IBM System Storage DS Storage Manager Version 10

Copy Services User's Guide

GA32-0964-05

IBM System Storage DS Storage Manager Version 10

Copy Services User's Guide

GA32-0964-05

Note: Before using this information and the product it supports, read the general information in "Notices" on page 239 and see the *Warranty Information* document that comes with the storage subsystem.

This edition applies version 10 modification 10 of the IBM DS Storage Manager, and to all subsequent releases and modifications until otherwise indicated in new editions.

This edition replaces GA32-0964-04.

Contents

Figures

Tables

Safety

Before installing this product, read the Safety Information.

قبل تركيب هذا المنتج، يجب قراءة الملاحظات الأمنية

Antes de instalar este produto, leia as Informações de Segurança.

在安装本产品之前，请仔细阅读 Safety Information (安全信息)。

安裝本產品之前，請先閱讀「安全資訊」。

Prije instalacije ovog produkta obavezno pročitajte Sigurnosne Upute.

Před instalací tohoto produktu si přečtete příručku bezpečnostních instrukcí.

Læs sikkerhedsforskrifterne, før du installerer dette produkt.

Lees voordat u dit product installeert eerst de veiligheidsvoorschriften.

Ennen kuin asennat tämän tuotteen, lue turvaohjeet kohdasta Safety Information.

Avant d'installer ce produit, lisez les consignes de sécurité.

Vor der Installation dieses Produkts die Sicherheitshinweise lesen.

Πριν εγκαταστήσετε το προϊόν αυτό, διαβάστε τις πληροφορίες ασφάλειας (safety information).

לפני שתתקינו מוצר זה, קראו את הוראות הבטיחות.

A termék telepítése előtt olvassa el a Biztonsági előírásokat!

Prima di installare questo prodotto, leggere le Informazioni sulla Sicurezza.

製品の設置の前に、安全情報をお読みください。

본 제품을 설치하기 전에 안전 정보를 읽으십시오.

Пред да се инсталира овој продукт, прочитајте информацијата за безбедност.

Les sikkerhetsinformasjonen (Safety Information) før du installerer dette produktet.

Przed zainstalowaniem tego produktu, należy zapoznać się
z książką "Informacje dotyczące bezpieczeństwa" (Safety Information).

Antes de instalar este produto, leia as Informações sobre Segurança.

Перед установкой продукта прочтите инструкции по
технике безопасности.

Pred inštaláciou tohto zariadenia si pečítaje Bezpečnostné predpisy.

Pred namestitvijo tega proizvoda preberite Varnostne informacije.

Antes de instalar este producto, lea la información de seguridad.

Läs säkerhetsinformationen innan du installerar den här produkten.

Safety statements

These statements provide the caution and danger information used in this documentation.

Important:

Each caution and danger statement in this documentation is labeled with a number. This number is used to cross reference an English-language caution or danger statement with translated versions of the caution or danger statement in the *Safety Information* document.

For example, if a caution statement is labeled “Statement 1,” translations for that caution statement are in the *Safety Information* document under “Statement 1.”

Be sure to read all caution and danger statements in this documentation before you perform the procedures. Read any additional safety information that comes with your system or optional device before you install the device.

Statement 1

DANGER

Electrical current from power, telephone, and communication cables is hazardous.

To avoid a shock hazard:

- **Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm.**
- **Connect all power cords to a properly wired and grounded electrical outlet.**
- **Connect to properly wired outlets any equipment that will be attached to this product.**
- **When possible, use one hand only to connect or disconnect signal cables.**
- **Never turn on any equipment when there is evidence of fire, water, or structural damage.**
- **Disconnect the attached power cords, telecommunications systems, networks, and modems before you open the device covers, unless instructed otherwise in the installation and configuration procedures.**
- **Connect and disconnect cables as described in the following table when installing, moving, or opening covers on this product or attached devices.**

To Connect:	**To Disconnect:**
1. Turn everything OFF.	1. Turn everything OFF.
2. First, attach all cables to devices.	2. First, remove power cords from outlet.
3. Attach signal cables to connectors.	3. Remove signal cables from connectors.
4. Attach power cords to outlet.	4. Remove all cables from devices.
5. Turn device ON.	

Statement 2

CAUTION:
When replacing the lithium battery, use only IBM® Part Number 33F8354 or an equivalent type battery recommended by the manufacturer. If your system has a module containing a lithium battery, replace it only with the same module type made by the same manufacturer. The battery contains lithium and can explode if not properly used, handled, or disposed of.

Do not:

- **Throw or immerse into water**
- **Heat to more than 100°C (212°F)**
- **Repair or disassemble**

Dispose of the battery as required by local ordinances or regulations.

Statement 3

CAUTION:
When laser products (such as CD-ROMs, DVD drives, fiber optic devices, or transmitters) are installed, note the following:

- **Do not remove the covers. Removing the covers of the laser product could result in exposure to hazardous laser radiation. There are no serviceable parts inside the device.**
- **Use of controls or adjustments or performance of procedures other than those specified herein might result in hazardous radiation exposure.**

DANGER

Some laser products contain an embedded Class 3A or Class 3B laser diode. Note the following.

Laser radiation when open. Do not stare into the beam, do not view directly with optical instruments, and avoid direct exposure to the beam.

Class 1 Laser Product
Laser Klasse 1
Laser Klass 1
Luokan 1 Laserlaite
Appareil À Laser de Classe 1

Statement 4

≥ 18 kg (39.7 lb)

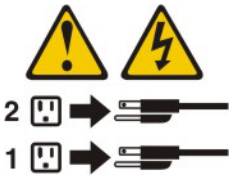
≥ 32 kg (70.5 lb)

≥ 55 kg (121.2 lb)

CAUTION:
Use safe practices when lifting.

Statement 5

CAUTION:
The power control button on the device and the power switch on the power supply do not turn off the electrical current supplied to the device. The device also might have more than one power cord. To remove all electrical current from the device, ensure that all power cords are disconnected from the power source.



Statement 8

CAUTION:
Never remove the cover on a power supply or any part that has the following label attached.

Hazardous voltage, current, and energy levels are present inside any component that has this label attached. There are no serviceable parts inside these components. If you suspect a problem with one of these parts, contact a service technician.

Statement 11

CAUTION:
The following label indicates sharp edges, corners, or joints nearby.

Statement 12

CAUTION:
The following label indicates a hot surface nearby.

Statement 13

DANGER

Overloading a branch circuit is potentially a fire hazard and a shock hazard under certain conditions. To avoid these hazards, ensure that your system electrical requirements do not exceed branch circuit protection requirements. Refer to the information that is provided with your device for electrical specifications.

Statement 15

CAUTION:
Make sure that the rack is secured properly to avoid tipping when the server unit is extended.

Statement 17

CAUTION:
The following label indicates moving parts nearby.

Statement 26

CAUTION:
Do not place any object on top of rack-mounted devices.

Statement 37

DANGER

When you populate a rack cabinet, adhere to the following guidelines:

- **Always lower the leveling pads on the rack cabinet.**
- **Always install the stabilizer brackets on the rack cabinet.**
- **Always install the heaviest devices in the bottom of the rack cabinet.**
- **Do not extend multiple devices from the rack cabinet simultaneously, unless the rack-mounting instructions direct you to do so. Multiple devices extended into the service position can cause your rack cabinet to tip.**
- **If you are not using the IBM 9308 rack cabinet, securely anchor the rack cabinet to ensure its stability.**

Attention: This product is suitable for use on an IT power distribution system whose maximum phase to phase voltage is 240 V under any distribution fault condition.

About this document

This document provides information about setting up, installing, configuring, and working with the IBM System Storage® premium features that assist with Copy Services: FlashCopy®, Enhanced FlashCopy, VolumeCopy, Enhanced Global Mirroring and Enhanced Remote Mirroring. These features are used with IBM DS Storage Manager software and are for the following storage subsystems: DS3500, DS5020, DS3950, DS5100, DS5300, DCS3700, DCS3700 storage subsystem with Performance Module Controllers, DS4200, DS4700, and DS4800.

Use this guide to accomplish the following tasks:

- Determine the hardware and software that are required to install the copy services features
- Install, enable, and activate the IBM FlashCopy, Enhanced FlashCopy, VolumeCopy, and Enhanced Remote Mirroring Option premium features
- Troubleshoot hardware and software problems

Note:

- Depending on the version of the DS Storage Manager, the SMclient instructions and screen captures in this document might be different from the menu paths in the SMclient software GUI that you are using.
- The VolumeCopy premium feature is only supported in Storage Manager version 8.4 or later, in conjunction with controller firmware versions 05.40.xx.xx and 06.1x.xx.xx or later.
- Enhanced Remote Mirroring, Remote Mirror, and Remote Mirroring are used interchangeably throughout this document, the client software, and the online help system to describe remote mirroring functionality. Although these terms are used interchangeably, their functionality is not the same.
- The Enhanced Remote Mirroring Option premium feature is only supported with controller firmware versions 06.1x.xx.xx or later.
- The Enhanced FlashCopy premium feature is only supported with controller firmware versions 7.83.xx.xx or later.

What's new in this release

The IBM DS Storage Manager Version 10.84 provides the following new features:

- Enhanced Global Mirroring premium feature
- Enhanced Remote Mirroring premium feature

Who should read this document

This guide is intended for system administrators who are responsible for operating and maintaining storage systems, with an emphasis on disaster prevention and recovery.

How this document is organized

Chapter 1, “Introduction,” on page 1 provides information about how to enable, view, and disable the premium features.

Chapter 2, “Overview of FlashCopy,” on page 15 provides information about the FlashCopy feature, how to enable the feature, plan, create, and reuse FlashCopy logical drives, and how to complete some common FlashCopy tasks.

Chapter 3, “Overview of Enhanced FlashCopy,” on page 43 provides information about the Enhanced FlashCopy feature, how to enable the feature, plan, create, and reuse Enhanced FlashCopy logical drives, and how to complete some common Enhanced FlashCopy tasks.

Chapter 4, “Overview of consistency groups,” on page 59 provides information about consistency groups, and how to create and work with consistency groups.

Chapter 5, “Common procedures for FlashCopy and Enhanced FlashCopy premium features,” on page 65 provides procedures that are common to FlashCopy and Enhanced FlashCopy premium features.

Chapter 6, “Overview of VolumeCopy,” on page 93 provides information about the VolumeCopy feature, how to use the Create Copy wizard and the Copy Manager to copy, back up, and restore data.

Chapter 7, “Managing VolumeCopy,” on page 109 provides information to help you manage your VolumeCopies. It also provides information about how to recopy, stop, or remove a VolumeCopy, modify the attributes of a logical drive, view the status of a VolumeCopy operation, and determine what logical drives are involved in a VolumeCopy operation.

Chapter 8, “Troubleshooting VolumeCopy,” on page 121 provides information about troubleshooting some of the more common problems encountered when you use the VolumeCopy feature.

Chapter 9, “Overview of the Enhanced Remote Mirroring Option,” on page 127 provides an introduction to the Remote Mirror Option and describes the hardware and software requirements for using the Remote Mirror Option. It also provides information about configuration types, describes how the Remote Mirror Option interfaces with other premium features (such as Storage Partitioning, FlashCopy, and Enhanced FlashCopy), and provides a hardware and software checklist to make sure that all the requirements are met before you install and configure your systems.

Note: The terms Enhanced Remote Mirroring, Remote Mirror Option, and Remote Mirroring are used interchangeably throughout this document to describe the remote mirroring functionality. Although these terms are used interchangeably, their functionality is different.

Chapter 10, “Installing hardware and software for the Enhanced Remote Mirroring Option,” on page 151 provides information about preparing the site and instructions for installing key hardware and software components to run the Remote Mirror Option.

Chapter 11, “Using the Enhanced Remote Mirroring Option,” on page 175 provides step-by-step instructions for enabling and activating the Remote Mirror Option, creating a mirror relationship, and maintaining a mirror relationship.

Chapter 15, “Disaster recovery,” on page 211 provides a number of scenarios about how the Remote Mirror Option can help prevent data loss, and assist with the recovery of critical data if a disaster or unrecoverable error occurs.

Chapter 16, “Troubleshooting the Enhanced Remote Mirroring Option,” on page 217 provides information for troubleshooting hardware and software components, and describes the events that might be logged when using the Remote Mirror Option.

Appendix A, “Upgrading controller firmware,” on page 231 describes the procedure that you must follow to upgrade controller firmware to make sure that the Remote Mirror Option works properly.

Appendix B, “Accessibility,” on page 233 provides information about the Storage Manager accessibility features such as alternate keyboard navigation and how to enable the screen reader software interface.

“Notices” on page 239 provides product notices and trademark information.

Notices used in this document

This document contains the following notices designed to highlight key information:

- **Note:** These notices provide important tips, guidance, or advice.
- **Important:** These notices provide information that might help you avoid inconvenient or problem situations.
- **Attention:** These notices indicate possible damage to programs, devices, or data. An attention notice is placed just before the instruction or situation in which damage could occur.

Finding Storage Manager software, controller firmware, and readme files

Storage Manager is available on the product CD. You can also download Storage Manager and the latest controller firmware from the IBM Support website.

Important: Before you install the Storage Manager software, consult the readme file. Updated readme files contain the latest device driver versions, firmware levels, limitations, and other information not found in this document.

