynchronization or cannot be contacted. If the existing original primary image can be contacted, the promotion converts it to a secondary image of the new mirror. It does not verify connectivity or determine if the promoted mirror will be in the synchronized state.

   - **Local Only Promote** to promote the secondary image without adding the original primary as a secondary image of the promoted mirror. This does not affect access to the existing primary image; it simply creates a second mirror which has the original secondary image as its primary (and has no secondary image).

   - **Cancel** to cancel the promotion.

2. Confirm whether you want to continue the promotion.

   The current primary image, if accessible, is demoted, so that it is now a secondary mirror image for the remote mirror.

3. If the original primary storage system failed, remove the primary storage system from the domain.
4. Add the newly promoted image to a storage group if necessary. See the Remote Mirror Help.

At some point later, you can also perform the following steps:

1. Verify that the failed storage system is not the master of the domain.
   
   If it is, assign another storage system to be the master. See the Manager Help.

2. Verify that the failed storage system is not a portal.
   
   If it is a portal, remove the portal and configure a different storage system as a portal. See the Manager Help.

The following example shows two storage systems with a mirror created. The primary image for mirror **Mirror1** is on the Peach storage system. The secondary image for the mirror is on the XRay storage system. The server can access only the mirrored LUN on Peach for I/O. The secondary image LUN in XRay is not accessible to a server for I/O. If you promote the image on XRay to be the primary image in the case of disaster recovery, it will be available for server I/O. The image on Peach will then become inaccessible.
Example promote scenarios

The following scenarios illustrate examples of promoting a mirror.

**Scenario 1**
You attempt to promote a mirror that has a secondary image, but the connection between the storage system is not working. The secondary image indicates that it is synchronized, when it is actually system fractured and consistent. An error, *Existing image unreachable*, appears. You can investigate the reason for the loss of connectivity and correct the problem before continuing with the promotion, or you can select the **Local Only Promote** option to complete the promotion.

If you select **Local Only Promote**, the software promotes the local mirror and attempts to contact the original primary image and remove the promoted image from the mirror. In the case described
here, it cannot contact the other storage system, so it converts the local image to a primary image in a mirror with no secondary images.

**Note:** In this scenario, a *Force Promote* has exactly the same effect as the *Local Only Promote* operation.

Since the software cannot contact the remote storage system, the original mirror still exists on the storage system originally hosting the primary image. However, even if connectivity is restored, any attempt to start an update will fail (since the secondary has been promoted), and the secondary image will remain administratively fractured forever. You should use *Force Destroy* to remove this original mirror.

The following example shows a Local Only promote when the connection worked and the secondary image was consistent.
Scenario 2
You attempt to promote a mirror whose secondary image is in the Consistent state. An error, Existing primary will be out-of-sync, appears. If possible, allow the secondary to go to the Synchronized state (for example, stop application I/O to the primary image, flush data from the server, start an update and wait for it to complete). You can then promote the secondary without requiring a full resynchronization. Otherwise, you can select either the Force Promote or the Local Only Promote option to continue the promotion. In either case, you must perform a full resynchronization before you again have the mirror providing protection for your data. The following example shows scenario 2.
Responding to failures

Running MirrorView/A on a VMware server

When you use MirrorView/A on a VMware ESX Server, after you promote the secondary image to a primary, perform the following steps:

1. Assign the newly promoted primary image to a storage group of the same or standby ESX Server.
2. Rescan the bus at the ESX Server level.
3. Create a Virtual Machine (VM) on the same or standby ESX Server.
4. Assign the newly promoted primary to the VM.
   Assign it to a different VM unless you remove the failed primary, in which case you can assign it to the same VM.
5. Power up the VM.

If the VM is created and running, perform these steps:

1. Power it down.
2. Use the Service Console on the ESX Server to assign the newly promoted primary to the powered-down VM.
3. Power up the VM.

The primary image (which is now the secondary image) will not be accessible to the primary ESX Server.
Recovering by promoting a secondary image

When you promote the secondary image, the software assigns a new mirror ID to the promoted image to distinguish it from the original mirror, even though the mirrors have the same name. The new image condition of the original primary image depends on whether the original primary image is accessible at the time of promotion.

If the existing primary image is accessible when you promote, the software attempts to add the original primary image as a secondary image of the promoted mirror; that is, the images swap roles.