Storage Manager readme files are found on the web, at the following address:

www.ibm.com/servers/storage/support/disk/

1. On the **Support for IBM System Storage and TotalStorage products** page, from the **Product family** menu, select **Disk systems**. From the **Product** menu, select your product (for example, **DS5100 Midrange Disk System**). Click **Go**.
2. In the **Support & downloads** box, again click **Download**. The **Software and device drivers** page opens.
3. In the **Storage Manager** section of the table, locate your operating system and version level (for example, **IBM DS5000 Storage Manager v10.xx.xx.xx for AIX® - IBM System Storage**), and click the version link in the right column. The DS5000 Storage Manager download page opens.
4. On the download page, in the table under **File details**, click the ***.txt** file link, and the readme file opens in your web browser.

IBM System Storage Productivity Center

The IBM System Storage Productivity Center (SSPC) is an integrated hardware and software solution that provides a single point of entry for managing IBM System Storage disk storage systems, SAN Volume Controller clusters, and other components of your data storage infrastructure. Therefore, you can use the IBM System Storage Productivity Center to manage multiple IBM System Storage product configurations from a single management interface.

To learn how to incorporate the Storage Manager with the IBM System Storage Productivity Center, see the IBM System Storage Productivity Center Information Center at the following website:

publib.boulder.ibm.com/infocenter/tivihelp/v4r1/index.jsp

Essential websites for support information

The most up-to-date information about IBM storage subsystems and the Storage Manager, including documentation and the most recent software, firmware, and NVSRAM downloads, can be found at the following websites:

IBM System Storage Disk Storage Systems
Find links to software and firmware downloads, readme files, and support pages for all IBM System Storage disk storage systems:

http://www.ibm.com/systems/support/storage/disk/

IBM System Storage Interoperation Center (SSIC)
Find technical support information for your specific storage subsystem/host configuration, including the latest firmware versions for your system, with this interactive web-based utility:

www.ibm.com/systems/support/storage/config/ssic/index.jsp

IBM DS3000, DS4000®, DS5000, and BladeCenter® Premium Feature Activation
Activate a premium feature with this web-based utility:

www-912.ibm.com/PremiumFeatures

IBM System Storage Productivity Center
Find the latest documentation that supports the IBM System Storage Productivity Center, a new system that is designed to provide a central management console for IBM System Storage DS3000, DS4000, DS5000, DS8000®, and SAN Volume Controller:

publib.boulder.ibm.com/infocenter/tivihelp/v4r1/index.jsp

IBM System Storage Support
Find the latest support information for host operating systems, HBAs, clustering, storage area networks (SANs), Storage Manager software and controller firmware:

www.ibm.com/systems/support/storage

Storage Area Network (SAN) Support
Find information about using SAN switches, including links to SAN user guides and other documents:

www.ibm.com/systems/support/storage/san

Support for IBM Power, System p®, and BladeCenter servers
Find the latest support information for IBM Power, System p, and BladeCenter servers with AIX, Linux, or IBM i operating system:

www.ibm.com/systems/support/supportsite.wss/brandmain?brandind=5000025

Support for IBM System x® servers
Find the latest support information for System x, Intel, and AMD servers:

http://www.ibm.com/systems/x/

System p and AIX Information Center
Find everything you need to know about using AIX with System p and POWER® servers:

publib.boulder.ibm.com/infocenter/pseries/index.jsp?

Power and IBM i Information Center
Find everything you need to know about using IBM i with POWER servers:

http://publib.boulder.ibm.com/infocenter/iseries/v6r1m0/index.jsp?

Fix Central
Find fixes and updates for your system software, hardware, and host operating system:

www.ibm.com/eserver/support/fixes

IBM System Storage products
Find information about all IBM System Storage products:

www.ibm.com/systems/storage

IBM Publications Center
Find IBM publications:

www.ibm.com/shop/publications/order/

Fire suppression systems

A fire suppression system is the responsibility of the customer. The customer's own insurance underwriter, local fire marshal, or a local building inspector, or both, should be consulted in selecting a fire suppression system that provides the correct level of coverage and protection. IBM designs and manufactures equipment to internal and external standards that require certain environments for reliable operation. Because IBM does not test any equipment for compatibility with fire suppression systems, IBM does not make compatibility claims of any kind nor does IBM provide recommendations on fire suppression systems.

Chapter 1. Introduction

This chapter introduces the Storage Manager premium features that assist with copy services:

FlashCopy

You use the FlashCopy feature to create and manage FlashCopy logical drives. A FlashCopy is the logical equivalent of a complete physical copy, but is created more quickly and requires less disk space. It is host addressable, so you can complete backups using FlashCopy while the base logical drive is online and user-accessible. When the backup completes, you can delete the FlashCopy logical drive or save it for reuse. For more information, see Chapter 2, "Overview of FlashCopy," on page 15.

For controllers with firmware version 7.83.xx.xx and later, the FlashCopy logical drive can be rolled back to the base logical drive as a new FlashCopy option.

Enhanced FlashCopy

- You can use the Enhanced FlashCopy feature to take a logical copy of the content of a standard logical drive or a thin logical drive at a particular point in time. These point-in-time images of logical drives are named Enhanced FlashCopy images.
- This premium feature is an alternate method of creating and organizing FlashCopies. It coexists with the FlashCopy premium feature in the same subsystem. Any references to this premium feature always have 'Enhanced' as a prefix to 'FlashCopy'.

For more information, see Chapter 3, "Overview of Enhanced FlashCopy," on page 43.

Note: This feature is available with only certain models such as DS3500, DCS3700, and DCS3700 storage subsystem with Performance Module Controllers. These models support the IBM DS Storage Manager version 10.83 and later.

VolumeCopy

The VolumeCopy feature is a storage subsystem controller firmware-based mechanism that you use to copy data from one logical drive (the *source* logical drive) to another logical drive (the *target* logical drive) in a single storage subsystem. Once defined, the combination of the source and target logical drives in a VolumeCopy relationship is referred to as a VolumeCopy logical drive pair. For more information about VolumeCopy, see Chapter 6, "Overview of VolumeCopy," on page 93.

The VolumeCopy feature can be used to complete the following tasks:

- Copy data from arrays that use smaller capacity drives to arrays that use larger capacity drives
- Back up data

The VolumeCopy feature includes a Create Copy wizard that is used to create a VolumeCopy, and a Copy Manager that is used to monitor logical drive pairs after they are created.

Important: During the VolumeCopy data transfer operation, any write requests to the source logical drive are rejected. If the source logical drive

is used in a production environment, the FlashCopy feature must be enabled and the FlashCopy of the logical drive must be specified as the VolumeCopy source logical drive instead of using the actual logical drive itself. This requirement is to prevent the logical drive from being inaccessible to the users.

Enhanced Remote Mirroring Option
With Enhanced Remote Mirroring, you can create remote logical drive mirror pairs with two features: Global Copy, and the write consistency group option. Enhanced Global Mirroring with the consistency group option is called Global Mirroring, and Enhanced Remote Mirroring *without* the consistency group option is called Global Copy. Mirroring that uses the synchronous write mode is called *Metro Mirroring*. For more information about remote mirroring, see Chapter 9, "Overview of the Enhanced Remote Mirroring Option," on page 127

Note: Enhanced Remote Mirroring, Remote Mirror, and Remote Mirroring are used interchangeably throughout this document, the online client, and online help system to describe remote mirroring. Although these terms are used interchangeably, this usage does not mean that they are identical.

Receiving product updates and support notifications

Be sure to download the latest versions of the following packages at the time of initial installation and when product updates become available:

- Storage Manager host software
- Storage subsystem controller firmware
- Storage expansion enclosure ESM firmware
- Drive firmware

Important

Keep your system up-to-date with the latest firmware and other product updates by subscribing to receive support notifications.

For more information about how to register for support notifications, see the following IBM Support web page:

http://www.ibm.com/systems/support/storage/subscribe/

You can also check the **Stay Informed** section of the IBM Disk Support website, at the following address:

www.ibm.com/systems/storage/support/disk/index.html

Supported features

Table 1 on page 3 indicates the support for FlashCopy, Enhanced FlashCopy, VolumeCopy, and the Enhanced Remote Mirror features on the DS3500 storage subsystems.

See Table 2 on page 4 for information about the FlashCopy, VolumeCopy, and the Remote Mirror support on the DS4000 storage subsystems, Table 3 on page 5 for information about the FlashCopy, VolumeCopy, and the Remote Mirror support on the DS5000 storage subsystems, or Table 4 on page 5 for information about the

FlashCopy, VolumeCopy, and the Remote Mirror support on the DCS3700 storage subsystems, or Table 5 on page 6 for information about FlashCopy, VolumeCopy, and Remote Mirror support on the DCS3700 storage subsystem with Performance Module Controllers.

Table 1. DS3500 Storage Subsystem Copy Services feature support

Feature	DS3500 (controller firmware version 07.77.xx.xx or later)	DS3500 (controller firmware version before 07.77.xx.xx)
FlashCopy supported?	Yes	Yes
• Maximum number of logical drives that can be defined	512	256
• Maximum total FlashCopy logical drives (see note 1.)	256	64
• Maximum FlashCopy logical drives per base RAID logical drive (see note 4)	8	8
Enhanced FlashCopy supported?	Yes - with firmware version 7.83 and later	No
• Maximum number of Enhanced FlashCopy images	512	-
• Maximum number of Enhanced FlashCopy groups per base logical drive	4	-
• Maximum number of Enhanced FlashCopy logical drives	256	-
VolumeCopy supported? (see note 5)	Yes	Yes
• Maximum number of VolumeCopy target logical drives for a specific source logical drive	256	128
• Maximum copy relationships per storage subsystem	256	128
• Maximum running copies per storage subsystem (see note 3.)	8	8
Remote Mirror Option supported? (see note 2.)	Yes	Yes
• Total Remote Mirror logical drives (see note 6.)	16	8

Note:

1. The total number of FlashCopy logical drives is limited to one half of the total number of logical drives.
2. For more information about the DS Storage Manager controller firmware support for the various storage subsystems, see the *IBM System Storage DS Storage Manager Version 10 Installation and Host Support Guide* (for DS Storage Manager V10.77 or earlier) or the *IBM System Storage DS Storage Manager Version 10.8 Installation and Host Support Guide* (for DS Storage Manager V10.83 or later) for the applicable host operating system.
3. Refers to logical drives in the copy-in-progress state.
4. FlashCopy premium feature supports 4 FlashCopy logical drives. A four to eight FlashCopy logical drive premium feature can be purchased to achieve the maximum of eight FlashCopy logical drives.
5. Requires the installation of the FlashCopy premium feature.
6. 16 Remote Mirror logical drives are supported with controller firmware 7.77.xx.xx and later. An 8 - 16 Remote Mirror logical drive premium feature upgrade can be purchased to achieve the maximum of 16 Remote Mirror logical drives per subsystem.
7. Enhanced Remote Mirroring is not supported on single-controller models.

Table 2 on page 4 indicates the support for FlashCopy, VolumeCopy, and the Enhanced Remote Mirror features on the DS4000 storage subsystems. This support matrix requires that the DS4200, DS4700, and DS4800 storage subsystem controller firmware is at version 07.10.xx.xx or later and the DS4100, DS4300, DS4400, the

DS4500 storage subsystem controller firmware is at version 06.1x.xx.xx or later and the Storage Manager host software is at version 10.10 or later.

Table 2. DS4000 Storage Subsystem Copy Services feature support

Feature	DS4100Base	DS4200	DS4300Base	DS4300Turbo	DS4400	DS4500	DS4700	DS4800
FlashCopy supported?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
• Maximum number of logical drives that can be defined	1024	1024	1024	1024	2048	2048	1024	2048
• Maximum total FlashCopy logical drives (see note 4)	512	512	512	512	1024	1024	512	1024
• Maximum FlashCopy logical drives per base RAID logical drive	4	8	4	4	4	4	8	16
VolumeCopy supported? (see note 7)	Yes (see note 3)	Yes	No	Yes	Yes	Yes	Yes	Yes
• Maximum number of VolumeCopy target logical drives for a specific source logical drive (see note 2)	1023	1023	N/A	1023	2047	2047	1023	2047
• Maximum copy relationships per storage subsystem	1023	1023	N/A	1023	2047	2047	1023	2047
• Maximum running copies per storage subsystem (see note 6)	8	8	N/A	8	8	8	8	8
Remote Mirror Option supported? (see notes 1 and 5)	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
• Total Remote Mirror logical drives	32	64	N/A	32	64	64	64	128

Note:

1. Enhanced Remote Mirroring is not available for DS4100 single-controller storage subsystems, or for DS4300 standard and single-controller storage subsystems. Please contact IBM representatives or resellers for availability of such support in the future.
2. When using firmware version 05.xx.xx.xx or later, the firmware reserves one logical drive for use by the system. For firmware version 05.2x.xx.xx or later, the maximum number of logical drives includes the FlashCopy repository logical drives, the VolumeCopy target logical drive and the Remote Mirror logical drives in addition to the standard data logical drives. If the Remote Mirror Option is enabled, two logical drives are reserved for use by the system.
3. VolumeCopy is supported with DS4100 controller firmware version 06.12.1x.xx or later.
4. The total number of FlashCopy logical drives is limited to one half of the total number of logical drives.
5. For more information about the DS Storage Manager controller firmware support for the various storage subsystems, see the *IBM System Storage DS Storage Manager Version 10 Installation and Host Support Guide* for the applicable host operating system.
6. Refers to logical drives in the copy-in-progress state.
7. Requires the installation of the FlashCopy premium feature.

Table 3 on page 5 indicates the support for FlashCopy, VolumeCopy, and the Enhanced Remote Mirror features on the DS3950, DS5020, DS5100, and DS5300 storage subsystems. This support matrix requires that the DS3950 and DS5020 storage subsystem controller firmware is at version 07.60.xx.xx or later and the Storage Manager host software is at version 10.60 or later. In addition, this support matrix requires that the DS5100 and DS5300 storage subsystem firmware is at version 7.30.xx.xx or later and the Storage Manager host software is at version 10.30 or later.