If the primary image is not accessible when you promote, the software creates a new mirror with the former secondary image as the new primary image and no secondary image, as shown in the example below. The mirror on the original primary storage system does not change, and so continues to have a stale record of the former secondary. You must remove the original mirror with the Force Destroy option once the original primary storage system is available again.

<table>
<thead>
<tr>
<th>Mirror before promotion</th>
<th>Mirror after promotion</th>
</tr>
</thead>
<tbody>
<tr>
<td>mirror ID = aaa</td>
<td>mirror ID = bbb</td>
</tr>
<tr>
<td>primary image = LUN xxxx</td>
<td>primary image = LUN yyyy</td>
</tr>
<tr>
<td>secondary image = LUN yyyy</td>
<td>secondary image = none</td>
</tr>
</tbody>
</table>

The following figure shows the result of a promote operation (starting from the configuration shown on page 5-6) when the SP doing the promotion could not contact the remote SP where the other image in the mirror resides.
Responding to failures

Restoring the original mirror configuration after recovery of a failed primary image

If the original mirror becomes accessible following a failure and the mirror’s secondary image has been promoted, the original mirror will be unable to communicate with the new one. To restore your mirrors to their original configuration, do the following:

1. If you want to retain any data on the original primary LUN, copy it to another LUN before continuing, or alternatively, you can create a LUN that will become the primary LUN. The following process overwrites the contents of the original primary LUN.
2. Remove the original primary LUN from any storage groups of which it is a member.

3. Destroy the original mirror using the Navisphere Manager **Force Destroy** menu option.

<table>
<thead>
<tr>
<th>Original mirror</th>
<th>New mirror</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original mirror is destroyed.</td>
<td>primary image = LUN yyyy</td>
</tr>
<tr>
<td>Original LUN used for primary image remains (LUN xxxx)</td>
<td>secondary image = none</td>
</tr>
</tbody>
</table>

4. Add a secondary image to the new mirror using the LUN that was the primary image for the original mirror (LUN xxxx).

**CAUTION**

Data from the promoted LUN will overwrite all the data in the secondary image (original primary) LUN.

The secondary image starts synchronizing automatically. Allow the synchronization to complete.

<table>
<thead>
<tr>
<th>New mirror</th>
</tr>
</thead>
<tbody>
<tr>
<td>primary image = LUN yyyy</td>
</tr>
<tr>
<td>secondary image = LUN xxxx</td>
</tr>
</tbody>
</table>

**CAUTION**

Allow the image to transition to the Synchronized state following the synchronization. If the image is in the Consistent state when you promote it, another full resynchronization is required, and data may be lost.

5. Promote the secondary image (LUN xxxx) in the new mirror to primary.

If you attempt promotion and the system indicates that the resulting mirror would be out-of-sync, do not complete the promotion. Instead, determine why the images are potentially different. If necessary, start an update of the mirror, wait for it to complete, and then for the secondary image to transition to the Synchronized state. Then you can retry the promotion.
The new mirror has the same configuration as the original mirror.

<table>
<thead>
<tr>
<th>New mirror</th>
</tr>
</thead>
<tbody>
<tr>
<td>primary image = LUN xxxx</td>
</tr>
<tr>
<td>secondary image = LUN  yyyy</td>
</tr>
</tbody>
</table>

During a promotion, the recovery policy for a secondary image is always set to manual recovery. This prevents a full synchronization from starting until you want it to.

6. If required, reset the recovery policy back to automatic.

**Recovering without promoting a secondary image**

If the primary storage system fails, but can be readily repaired, recovery is simpler. MirrorView/A records any writes that had completed before the failure and transfers them to the remote image when the next update occurs. Any writes that were sent to the storage system but not yet acknowledged may be lost, but application-specific recovery techniques, such as **chkdsk** or **fsck** for filesystems, can usually correct any issues.

To recover without promoting a secondary image, follow these steps:

1. Repair the primary storage system and/or server.
2. Fracture the asynchronous mirror(s).
3. Complete any necessary application-specific recovery of the data on the primary image.
4. Make sure that the data is flushed from the server to the storage system.
5. Synchronize the asynchronous mirror(s).
Failure of the secondary image

When a primary image cannot communicate with a secondary image, it marks the secondary as *unreachable* and stops updating the secondary image. The secondary image is marked System Fractured, as shown in the following example. The loss of communication may be due to a link between storage systems, an SP failure on the secondary storage system, or some other failure on the secondary storage system. In the event of the communication failure, the secondary image remains a member of the mirror.

If the mirror is set for automatic recovery, an update automatically starts once the secondary storage system is again accessible. Otherwise, you must manually start the update.
Responding to failures

Promoting a secondary image when there is no failure

You may want to promote your secondary image even if no failure occurs on the storage systems. For example, you may want to test your disaster recovery procedure before a real failure occurs, or perhaps the server attached to the primary storage system failed, and you must resume operations using the server attached to the secondary storage system.

If the original primary is accessible when you promote the secondary, the software verifies whether the images are identical. If possible, the secondary image should be in the Synchronized state (stop application I/O, flush data from the servers, start and update and wait for it to complete). If the images are identical, they swap roles, resynchronization is not necessary, and the promotion is complete. If the images are potentially different (that is, the secondary image is not in the Synchronized state), then you must choose either the Local Only Promote or the Force Promote option (see page 5-5). In either case, you must perform a full resynchronization of the entire LUN before your mirror is again providing disaster protection for your data.

<table>
<thead>
<tr>
<th>Mirror before promotion</th>
<th>Mirror after promotion</th>
</tr>
</thead>
<tbody>
<tr>
<td>mirror ID = aaa</td>
<td>mirror ID = bbb</td>
</tr>
<tr>
<td>primary image = LUN xxxx</td>
<td>primary image = LUN yyyy</td>
</tr>
<tr>
<td>secondary image = LUN yyyy</td>
<td>secondary image = LUN xxxx</td>
</tr>
</tbody>
</table>

If the images are not synchronized, you can force promote, local-only promote, or not promote. Force promote and local-only promote require a full resynchronization of the data before mirrored protection is again in effect.
Summary of MirrorView/A failures

Table 5-1 shows how MirrorView/A might help you recover from system failure at the primary and secondary sites. It assumes that the secondary image of the mirror is in either the Synchronized or Consistent state.

Table 5-1  Recovery from system failure

<table>
<thead>
<tr>
<th>Event</th>
<th>Result and recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of access to primary image LUN</td>
<td>Check connections between server and storage system, including zoning and correct operation of any switches. Check for an SP reboot.</td>
</tr>
<tr>
<td>Secondary SP is rebooted</td>
<td>If the secondary SP reboots, for example, due to a software failure, an explicit command or the SP is physically pulled and reseated, you may see the secondary image become system fractured. It is also possible for the secondary to become administratively fractured, in which case simply synchronize the image.</td>
</tr>
<tr>
<td>Server accessing primary image fails</td>
<td>Catastrophic failure. I/O stops. After two more update periods, if the secondary image is in the Consistent state, it will transition to the Synchronized state. Nothing more happens until the server is repaired or replaced, or a secondary image is promoted.</td>
</tr>
</tbody>
</table>
| Storage system running primary image fails | Option 1 - Catastrophic failure. The mirror is left in the state it was already in. If the secondary image is in either the Consistent or Synchronized state, it may be promoted to provide access to your data.  
Note: Any writes to the primary since the start of the last completed update are not propagated to the secondary.  
Option 2 - Noncatastrophic failure, repair is feasible.  
The administrator has the problem fixed; then normal production operation can resume.  
Option 3 - Only one SP fails.  
If the SP that controls the mirror fails, software on the server (for example, PowerPath) can detect the failure. This software can then cause control of the mirror to be transferred to the surviving SP, and normal operations can continue. If such software is not running on the server, then you must either manually transfer control using Navisphere, or access to the mirror stops until the SP is back in service.  
If the SP that does not control the LUN fails, then mirroring continues as normal. |

How MirrorView/A handles failures  5-17
Responding to failures

Table 5-1  Recovery from system failure (continued)