Table 3. DS5000 Storage Subsystem Copy Services feature support

Feature	DS3950	DS5020	DS5100	DS5300
FlashCopy supported?	Yes	Yes	Yes	Yes
• Maximum number of logical drives that can be defined	1024	1024	2048	2048
• Maximum total FlashCopy logical drives (see note 1)	512	512	1024	1024
• Maximum FlashCopy logical drives per base RAID logical drive	8	8 (see note 5)	16	16
VolumeCopy supported? (see note 4)	Yes	Yes	Yes	Yes
• Maximum number of VolumeCopy target logical drives for a specific source logical drive	1023	1023	2047	2047
• Maximum copy relationships per storage subsystem	1023	1023	2047	2047
• Maximum running copies per storage subsystem (see note 3)	8	8	8	8
Remote Mirror Option supported? (see note 2)	Yes	Yes	Yes	Yes
• Total Remote Mirror logical drives	64	64	128	128

Note:

1. The total number of FlashCopy logical drives is limited to one half of the total number of logical drives.
2. For more information about the DS Storage Manager controller firmware support for the various storage subsystems, see the *IBM System Storage DS Storage Manager Version 10 Installation and Host Support Guide* for the applicable host operating system.
3. Refers to logical drives in the copy-in-progress state.
4. Requires the installation of the FlashCopy premium feature.
5. FlashCopy premium feature supports 4 FlashCopy logical drives. A four to eight FlashCopy logical drive premium feature can be purchased to achieve the maximum of eight FlashCopy logical drives.

Table 4 indicates the support for FlashCopy, VolumeCopy, and the Enhanced Remote Mirror features on the DCS3700 storage subsystem. This support matrix requires that the DCS3700 storage subsystem controller firmware is at version 07.77.xx.xx or later and the Storage Manager host software is at version 10.77 or later.

Table 4. DCS3700 Storage Subsystem Copy Services feature support

Feature	DCS3700
FlashCopy supported?	Yes
• Maximum number of logical drives that can be defined	512
• Maximum total FlashCopy logical drives (see note 1.)	256
• Maximum FlashCopy logical drives per base RAID logical drive	8
Enhanced FlashCopy supported?	Yes - with firmware version 7.83 and later
• Maximum number of Enhanced FlashCopy images	512

Table 4. DCS3700 Storage Subsystem Copy Services feature support (continued)

Feature	DCS3700
• Maximum number of Enhanced FlashCopy groups per base logical drive	4
• Maximum number of Enhanced FlashCopy logical drives	256
VolumeCopy supported?	Yes
• Maximum number of VolumeCopy target logical drives for a specific source logical drive	511
• Maximum copy relationships per storage subsystem	511
• Maximum running copies per storage subsystem (see note 3.)	8
Remote Mirror Option supported? (see note 2.)	Yes
• Total Remote Mirror logical drives	16

Note:

1. The total number of FlashCopy logical drives is limited to one half of the total number of logical drives.
2. For more information about the DS Storage Manager controller firmware support for the various storage subsystems, see the *IBM System Storage DS Storage Manager Version 10 Installation and Host Support Guide* (for DS Storage Manager V10.77 or earlier) or the *IBM System Storage DS Storage Manager Version 10.8 Installation and Host Support Guide* (for DS Storage Manager V10.83 or later) for the applicable host operating system.
3. Refers to logical drives in the copy-in-progress state.

Table 5. DCS3700 storage subsystem with Performance Module Controllers - Copy Services feature support

Feature See note 1	DCS3700 storage subsystem with Performance Module Controllers
FlashCopy supported?	**Yes**
Maximum number of logical drives that can be defined	2048
Maximum total FlashCopy logical drives	256
Maximum FlashCopy logical drives per base RAID logical drive	8
Enhanced FlashCopy supported?	**Yes**
Maximum number of Enhanced FlashCopy images	2048
Maximum number of Enhanced FlashCopy groups per base logical drive	4
Maximum number of Enhanced FlashCopy logical drives	1024
VolumeCopy supported?	**Yes**
Maximum number of VolumeCopy target logical drives for a specific source logical drive	1024
Maximum copy relationships per storage subsystem	1024
Maximum running copies per storage subsystem See note 2	8
Remote Mirror Option supported?	**Yes**

Table 5. DCS3700 storage subsystem with Performance Module Controllers - Copy Services feature support (continued)

Feature [See note 1]	DCS3700 storage subsystem with Performance Module Controllers
Total Remote Mirror logical drives	16

Note:

1. For more information about the DS Storage Manager controller firmware support for the various storage subsystems, see the *IBM System Storage DS Storage Manager Version 10 Installation and Host Support Guide* (for DS Storage Manager V10.77 or earlier) or the *IBM System Storage DS Storage Manager Version 10.8 Installation and Host Support Guide* (for DS Storage Manager V10.83 or later) for the applicable host operating system.
2. Refers to logical drives in the copy-in-progress state.

Enabling premium features using firmware version 6.xx.xx or earlier

You must complete the following tasks to enable a premium feature on your storage subsystem that has firmware version 6.xx.xx or earlier installed:

- "Obtaining the feature enable identifier using firmware version 6.xx.xx or earlier"
- "Generating the feature key file" on page 8
- "Enabling the premium feature using firmware version 6.xx.xx or earlier" on page 8
- "Verifying that the premium feature is enabled using firmware version 6.xx.xx or earlier" on page 8

To obtain the storage subsystem feature enable identifier, make sure that your controller unit and storage expansion enclosures are connected, powered on, and managed using the SMclient. Continue with the next section.

Obtaining the feature enable identifier using firmware version 6.xx.xx or earlier

Each storage subsystem has its own unique feature enable identifier. This identifier makes sure that a particular feature key file is applicable only to that storage subsystem. Complete the following steps to obtain the feature enable identifier:

1. Click **Start → Programs → Storage Manager 10 Client**. The Enterprise Management window opens.
2. In the Enterprise Management window, double-click the storage subsystem for which you want to enable the premium feature. The Subsystem Management window opens for the selected storage subsystem.
3. In the Subsystem Management window, click **Storage Subsystem → Premium Features → List**. The List Premium Features window opens and displays the feature enable identifier.
4. Record the feature enable identifier.
5. Close the List Premium Features window.

Continue to next section, "Generating the feature key file" on page 8.

Note: To check the status of an existing premium feature, select **Storage Subsystem → Premium Features → List** from the menu.

Generating the feature key file

To generate the feature key file, you need the following information:

- Premium feature activation code: This code is available on the upper-right corner of the web activation flyer that is shipped with your premium feature.
- The storage subsystem Feature Key Identifier: For details, see "Obtaining the feature enable identifier using firmware version 6.xx.xx or earlier" on page 7.
- The machine type, model information, and serial number for the storage subsystem: This information is on the enclosure chassis. It might also be available in the shipping paper work that is associated with your order.

You can generate the feature key file with the Premium Feature activation tool that is available at the following website: IBM System Storage: Storage subsystem solutions and premium features: activation and expansion module feature registration.

The premium feature key generation process:

1. Follow the steps provided on the website. After you complete all steps, the Feature key file is sent to you by email, if an email address was provided during the activation process.
2. On your hard disk drive, create a directory that you can find easily (for example, you can name the directory **FlashCopy feature key.**)
3. Save the feature key file in the new directory.

Enabling the premium feature using firmware version 6.xx.xx or earlier

In the Storage Manager Subsystem Management window:

1. In the menu, click **Premium Features → Enable**.
2. Browse to the appropriate key file in the directory you saved it to in the previous task, "Generating the feature key file."
3. Click **OK**.
4. Confirm that the premium feature is enabled. See the next section, "Verifying that the premium feature is enabled using firmware version 6.xx.xx or earlier."

Verifying that the premium feature is enabled using firmware version 6.xx.xx or earlier

Complete the following steps to see a list of those premium features that are enabled on your storage subsystem:

1. In the Subsystem Management window, click **Storage Subsystem → Premium Features → List**

   The List Premium Features window opens (see Figure 1 on page 9).

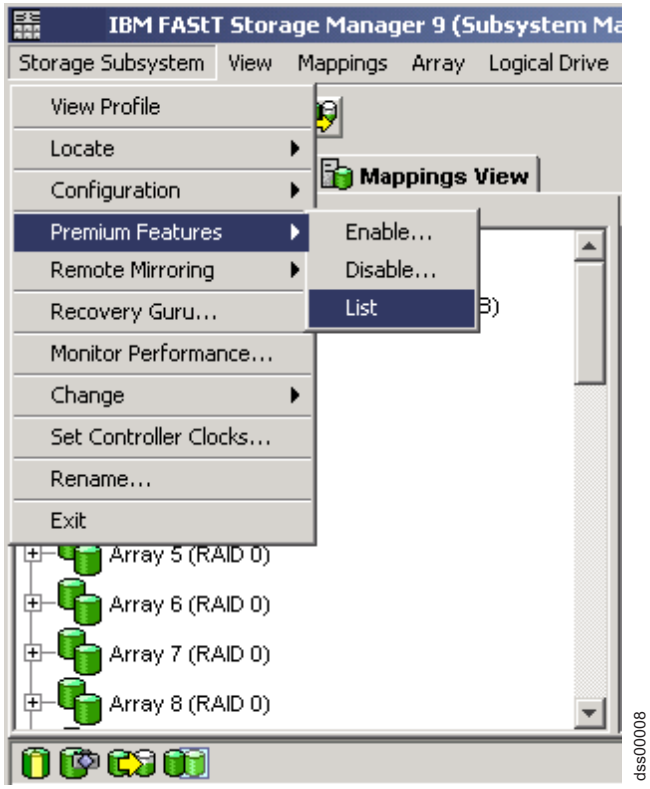


Figure 1. Listing premium features

The dialog lists the following items:

- The premium features that are enabled on the storage subsystem
- The feature enable identifier

2. Click **Close** to close the window.

Disabling premium features using firmware version 6.xx.xx or earlier

In normal system operations, you do not need to disable the premium features. However, if you want to disable a premium feature, make sure that you have the key file or the IBM premium feature entitlement card with the premium feature activation code for generating the key file. You need this key file to re-enable the premium feature at a later time.

Complete the following steps to disable a premium feature on the storage subsystem:

1. In the Subsystem Management window, click **Storage Subsystem → Premium Features → Disable**.

   The Disable Premium Feature window opens, listing all the premium features that are enabled.

2. Select one item in the list, and then click **OK**.

   A confirmation dialog displays.

3. Click **Yes**.

   The Working dialog displays while the feature is being disabled. When the feature is disabled, the Working dialog closes.

Note:

1. If you want to enable the premium feature in the future, you must reapply the Feature Key file for that feature.
2. You can disable the Remote Mirror Option without deactivating the feature. If the feature is disabled but activated, you can complete all mirroring operations on existing remote mirrors. However, when the feature is disabled you cannot create any new remote mirrors. For more information about activating the Remote Mirror Option, see the *Storage Manager Copy Services Guide* or see "Using the Activate Remote Mirroring" wizard in the Storage Manager online help.
3. If a premium feature is disabled, you can use the saved premium feature key file to reactivate the premium feature. Alternatively, you can access the IBM premium feature key website (IBM System Storage: Storage subsystem solutions and premium features: activation and expansion module feature registration) to reactivate the premium feature key. Ensure that the machine type, model information, and serial number are the same as those of the storage subsystem that you used to generate the original premium feature key.

For any additional assistance, contact your local IBM service provider. Ensure that you have the information listed in "Enabling the premium feature using firmware version 6.xx.xx or earlier" on page 8.

Enabling premium features using firmware version 7.xx.xx or later

You must complete the following tasks to enable a premium feature on your storage subsystem that has firmware version 7.xx.xx or later installed:

- "Obtaining the feature enable identifier using firmware version 7.xx.xx or later"
- "Generating the feature key file" on page 8
- "Enabling the premium feature or feature pack using firmware version 7.xx.xx or later" on page 11
- "Verifying that the premium feature is enabled using firmware version 7.xx.xx or later" on page 12

To obtain the storage subsystem feature enable identifier, make sure that your controller unit and storage expansion enclosures are connected, powered on, and managed using the SMclient. Continue with the next section.

Obtaining the feature enable identifier using firmware version 7.xx.xx or later

Each storage subsystem has its own unique feature enable identifier. This identifier makes sure that a particular feature key file is applicable only to that storage subsystem. Complete the following steps to obtain the feature enable identifier:

1. Click **Start → Programs → DS Storage Manager 10 Client**. The Enterprise Management window opens.
2. In the Enterprise Management window, double-click the storage subsystem for which you want to enable the premium feature. The Subsystem Management window opens for the selected storage subsystem.
3. In the Subsystem Management window, click **Storage Subsystem → Premium Features**. The Premium Features and Feature Pack window opens and displays the feature enable identifier.
4. Record the feature enable identifier.

Note: You can highlight the feature enable identifier, press CNTRL+C key to copy it and then in the appropriate field in the premium feature key website, press CNTRL+V to paste it.

5. Close the Premium Features and Feature Pack window.

Continue to next section, "Generating the feature key file" on page 8.

Note: To check the status of an existing premium feature, select **Storage Subsystem → Premium Features** from the menu.

Generating the feature key file

To generate the feature key file, you need the following information:

- Premium feature activation code: This code is available on the upper-right corner of the web activation flyer that is shipped with your premium feature.
- The storage subsystem Feature Key Identifier: For details, see "Obtaining the feature enable identifier using firmware version 7.xx.xx or later" on page 10.
- The machine type, model information, and serial number for the storage subsystem: This information is on the enclosure chassis. It might also be available in the shipping paper work that is associated with your order.

You can generate the feature key file with the Premium Feature activation tool that is available at the following website: IBM System Storage: Storage subsystem solutions and premium features: activation and expansion module feature registration.

The premium feature key generation process:

1. Follow the steps provided on the website. After you complete all steps, the Feature key file is sent to you by email, if an email address was provided during the activation process.
2. On your hard disk drive, create a directory that you can find easily (for example, you can name the directory **FlashCopy feature key.**)
3. Save the feature key file in the new directory.

Enabling the premium feature or feature pack using firmware version 7.xx.xx or later

Perform the following steps to enable a premium feature or feature pack:

1. In the Storage Manager Subsystem Management window, click **Storage Subsystem → Premium Features**. A Premium Features and Feature Pack window is displayed.
   - To activate a premium feature for controller firmware versions 7.10.xx.xx to 7.77.xx.xx, select the premium feature in the **Premium Feature** list, and click **Enable**.
   - To activate a premium feature for controller firmware versions 7.83.xx.xx or later, click **Use Key File**.
   - To activate a software feature pack, click **Change**.
2. Browse to the appropriate key file in the directory you saved it to in the previous task, "Generating the feature key file" on page 8.
3. Click **OK**.
4. Click **Yes** to use the key file to enable the premium feature or software feature pack.

Important: When a feature pack is enabled, both controllers will be rebooted.

5. Confirm that the premium feature is enabled. See the next section, "Verifying that the premium feature is enabled using firmware version 7.xx.xx or later."

Verifying that the premium feature is enabled using firmware version 7.xx.xx or later

Complete the following steps to see a list of those premium features that are enabled on your storage subsystem:

1. In the Subsystem Management window, click **Storage Subsystem → Premium Features**

   The Premium Features and Feature Pack window opens. The dialog lists the following items:

   - The premium features that are available on the storage subsystem
   - The premium features that are enabled on the storage subsystem
   - The feature enable identifier

2. Click **Close** to close the window.

Disabling premium features using firmware version 7.xx.xx or later

In normal system operations, you do not need to disable the premium features. However, if you want to disable a premium feature, ensure that you have the key file or the IBM premium feature entitlement card with the premium feature activation code for regenerating the key file. You need this key file to re-enable the premium feature at a later time.

You must remove any configuration that is associated with the premium feature that is to be disabled. If you fail to do so, the storage subsystem moves to the **premium feature out-of-compliance** state. In this state, the subsystem cannot have new activities (such as creating an array) until the configuration that is associated with the premium feature is removed or the premium feature is re-enabled.

Complete the following steps to disable a premium feature on the storage subsystem:

1. In the Subsystem Management window, click **Storage Subsystem → Premium Features**

   The Premium Features and Feature Pack window opens, listing all the premium features that are enabled.

2. For controller firmware versions 7.10.xx.xx to 7.77.xx.xx, select one item in the list, and then click **Disable**. For controller firmware version 7.83 or later, click **Disable** in the same display box as the premium feature.

   A confirmation dialog displays.

3. Click **Yes**.

   The Working dialog is displayed while the feature is being disabled. When the feature is disabled, the Working dialog closes.

Note:

1. You cannot disable a feature pack in the using the Storage Manager GUI. You can disable the feature pack by using the Storage Manager CLI command `disable storageSubsystem featurePack`. When a feature pack is disabled, both

controllers are rebooted. You must schedule downtime to disable a premium feature pack. You do not have to schedule downtime when you disable a premium feature.

2. If you want to enable the premium feature in the future, you must reapply the Feature Key file for that feature.
3. You can disable the Remote Mirror Option without deactivating the feature. If the feature is disabled but activated, you can complete all mirroring operations on existing remote mirrors. However, when the feature is disabled you cannot create any new remote mirrors. For more information about activating the Remote Mirror Option, see the *Storage Manager Copy Services Guide* or see "Using the Activate Remote Mirroring" wizard in the Storage Manager online help.
4. If a premium feature is disabled, you can use the saved premium feature key file to reactivate the premium feature. Alternatively, you can access the IBM premium feature key website (IBM System Storage: Storage subsystem solutions and premium features: activation and expansion module feature registration) to reactivate the premium feature key. Ensure that the machine type, model information, and serial number are the same as those of the storage subsystem that you used to generate the original premium feature key.

For any additional assistance, contact your local IBM service provider. Ensure that you have the information that is listed in the "Generating the feature key file" on page 8 section handy.

Chapter 2. Overview of FlashCopy

Important: This FlashCopy premium feature is the original or existing FlashCopy premium feature that is available for purchase with the DS storage subsystem that has controller firmware earlier than 7.83.xx.xx installed on it. It is also available for purchase with the DS storage subsystem with controller firmware version 7.83.xx.xx or later installed on it. Enhanced FlashCopy is a new premium feature that is available with only certain models such as DS3500, DCS3700, and DCS3700 storage subsystem with Performance Module Controllers. These models have controller firmware version 7.83.xx.xx or later installed on them in conjunction with the IBM DS Storage Manager version 10.83 and later. It is an alternate method of creating and organizing FlashCopies.

Use the FlashCopy premium feature to create and manage FlashCopy logical drives. A FlashCopy logical drive is a point-in-time image of a standard logical drive in your storage subsystem. The logical drive that is copied is called a *base logical drive*. The FlashCopy premium feature can be used with arrays only. It does not support disk pools.

When you make a FlashCopy, the controller suspends write operations to the base logical drive for a few seconds while it creates a FlashCopy *repository logical drive*, which is a physical logical drive where FlashCopy metadata and copy-on-write data are stored.

Depending on the version of the DS Storage Manager, the SMclient instructions and screen captures in this document might be different from the menu paths in the SMclient software GUI that you are using.

Note: To obtain an accurate FlashCopy view of the base logical drive, you must follow the procedures that are described in "Preparing the host operating system before creating FlashCopy logical drive or Enhanced FlashCopy image" on page 70.

Depending on the subsystem, you can create up to 16 FlashCopies of a base logical drive, and then write data to the FlashCopy logical drives to complete testing and analysis. For example, before upgrading a database management system, you can use FlashCopy logical drives to test different configurations. In addition, the maximum number of FlashCopies per logical drive varies depending on the subsystem model and whether FlashCopy per logical drive premium feature upgrade is purchased and enabled. See Table 1 on page 3, Table 2 on page 4, Table 3 on page 5, or Table 4 on page 5 for more information.

You can create FlashCopy logical drives for repeated reuse (frequent or nightly backups) or for one-time use (speculative change or upgrade testing).

This chapter describes the following procedures:

You can complete these procedures from the SMclient GUI, or with the command-line interface (SMcli) and the script editor. For more information, click the **Help** tab in the Enterprise Management window, and then search for *SMcli* or *script editor*.

Note:

1. FlashCopy is not supported on a DS4300 that is running firmware version 05.33.xx.xx.
2. Making a FlashCopy of a "Dynamic Disk" type of logical drive is not supported on Windows operating systems.

Enabling FlashCopy

Before you begin, obtain the following information:

- Your Feature Activation Code, which is printed on the IBM FlashCopy premium feature web activation instructions.
- Your controller unit IBM serial number, machine type, and model number. For some storage subsystems, this information is printed on a black label on the front-left mounting flange of the controller. The location of this information varies depending on your subsystem model. To locate the information that is specific to your subsystem, refer to the related 'Installation, User's, and Maintenance Guide'.
- The 32 alphanumeric-character feature enable identifier (see “Obtaining the feature enable identifier using firmware version 6.xx.xx or earlier” on page 7 or “Obtaining the feature enable identifier using firmware version 7.xx.xx or later” on page 10 depending on whichever version is applicable to your storage subsystem.)

To enable FlashCopy, follow the instructions that are applicable to your controller firmware version. For details, see “Enabling premium features using firmware version 6.xx.xx or earlier” on page 7 or “Enabling premium features using firmware version 7.xx.xx or later” on page 10.

To obtain the storage subsystem feature enable identifier, ensure that your controller unit and storage expansion enclosures are connected, powered on, and managed by the SMclient.

For information about viewing the list of premium features that are enabled on your storage subsystem, see “Verifying that the premium feature is enabled using firmware version 6.xx.xx or earlier” on page 8 or “Verifying that the premium feature is enabled using firmware version 7.xx.xx or later” on page 12 depending on whichever version is applicable to your storage subsystem.

Planning a FlashCopy logical drive

Before you create a FlashCopy logical drive, ensure that you are familiar with the following concepts:

- Specifying FlashCopy repository logical drive settings
- Estimating FlashCopy repository logical drive capacity
- Estimating FlashCopy repository life

For more information about these concepts, see “Planning a FlashCopy or an Enhanced FlashCopy logical drive” on page 65

See “Overview of the FlashCopy Logical Drive wizard” for descriptions of the parameters that you need to specify in the FlashCopy Logical Drive Wizard.

Overview of the FlashCopy Logical Drive wizard

This section contains descriptions of the parameters that you specify on the following FlashCopy Logical Drive wizard panels:

Important: The instructions and screen shots provided in this section vary depending on the version of your controller firmware.

Note: See the FlashCopy Logical Drive wizard online help for additional information.

Introduction panel

The Introduction panel, shown in Figure 2 on page 18, provides a definition of a FlashCopy logical drive and describes its physical components.

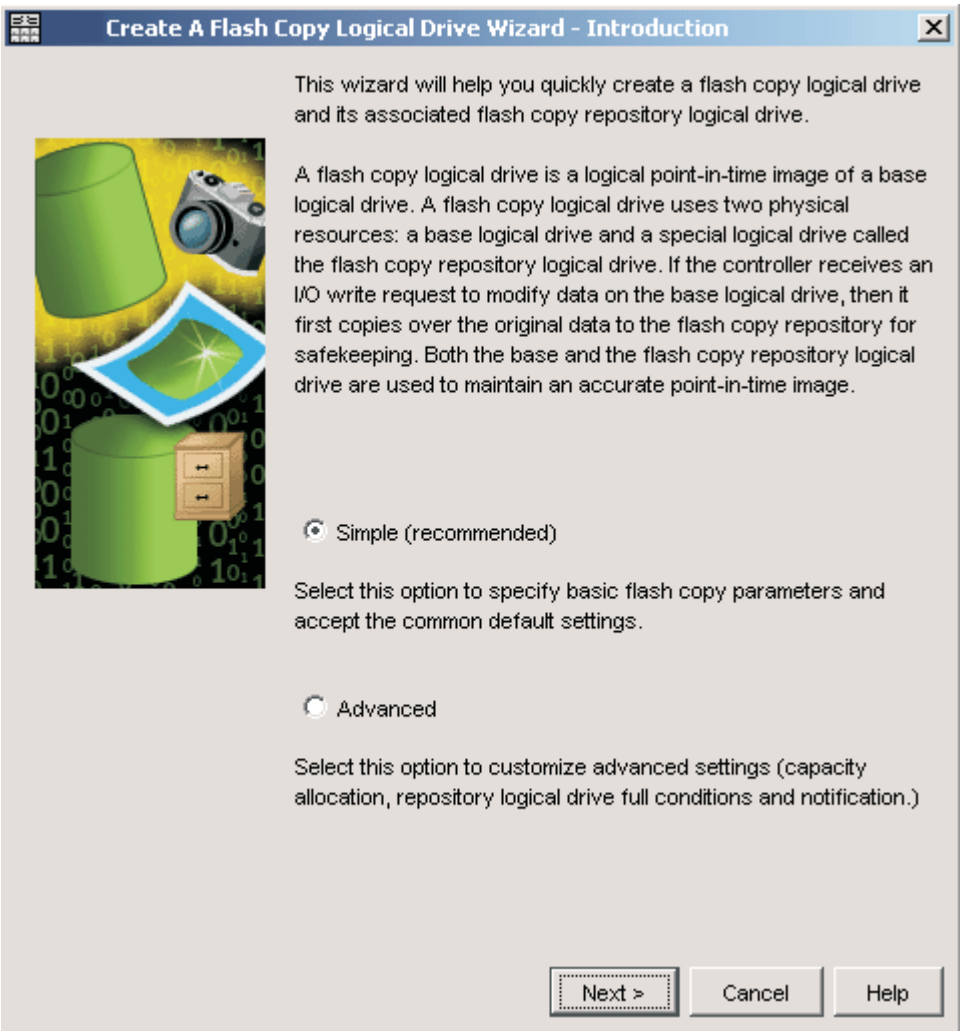


Figure 2. FlashCopy Logical Drive Wizard Introduction panel

On this panel you can select one of the following options:

Simple

You can use this option if there is free capacity in the array in which the base logical drive is allocated and the free capacity is at least 8 MB plus one percent (1%) of the base logical drive capacity. Select this option to specify basic FlashCopy parameters with default settings for FlashCopy logical drive mappings.

Advanced

You can use this option if you want to specify the following factors:

- Where the FlashCopy repository logical drive will be created
- All of the customizable FlashCopy settings

Note: The screens will appear differently, depending on the installed version of the controller firmware.

Allocate Capacity panel

On the Allocate Capacity panel, shown in Figure 3 on page 19, you can specify where to allocate the repository storage capacity.