<table>
<thead>
<tr>
<th>Event</th>
<th>Result and recovery</th>
</tr>
</thead>
</table>
| Storage system running secondary image fails | • If the SP that does not control the secondary image fails, nothing happens with respect to this mirror.  
• If the SP that controls the mirror fails (or both SPs fail or a catastrophic failure of the entire system occurs), the secondary image of the mirror will become system fractured at the start of the next update. If the mirror is appropriately configured, this will cause the mirror to go into the Attention state, although I/O will continue as normal to the primary image.  
The administrator has a choice: If the secondary can easily be fixed (for example, if someone pulled out a cable), then the administrator can have it fixed and let things resume. Otherwise, to regain protection of your data and you have another storage system available, you can force destroy the existing mirror, recreate it, and add a secondary image on another working storage system. Protection is not established until the full synchronization of the secondary image completes. |
| Loss of connection between storage systems (indicated by system fractures) | Check the cables, make sure that all SPs are still working, and make sure the MirrorView path between the storage systems is still enabled and active. Check correct zoning and other function of any switches. |
| Failures when adding secondary images       | Make sure that:  
• The connection between storage systems works.  
• You are managing both storage systems (which may require managing two domains).  
• The secondary LUN is available and the same size as the primary image.  
• The secondary image LUN is not in the storage group.  
• The secondary image LUN is not already a secondary image, of either a synchronous or asynchronous mirror.  
• The secondary LUN is not part of a clone group.  
• The reserved LUN pools on both primary and secondary storage systems are adequately configured.  
• The secondary LUN is not set up as a destination for SAN Copy. |
| When the secondary image does not synchronize | Make sure that:  
• The connection between the storage systems is still good.  
• The recovery policy is set to auto, not manual.  
• The secondary SP is working.  
Try manually fracturing and then manually synchronizing the image. |
Recovering from serious errors

In the unlikely event that the mechanism for tracking changes made to the primary image fails (for example, insufficient memory available on the SP), the secondary image is marked as permanently fractured. To recover from this situation, you must remove the secondary image from the mirror, and then re-add it (which does a full resynchronization). This failure may indicate that you are using close to the storage system’s capacity for layered features.

Some other serious failures will transition MirrorView/A into a degraded mode of operation, where administrative requests will be rejected and no further updates run. Degraded mode affects only a single SP; the other SP in the storage system may continue to run normally (depending on the nature of the failure).

When an SP enters degraded mode, the system logs an event that indicates why MirrorView/A is in the degraded mode. Usually you can recover from the degraded mode by simply rebooting the affected SP, but some specific cases require you to check other components that MirrorView/A uses before rebooting the SP. Table 5-2 lists various scenarios in which MirrorView/A goes to the degraded mode and the recovery options you can take.

**Table 5-2 Recovery from degraded mode**

<table>
<thead>
<tr>
<th>Event</th>
<th>Result and recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal memory corruption</td>
<td>Mirror data does not match the expected value. Reboot the SP.</td>
</tr>
<tr>
<td>Serious, unexpected errors</td>
<td>MirrorView/A receives unexpected errors from its underlying components during operation. Check the event log for a record of errors, and take steps to correct them. For example, if the reserved LUN pool LUNs are faulted, recover the reserved LUN pool LUNs. Then reboot the SP.</td>
</tr>
<tr>
<td>Internal fracture failure</td>
<td>A fracture operation fails due to reasons other than an error you made. Check the event log for the appropriate failure reason. Reboot the SP to fix the problem.</td>
</tr>
</tbody>
</table>
How consistency groups handle failures

When a failure occurs during normal operations for consistency groups, MirrorView/A lets you perform several actions to recover. When recovering from failures, MirrorView/A achieves three goals:

- Preserves data integrity
- Minimizes the amount of time that data is unavailable to the user
- Ensures that the consistency of the consistency group is maintained

Access to the SP fails

Consider a consistency group that has member mirrors, some of which SP A controls and some of which SP B controls. If SP A on the primary storage system fails, then software on the attached server, for example, PowerPath, moves control of the mirrors that were controlled by SP A to SP B. This allows applications on the server, as well as the mirroring of data to the secondary storage system, to continue uninterrupted. However, as part of the transfer of control, the consistency group becomes system fractured. If the recovery policy is set to automatic, an update automatically starts on the surviving SP (SP B in this example). However, if the recovery policy is manual, you must manually start an update.

Primary storage system fails

If the storage system running the primary consistency group fails, access to the data in the group’s member LUNs is lost. You can either repair the failed storage system and then continue operations, or you can promote the secondary consistency group, so as to access the data from the secondary storage system.

Recovering by promoting the secondary consistency group

As part of the consistency group promotion each of the mirror members is promoted. This section describes the promotion procedure and the three types of group promotions, which are based on the connectivity status between the primary and the secondary and the condition of the individual members.
Note: You can promote a consistency group only if it is in the Consistent or Synchronized state.