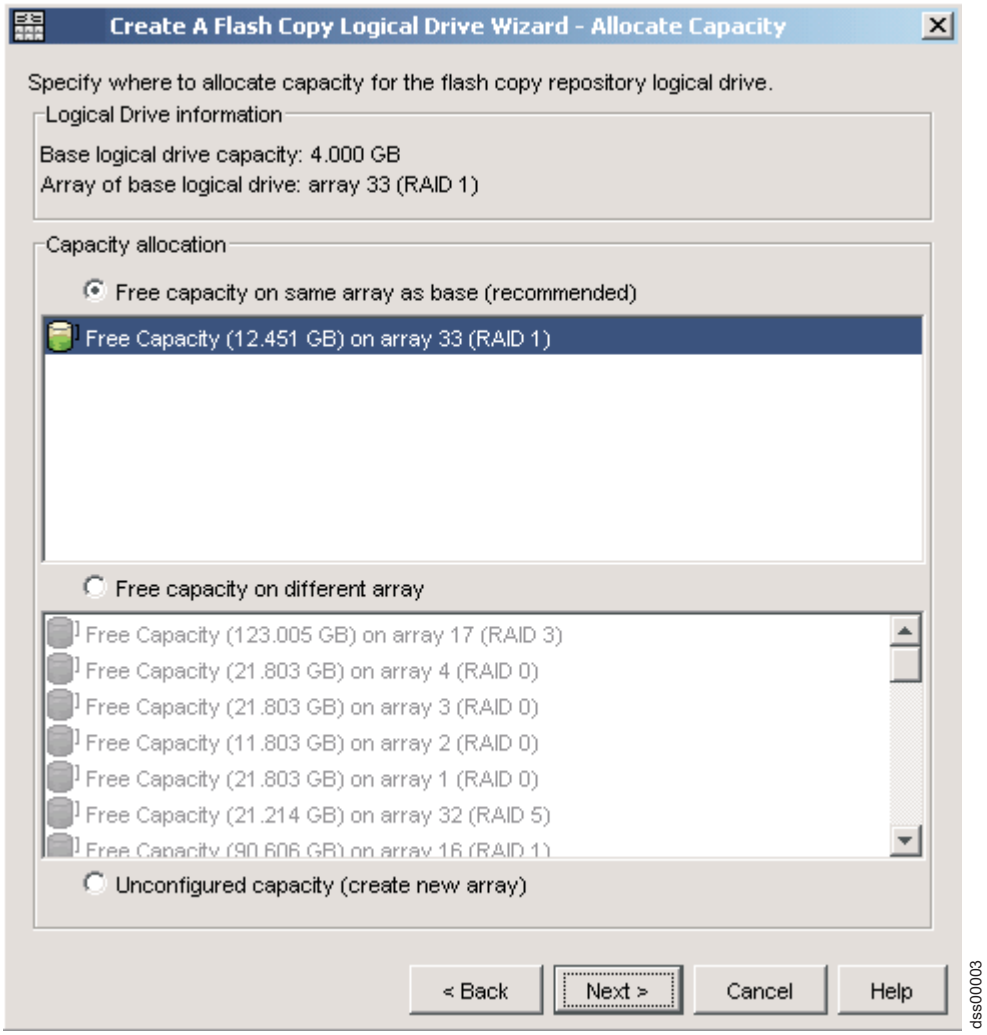


Figure 3. Allocate Capacity panel

Free Capacity

You can choose **Free Capacity on same array as base** or **Free capacity on different array**. These paths take you to the Specify Logical Drive Parameters panel, where you can define the mapping and repository logical drive parameters.

Unconfigured Capacity

This path takes you to the Specify Array Parameters panel, where you can specify a new array on which the repository resides and choose the RAID level of the array.

Specifying schedule

For a storage subsystem with controller firmware 7.77.xx.xx or later, you can define a schedule to create the FlashCopy logical drive. For more information, see "Creating a schedule for a FlashCopy or an Enhanced FlashCopy logical drive" on page 90.

Specify Logical Drive Parameters panel

Use the Specify Logical Drive Parameters panel, shown in Figure 4, to specify the action that you want the system to complete when a FlashCopy repository logical drive reaches its capacity and becomes full.

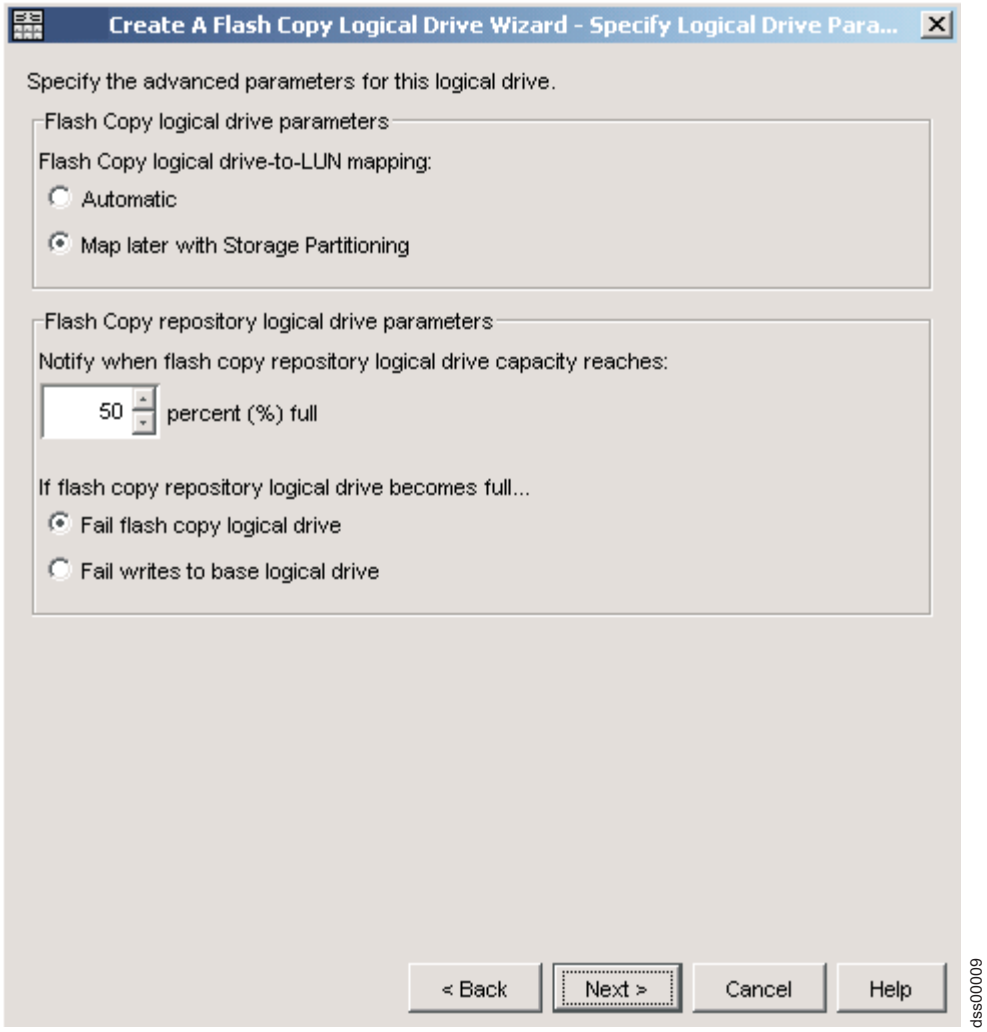


Figure 4. Specify Logical Drive Parameters panel

FlashCopy logical drive parameters

In this section of the panel you can specify one of the following options for logical drive-to-LUN mapping:

Automatic

If you choose this option, the system maps the FlashCopy logical drive automatically.

Map later with Storage Partitioning

If you choose this option, follow the procedure described in "Mapping the FlashCopy or Enhanced FlashCopy logical drive to the host" on page 72 after you have finished using the wizard.

Repository logical drive parameters

In this section of the panel you can specify the threshold warning level and repository fail policy.

Percent (%) full

This field specifies the threshold warning level for the FlashCopy repository logical drive. Storage Manager provides a warning message when the FlashCopy repository logical drive exceeds the threshold level that you specify.

Important: This warning is the only notification that you receive before the repository becomes full.

The threshold warning level for the FlashCopy repository logical drive is initially set to 50%. If you are not sure how high to set the threshold warning level, accept this default setting.

You can specify one of the following actions that you want Storage Manager to complete when the repository becomes full:

Fail FlashCopy logical drive

If you specify this option, the FlashCopy logical drive data is not recoverable when the FlashCopy repository logical drive becomes full, and the FlashCopy cannot be accessed. In this case, the only possible action is to delete the FlashCopy logical drive or re-create the FlashCopy logical drive to create a new point-in-time image.

This is the default option.

Fail writes to base logical drive

If you specify this option, the FlashCopy logical drive data is accessible when the FlashCopy repository logical drive becomes full. However, the FlashCopy repository logical drive capacity must be increased so that writes to the base logical drive are not rejected.

Attention: AIX and IBM i do not support the "Fail writes to base logical drive" option. Selecting this option might cause data loss on the base logical drive. If you are using AIX or IBM i, select the "Fail FlashCopy logical drive" option, which is the default. Be sure to monitor the capacity of the FlashCopy repository logical drive, because you cannot access the FlashCopy if the repository logical drive becomes full.

See “Specifying FlashCopy or Enhanced FlashCopy repository logical drive settings” on page 65 for more information about repository capacity and settings.

When you click **Next**, the Preview panel opens and displays the parameters that you specified. Click **Back** to return to the previous panels to edit the repository parameters or click **Finish** to proceed to the Specify Names panel.

Specify Array Parameters panel

If you specified the **Unconfigured Capacity** option on the Allocate Capacity panel, the Specify Array Parameters panel shown in Figure 5 on page 22, displays. On this panel you can specify a new array on which to place the repository logical drive. You can also specify the RAID level of the array that meets the FlashCopy repository logical drive data storage and protection requirements.

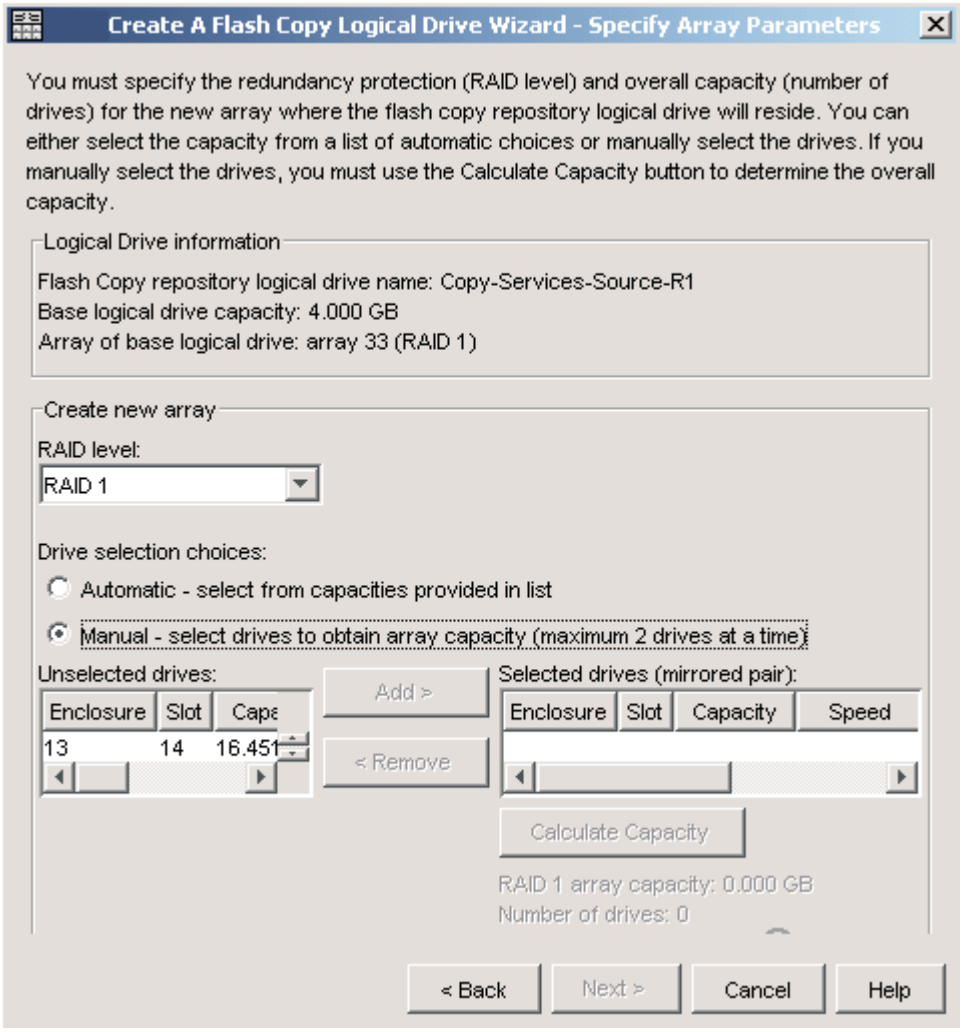


Figure 5. Specify Array Parameters panel

Click **Next** to go to the Specify Names panel.

Specify Names panel

On the Specify Names panel, shown in Figure 6 on page 23, you can define the FlashCopy logical drive name and the name of its associated FlashCopy repository logical drive.

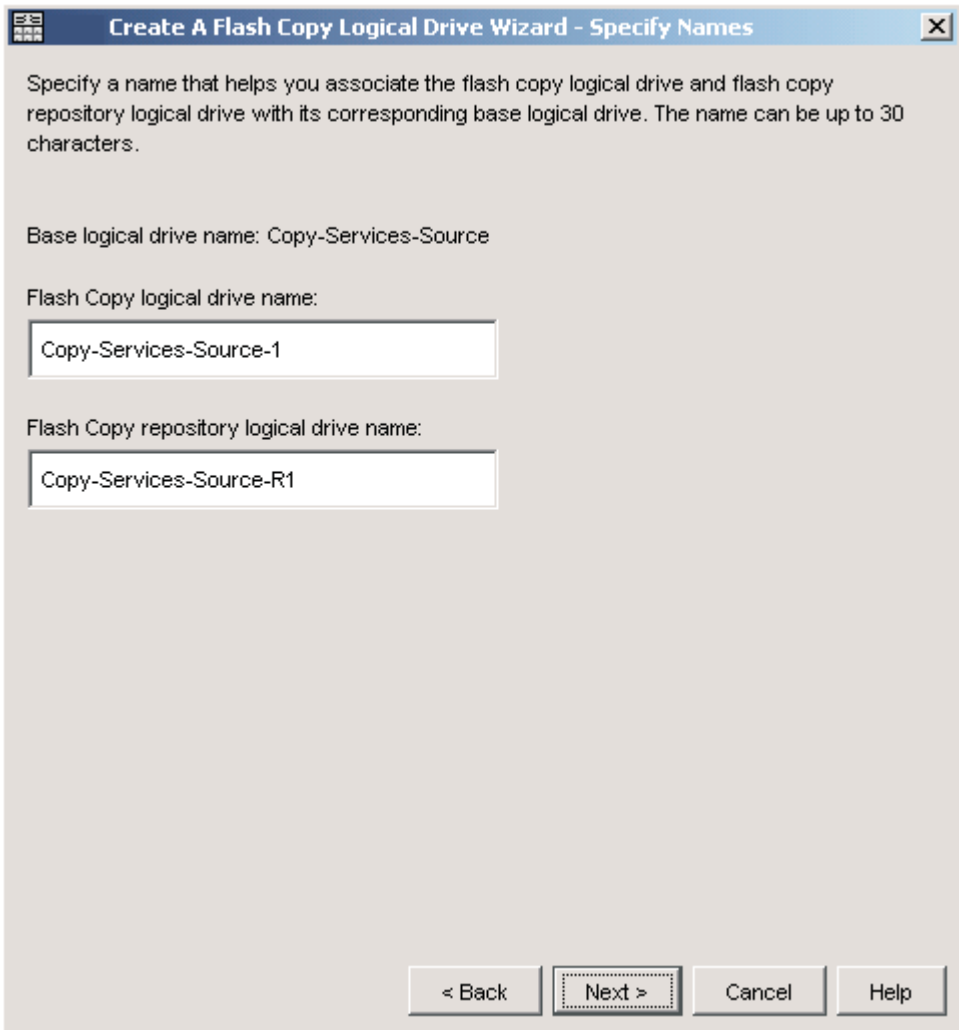


Figure 6. Specify Names panel

The default naming convention for the first FlashCopy uses the base logical drive name and adds a suffix of "-1" for the FlashCopy logical drive and "-R1" for the FlashCopy logical repository drive. The second FlashCopy increments this number to 2, and so on, up to the four logical drives.

For example, if you are creating the first FlashCopy logical drive for a base logical drive called DataVol, then the default FlashCopy logical drive name is *DataVol-1*. The associated FlashCopy repository logical drive default name is *DataVol-R1*. The default name of the next FlashCopy logical drive that you create based on DataVol is *DataVol-2*, and the corresponding FlashCopy repository logical drive name is *DataVol-R2*.

Change the default names if required.

The following are tips when changing names:

- You must choose a unique name for the FlashCopy and FlashCopy repository logical drives. Otherwise, the system displays an error message.
- Regardless of whether you use the software-supplied sequence number that (by default) populates the FlashCopy logical drive name or FlashCopy repository logical drive name field, the next default name for a FlashCopy or FlashCopy

repository logical drive still receives a sequence number determined by the software. For example, you might name the first FlashCopy of base logical drive DataVol *DataVolMay28*, without using the software-supplied sequence number of -1. Regardless, the software assigns a default name for the next FlashCopy as *DataVol-2*.

- The next available sequence number is based on the number of existing FlashCopies of a base logical drive. If you delete a FlashCopy logical drive, the assigned sequence number becomes available again.
- Names have a 30-character limit, including spaces. When you reach this limit in either the FlashCopy logical drive name or FlashCopy repository logical drive name field, no more input is accepted. If the base logical drive name contains 30 characters, the default names for the FlashCopy and its associated FlashCopy repository logical drive use the base logical drive name truncated just enough to add the sequence string. For example, for "Host Software Engineering Group GR-1", the default FlashCopy name would be "Host Software Engineering GR-1". The default repository name would be "Host Software Engineering G-R1."

Click **Next** to go to the Specify FlashCopy Repository Logical Drive Capacity panel.

Specify FlashCopy Repository Logical Drive Capacity panel

Note: This procedure refers to FlashCopy. It is also applicable for Enhanced FlashCopy.

On the Specify FlashCopy Repository Logical Drive Capacity panel, shown in Figure 7 on page 25, you can set the repository drive capacity as a percentage of the capacity of the base logical drive.

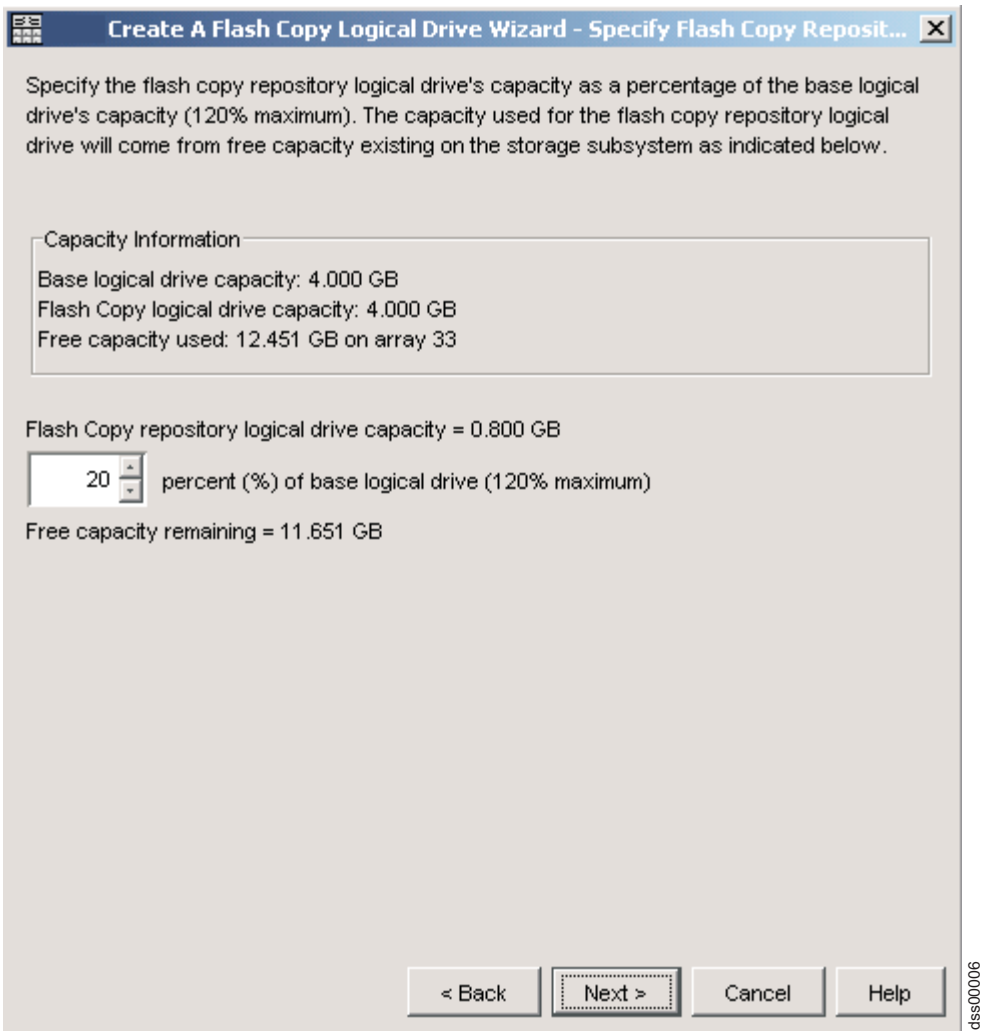


Figure 7. Specify Repository Logical Drive Capacity panel

percent (%) of base logical drive

This field sets the FlashCopy repository logical drive capacity as a percentage of the base logical drive. The default is 20%.

If you calculate a different capacity using the procedure described in "Estimating a FlashCopy or an Enhanced FlashCopy repository logical drive capacity" on page 67, you can increase or decrease the percentage in this field until the FlashCopy Repository Logical Drive Capacity value matches the estimated capacity that you calculated. You might need to round up the number.

Preview panel

The Preview panel, shown in Figure 8 on page 26, displays the parameters that you have specified for the FlashCopy logical drive and the FlashCopy repository logical drive. If you click **Finish** on this panel, the FlashCopy logical drive create process initiates.

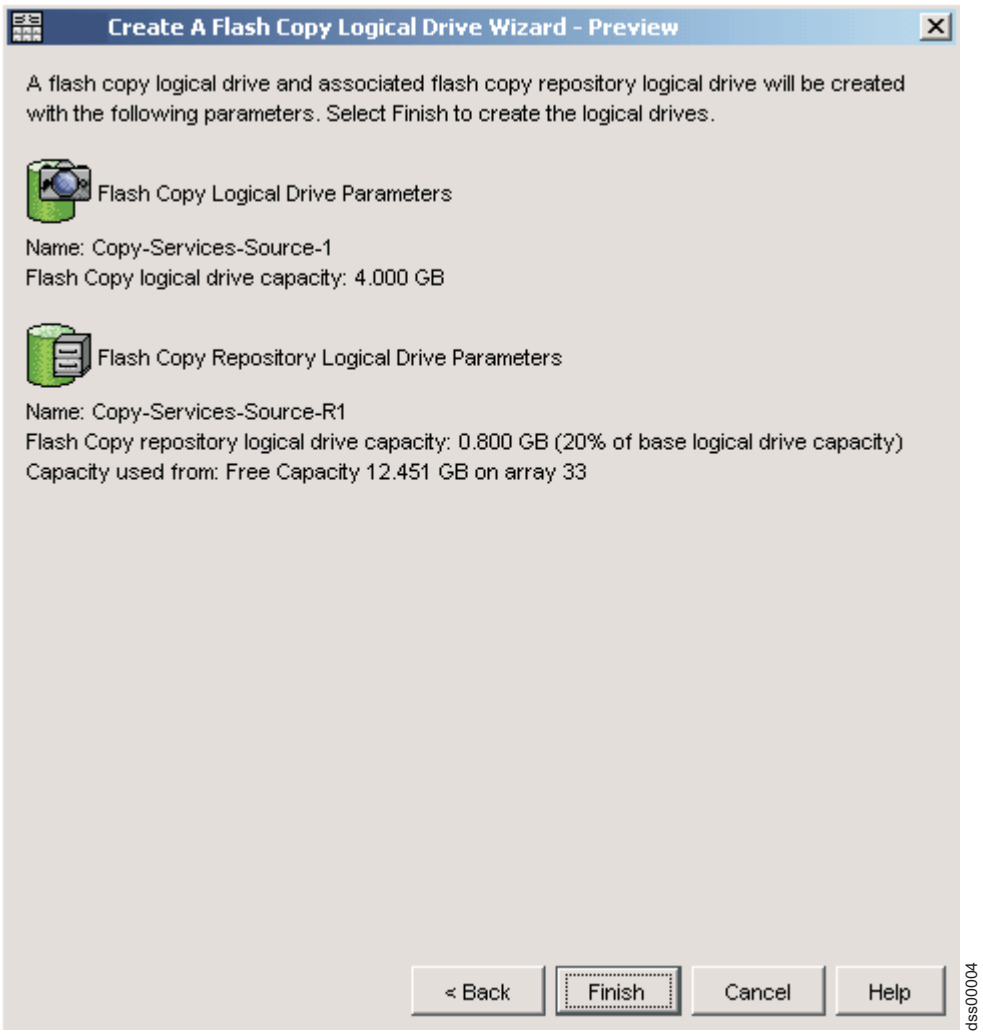


Figure 8. Preview panel

Creating a FlashCopy logical drive

This section describes how to create a FlashCopy logical drive by completing the following procedures, in the order that they are listed:

1. "Preparing the host operating system before creating FlashCopy logical drive or Enhanced FlashCopy image" on page 70
2. "Creating a FlashCopy logical drive by using the FlashCopy Logical Drive wizard" on page 27
3. "Mapping the FlashCopy or Enhanced FlashCopy logical drive to the host" on page 72
4. "Configuring the host for the FlashCopy logical drive" on page 77

Attention: Failure to complete the procedures that are required for your host operating system can result in an inaccurate point-in-time image of the base logical drive.

Creating a FlashCopy logical drive by using the FlashCopy Logical Drive wizard

After you prepare the host operating system, create a FlashCopy logical drive by using the FlashCopy Logical Drive wizard, which you access through SMclient.

Before you begin, see "Overview of the FlashCopy Logical Drive wizard" on page 17 to view screen captures of the FlashCopy Logical Drive wizard panels and read descriptions of the parameters.

To create a FlashCopy logical drive, complete the following steps:

1. Right-click the logical drive in either the **Logical/Physical**, **Logical**, or **Storage & Copy Services** tab of the subsystem management window, depending on the controller firmware version installed in the storage subsystem.
2. Select **Create FlashCopy Logical Drive** or **Create -> FlashCopy** in the pull-down menu.