1. From the Storage tab of the Enterprise Storage dialog box, navigate to a consistency group, and select Promote.

2. Confirm the operation.

   The MirrorView/A software displays an error if either of the following conditions is true:
   - The primary storage system is not reachable.
   - The promotion will result in a full synchronization from the new primary to the original one.

   If one of these errors occurs, a dialog box appears and asks you how to continue. Choose one of the following:

   - **Normal Promote** - When you request promotion of a secondary consistency group, the software determines if connectivity exists between the storage systems hosting the primary and secondary consistency groups. If a working connection exists and there is no incomplete update of the group, each member of the group is checked to determine whether the secondary image is identical to the primary. If all members of the group have their secondary image identical to their primary, then the promotion will complete without any resynchronization required. Otherwise, (that is, if an incomplete update exists for the group, or at least one member’s secondary image differs from its primary), you must perform a full resynchronization of all members of the group following the promotion. In this case, you can choose **Force Promote**, **Local Only Promote**, or **Cancel** (not to do the promotion).

   - **Force Promote** - promotes each member of the group and places the newly promoted mirrors in the group (removing the original members). If the original primary storage system is available, the original primary images will become secondary images of the promoted mirrors. The promoted group is marked as Out-of-Sync and its recovery policy is set to manual. You must initiate an update for the group in order to start the full update, which is required for the group to be once again protecting your data. If the original primary storage system is unavailable, **Force Promote** has the same effect as **Local Only Promote**, described below.
Note: You must perform a full update on the new secondary image, which will overwrite all existing data on that image.

- **Local Only Promote** - promotes the secondary image of each consistency group member to a primary image, but does not attempt to add the original primary image to the promoted mirror. If a connection exists between the primary and the secondary, for each member of the primary, the software attempts to remove the image being promoted on the secondary. Thus, the original primary consistency group will have all primary images and no secondary images. If no connection exists, the promote will still continue on the secondary, and the operation will not fail. The original primary consistency group cannot communicate with the promoted secondary consistency group even if the MirrorView/A connection between the storage systems is restored (since the secondary consistency group was promoted to a primary consistency group).

If a failure occurs during promoting (for example, an SP reboots), the consistency group may be left in an inconsistent state. It is possible that some members have only primary images or some have been promoted or not promoted at all. Check the state of the promoted consistency group to detect any problems during promotion.

A consistency group is in the *scrambled* state if at least one of its member’s primary images is missing its corresponding secondary images. Table 5-3 lists the configurations in which the scrambled state can occur.

- **Cancel** cancels the promote operation.

Note: Either the **Local Only Promote** or the **Force Promote** operation can result in a consistency group that contains mirrors that have no secondary images at all. In this case, the consistency group is no longer performing its function. The best way to correct this is to remove the mirrors from the consistency group, add secondary images as required, and add the mirrors back to the group.
**Table 5-3  Configurations in which the scrambled state can occur**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Ways to reach this state</th>
<th>Recovery options</th>
<th>Is the consistency group promotable in this state?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistency group members consist of only primary images. Individual members do not have any secondary images associated with them.</td>
<td>After a local promotion.</td>
<td>Force the removal of each member from the consistency group, add secondary images to each mirror, and add the mirrors in the consistency group again.</td>
<td>No, because there are no secondary images associated with the consistency group.</td>
</tr>
<tr>
<td>If a normal promotion or a force promotion fails in mid-operation, some members may consist of only primary images. The remaining members are successfully promoted and have secondaries associated with them.</td>
<td>After a failed normal promotion or out-of-sync promotion. Failure can occur by pulling the SP to which the promotion was directed.</td>
<td>Force the removal of the members with no secondary image, and then add secondaries to those mirrors. Add them back into the consistency group as necessary.</td>
<td>The consistency group is not promotable from the original primary until you remove the consistency group members that lack a secondary image. However, you can issue a local promotion on the original primary in this case.</td>
</tr>
<tr>
<td>If any type of promotion fails in mid-operation, some members may consist of only primary images. The remaining members are not successfully promoted.</td>
<td>After a promotion fails on the local SP before you attempt a remote promotion.</td>
<td>Force the removal of the members with no secondary image, add secondaries to those mirrors, and add them back into the consistency group as necessary.</td>
<td>Not until you remove the consistency group members that lack a secondary image. You can issue a <strong>Force Promote</strong> again in order to promote the mirrors that were not promoted.</td>
</tr>
</tbody>
</table>
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