   Note: If the FlashCopy logical drive is to be based on the root disk of the host operating system, the final point-in-time image might not be consistent with the base logical drive.
3. Review the information in the initial panel. Click **OK** to proceed to the Introduction screen of the wizard.
4. For controller firmware versions 7.77.xx.xx and later, select whether you want to create a schedule and click **Next**.
   a. To create a schedule, specify the scheduling parameters. For more information, see "Creating a schedule for a FlashCopy or an Enhanced FlashCopy logical drive" on page 90.
5. Allocate capacity for the FlashCopy repository logical drive and click **Next**.
6. Specify parameters for the Enhanced FlashCopy logical drive and the FlashCopy repository logical drive and click **Next**.
7. Review the information that is displayed on the Preview screen and click **Finish** to create the FlashCopy logical drive.
8. The FlashCopy drives are now displayed in either the **Logical/Physical**, **Logical**, or **Storage & Copy Service** tab of the Subsystem Management window.
9. Restart the host application. After you create one or more FlashCopy logical drives, mount the base logical drive and restart the host application by using that base logical drive.

If you did not choose automatic mapping when using the wizard, go to "Mapping the FlashCopy or Enhanced FlashCopy logical drive to the host" on page 72. If you chose automatic mapping, go to "Configuring the host for the FlashCopy logical drive" on page 77.

Note: You are not done creating the FlashCopy logical drive until you complete the procedure described for your host operating system in "Configuring the host for the FlashCopy logical drive" on page 77.

Note: Click **Help** in a wizard panel to view more information about that panel.

Reusing an Enhanced FlashCopy logical drive

Typically, after a FlashCopy logical drive is created, the point-in-time view of the logical drive is preserved until a new point-in-time image of the same base logical drive is needed.

To re create a point-in-time image of the same base logical drive, complete the procedure that is applicable for your host operating system. For details, see "Reusing a FlashCopy or an Enhanced FlashCopy logical drive" on page 84.

FlashCopy related tasks

This section describes the following FlashCopy related tasks:

- "Viewing the FlashCopy logical drive status"
- "Disabling a FlashCopy logical drive" on page 32
- "Recreating a FlashCopy logical drive" on page 34
- "Resizing a FlashCopy repository logical drive" on page 36
- "Deleting a FlashCopy drive" on page 38

Viewing the FlashCopy logical drive status

You can determine the status of the FlashCopy logical drive by viewing the icons. The icons change depending of the state of the drive. The logical drive component property display is also useful in determining the state of the logical drives.

Use the FlashCopy Repository Logical Drive - Properties window to view the FlashCopy repository logical drive base and capacity properties. You can also use this window to specify the capacity percentage full and the action to be taken if the FlashCopy repository logical drive becomes full.

The progress of the modification operations is displayed at the bottom of the window.

FlashCopy icon states

To view the FlashCopy icon, open the Storage Management Device Manager GUI Physical/Logical view. The icon states are shown in Figure 9 on page 29.

FlashCopy status representation in logical view

Logical drive status icon	Mirror status	Icon
FlashCopy	Optimal	
	Disabled	
	Failed	
	Offline	
Repository	Optimal	
	Degraded	
	Failed	
	Full	
	Offline	
	Warning	
Free capacity	Spare capacity	

SJ000847

Figure 9. FlashCopy icon states

What to do if the FlashCopy repository logical drive becomes full

If the FlashCopy repository logical drive becomes full, you must first view the current FlashCopy logical drive properties and then specify the action to be taken when the repository drive is full, or increase the capacity of the repository logical drive.

Viewing the current FlashCopy logical drive properties:
Complete the following steps to view the current FlashCopy logical drive properties.

1. Select a FlashCopy repository logical drive in the Logical view of the Subsystem Management window.
2. Click **Logical Drive → Properties**. The FlashCopy Repository Logical Drive - Properties window opens. See Figure 10 on page 30.

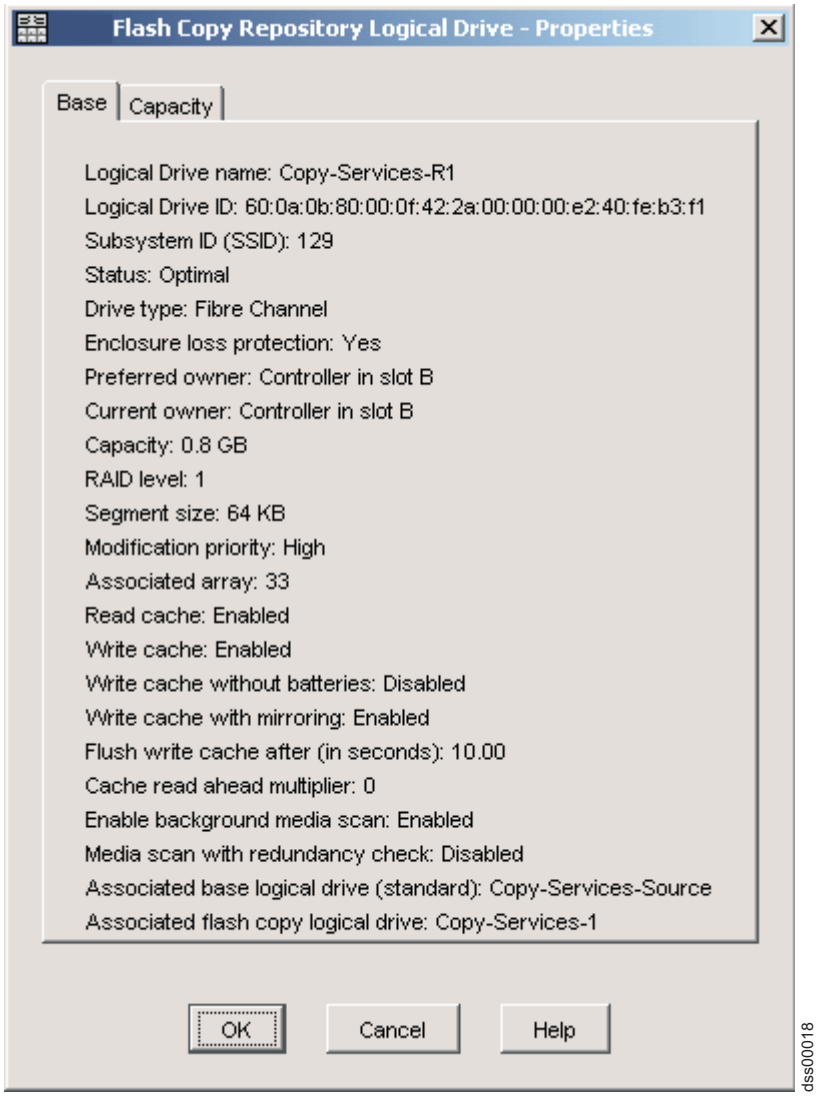


Figure 10. FlashCopy repository logical drive properties

3. Click the **Capacity** tab to view the currently defined settings, as shown in Figure 11 on page 31.

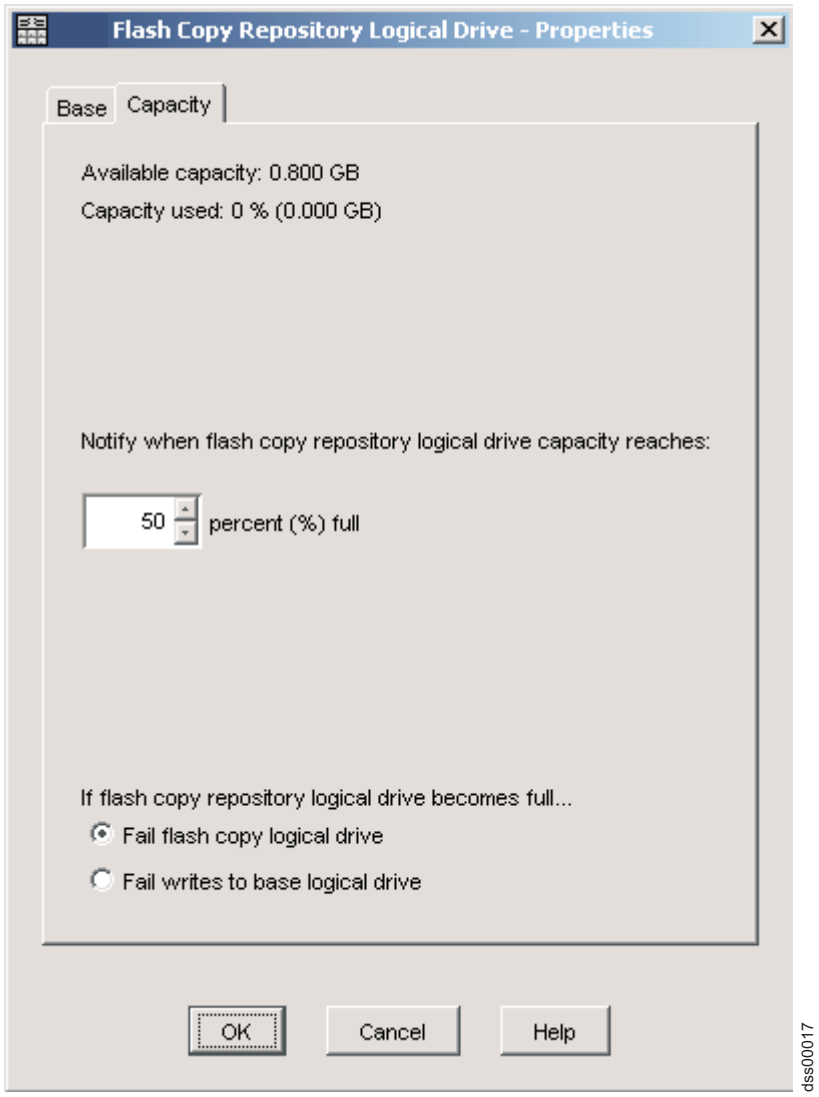


Figure 11. Repository capacity settings

Changing FlashCopy repository logical drive properties:
If the repository full policy is set to **Fail FlashCopy logical drive** (default setting), the data is not recoverable when the drive becomes full and FlashCopy cannot be accessed. If this situation occurs, you can complete one of the following actions:

- Delete theFlashCopy logical drive
- Re-create the FlashCopy logical drive to create a new point-in-time image

If the repository full policy is set to "Fail writes to base logical drive," the data is accessible. However, all write requests to the base logical drive are rejected until the FlashCopy repository logical drive capacity is increased.

Attention: AIX does not support the "Fail writes to base logical drive" option of the repository full policy. Selecting this option might cause data loss on the base logical drive. If you are using AIX make sure that the default option, "Fail FlashCopy logical drive," is selected. Be sure to monitor the capacity of the FlashCopy repository logical drive, because the you cannot access the FlashCopy if the repository logical drive becomes full.

For information about increasing the capacity of a FlashCopy repository logical drive, see "Resizing a FlashCopy repository logical drive" on page 36.

Note:

1. Deleting a FlashCopy logical drive automatically deletes the associated FlashCopy repository logical drive.
2. Deleting a FlashCopy repository logical drive automatically deletes the associated FlashCopy logical drive.
3. Deleting a FlashCopy logical drive, and then creating it again, forces you to stop the host application and unmount the base logical drive while the FlashCopy is being created again.
4. If you re-create a FlashCopy logical drive, you do not need to create a FlashCopy repository logical drive, or remap the assigned logical drive-to-LUN mappings between the FlashCopy logical drive and the host.
5. After you re-create the FlashCopy logical drive, you can change parameters on the FlashCopy repository logical drive through the appropriate menu options.
6. To avoid another *FlashCopy repository logical drive full* failure, increase the capacity of the FlashCopy repository logical drive. For more information, see "Resizing a FlashCopy repository logical drive" on page 36.

Viewing the progress of a modification operation

The progress bar at the bottom of the FlashCopy Repository Logical Drive Properties window shows the progress of an operation. You can view the progress of the following operations:

- Copyback
- Reconstruction
- Initialization
- RAID level change
- Dynamic logical drive expansion
- Capacity increase
- Defragmentation
- Segment size change

Note: The storage management software cannot obtain progress information from the storage subsystem controllers if the network management connection to the controllers is down or if the storage subsystem is partially managed. For more information about a partially managed storage subsystem or an unresponsive controller or storage subsystem condition, see the Enterprise Management window online help.

Disabling a FlashCopy logical drive

If you no longer need a FlashCopy logical drive, you might want to disable it. Until a FlashCopy logical drive is in enabled state, your storage subsystem performance can be impacted by copy-on-write activity that is directed to the associated FlashCopy repository logical drive. The copy-on-write activity ends when you disable a FlashCopy logical drive.

If you disable a FlashCopy logical drive instead of deleting it, you can retain it and its associated repository for future use. When you need to create a different FlashCopy of the same base logical drive, you can use the Re-Create option to re-enable the previously disabled FlashCopy. Re-enabling the FlashCopy takes lesser time than creating a FlashCopy.

When you disable a FlashCopy logical drive, note the following points:

- You cannot use that FlashCopy logical drive again until you use the Re-Create option on that logical drive.
- Only that FlashCopy logical drive is disabled. All other FlashCopy logical drives remain functional.

If you do not intend to re-create a FlashCopy, you can delete that FlashCopy logical drive instead of disabling it.

Complete the following steps to disable a FlashCopy logical drive:

1. Select the FlashCopy logical drive. Right-click and select **Disable**, as shown in Figure 12.

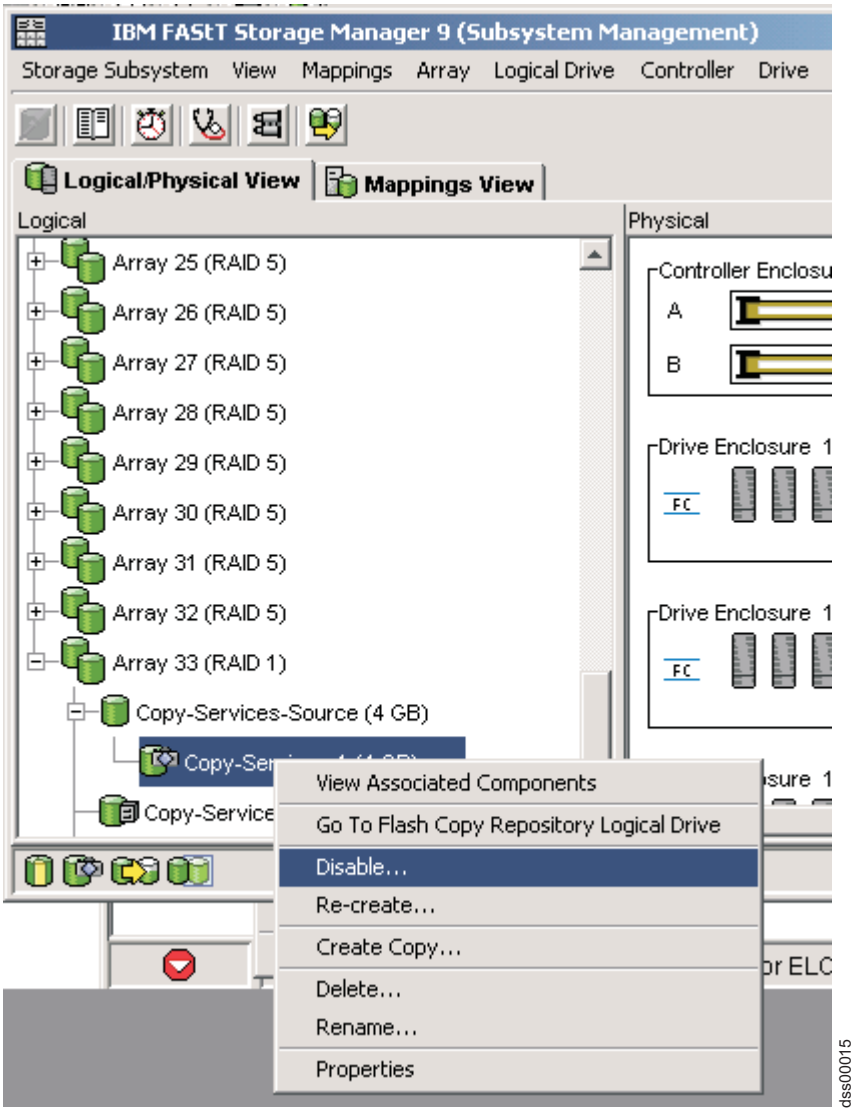


Figure 12. Choosing to disable the FlashCopy drive

2. The Disable FlashCopy Logical Drive confirmation window opens, as shown in Figure 13 on page 34. In this window, type `Yes` and click **OK** to begin the disable operation.

Figure 13. Disable FlashCopy confirmation window

The FlashCopy icon in the Physical/Logical view is now displayed as disabled.

Recreating a FlashCopy logical drive

Recreating a FlashCopy logical drive takes lesser time than creating a new one. If you have a FlashCopy logical drive that you no longer need, instead of deleting it, you can reuse it (and its associated FlashCopy repository logical drive) to create a different FlashCopy logical drive of the same base logical drive.

Starting with controller firmware version 7.77.xx.xx, a schedule can be defined to automatically re-create the FlashCopy logical drive at intervals. For more information, see "Creating a schedule for a FlashCopy or an Enhanced FlashCopy logical drive" on page 90.

When you re-create a FlashCopy logical drive, note the following points:

- The FlashCopy logical drive must be in either an optimal or a disabled state.

  If the FlashCopy logical drive is in an optimal state, the process first disables, and then re-creates the FlashCopy logical drive. This process invalidates the current FlashCopy .
- All copy-on-write data on the FlashCopy repository logical drive is deleted.
- When you use the Re-Create option, the previously configured FlashCopy name, parameters, and FlashCopy repository logical drive are used.

  FlashCopy and FlashCopy repository logical drive parameters remain the same as the previously disabled FlashCopy logical drive and its associated FlashCopy repository logical drive. After you re-create a FlashCopy logical drive, you can change parameters on its associated FlashCopy repository logical drive through the appropriate menu options.
- The system retains the original names for the FlashCopy and FlashCopy repository logical drives. You can change these names, however, after the Re-Create option completes.

Before you re-create a FlashCopy logical drive, go to “Preparing the host operating system before creating FlashCopy logical drive or Enhanced FlashCopy image” on page 70 and complete the procedure to prepare your host operating system. Then, complete the following steps to re-create a FlashCopy drive:

1. Select the FlashCopy logical drive. Right-click and select **Re-Create**, as shown in Figure 14.

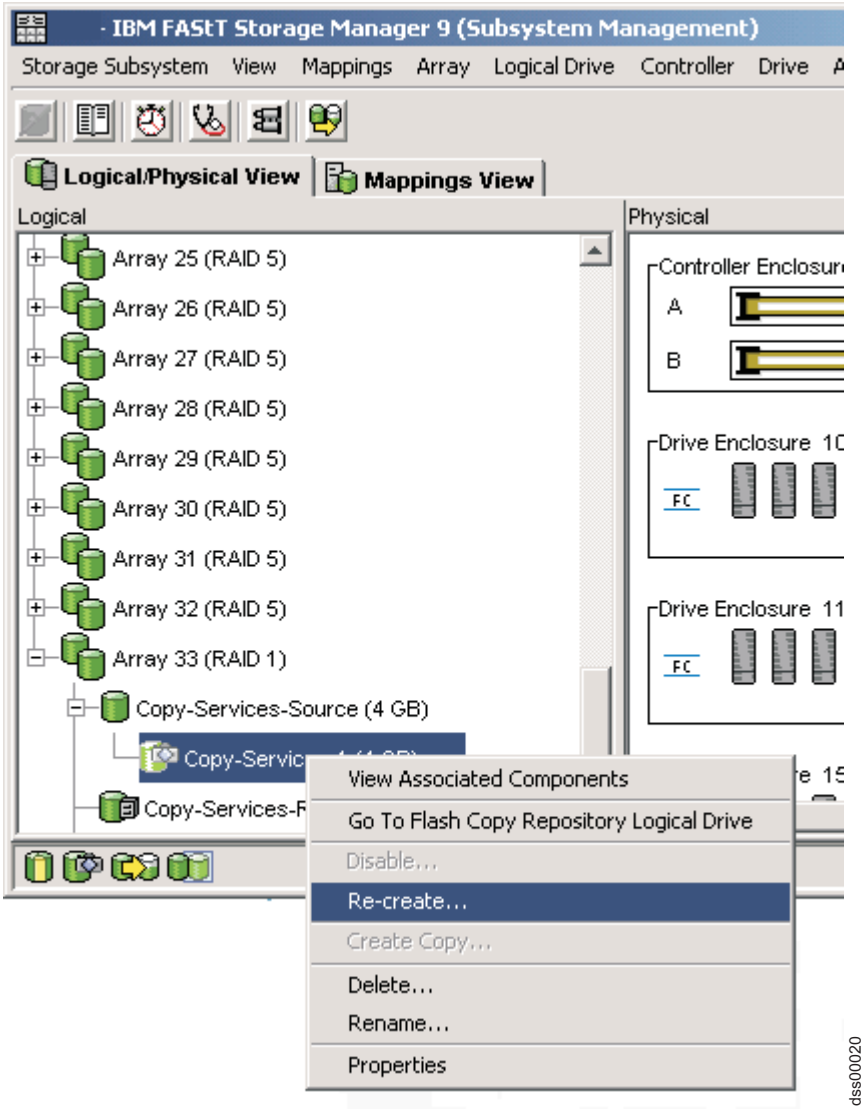


Figure 14. Recreating a FlashCopy logical drive

2. The Re-Create FlashCopy Logical Drive window opens. Type `Yes` and click **OK**.

This disables and re-creates the FlashCopy logical drive (if it had not been previously disabled) and displays it in the Logical view in an Optimal state. The creation timestamp shown on the FlashCopy Logical Drive Properties window is updated to reflect the new point-in-time image. Copy-on-write activity resumes to the associated FlashCopy repository logical drive.

Resizing a FlashCopy repository logical drive

Use this option to increase the storage capacity of an existing FlashCopy repository logical drive. Typically, this option is used when you receive a warning that the FlashCopy repository logical drive is in danger of becoming full.

You can achieve an increase in storage capacity with one of the following methods:

- Use the free capacity that is available on the array of the FlashCopy repository logical drive.
- Add unconfigured capacity (in the form of unused drives) to the array of the FlashCopy repository logical drive. Use this method when no free capacity exists on the array.

  Note: A maximum of two drives can be added at one time to increase FlashCopy repository logical drive capacity.

The storage capacity of a FlashCopy repository logical drive cannot be increased if any of the following conditions exists:

- One or more hot-spare drives are in use in the logical drive.
- The logical drive has a non-optimal status.
- Any logical drive in the array is in any state of modification.
- The controller that owns this logical drive is in the process of adding capacity to another logical drive. Each controller can add capacity to only one logical drive at a time.
- No free capacity exists in the array.
- No unconfigured capacity (in the form of drives) is available to add to the array.

Complete the following steps to resize a FlashCopy repository drive:

1. Select a FlashCopy repository logical drive in the Logical view of the Subsystem Management window.
2. Click **Logical Drive → Increase Capacity**.

   Note: If no free capacity or unconfigured capacity is available, the Increase Capacity option is not available.

   An Additional Instructions window opens. Read the information, and click OK if you still want to increase capacity. The Increase Repository Capacity window opens.

   You can see the FlashCopy repository logical drive name, the associated FlashCopy logical drive name, the associated base logical drive name, the current capacity, and the amount of free capacity that is available for the selected repository.

   If free capacity is available, the maximum free space is shown in the **Increase Capacity by** field. If there is no free capacity on the array, the value that is shown in the **Increase Capacity by** field is `0`. Add drives to create free capacity on the array of the standard logical drive.
3. Use one of the following two methods to increase capacity:
   - Using the free capacity on the array of the FlashCopy repository logical drive:
     a. Accept the final capacity increase or use the **Increase Capacity by** field to adjust the capacity. Click **OK**.
     b. A confirmation window displays. Type `Yes` and click **OK** to continue.

The Logical view is updated. The FlashCopy repository logical drive with its capacity increased shows a status of `Operation in Progress`, together with its original capacity and the total capacity being added.

c. The Free Capacity node involved shows a reduction in capacity. If all of the free capacity is used to increase the logical drive size, then the Free Capacity node involved is removed from the Logical view.

- Adding unconfigured capacity (drives) to the array of the FlashCopy repository logical drive:

  a. If there are no unassigned drives available and empty slots in the storage expansion enclosures are available, insert new drives.

     If there are no unassigned drives available, and there are no empty slots available in the storage expansion enclosures, install another storage expansion enclosure and additional drives.

  b. Click **Add Drives**.

     The Increase Repository Capacity - Add Free Capacity window opens. Details about storage expansion enclosure, slot, and usable capacity for the available free drives are displayed.

     Note: The drives that are displayed have a capacity that is either equivalent to or larger than those that are already employed by the array.

  c. Select a single drive, or two drives, to be added:
     - Press Ctrl+Enter to select the nonadjacent drives.
     - Press Shift+Enter to select the adjacent drives.

  d. Click **Add**.

     The Add Free Capacity window closes. Check the **Drives to add [enclosure, slot]** field to make sure that the correct drives are added.

  e. Accept the final capacity or use the **Increase Capacity by** field to adjust the capacity.

  f. Click **OK**.

  g. A confirmation window opens. Type `Yes` to confirm the operation, and click **OK** to continue.

  The Logical view is updated. The FlashCopy repository logical drive that is having its capacity increased shows a status of `Operation in Progress`. It also shows its original capacity and the total capacity that is being added. The Free Capacity node involved in the increase shows a reduction in capacity.

  If all of the free capacity is used to increase the size of the logical drives, then the Free Capacity node that is involved is removed from the Logical view.

  If a Free Capacity node did not exist before you added capacity and not all of the capacity that is added will be used to increase the capacity of the FlashCopy repository logical drive, a new Free Capacity node is created and displayed in the Logical view.

  Unassigned drives (unconfigured capacity) that are added to increase the FlashCopy repository logical drives capacity change in the Physical view to assigned drives. They become associated to the array of the FlashCopy repository logical drive.

4. View the progress of the capacity increase process. Select the FlashCopy repository logical drive. Click **Logical Drive → Properties**.

The FlashCopy Repository Logical Drive - Properties window opens. A progress bar at the bottom of the window indicates the status of the capacity increase.

Deleting a FlashCopy drive

Use this option to delete a FlashCopy logical drive that is no longer needed for backup or application testing purposes. This option results in an increase of free capacity in the array or additional unconfigured capacity.

Note:

1. When you delete a logical drive, all data on the logical drive is lost. Back up the data and stop all I/O before you complete this operation, if necessary.
2. If a file system is mounted on the logical drive, unmount it before you complete this operation.
3. When you delete a base logical drive, the associated FlashCopy logical drive and FlashCopy repository logical drive are automatically deleted.

Complete the following steps to delete a FlashCopy drive:

1. Select the FlashCopy logical drive in the Logical view.
2. Click **Logical Drive → Delete**, as shown in Figure 15 on page 39.

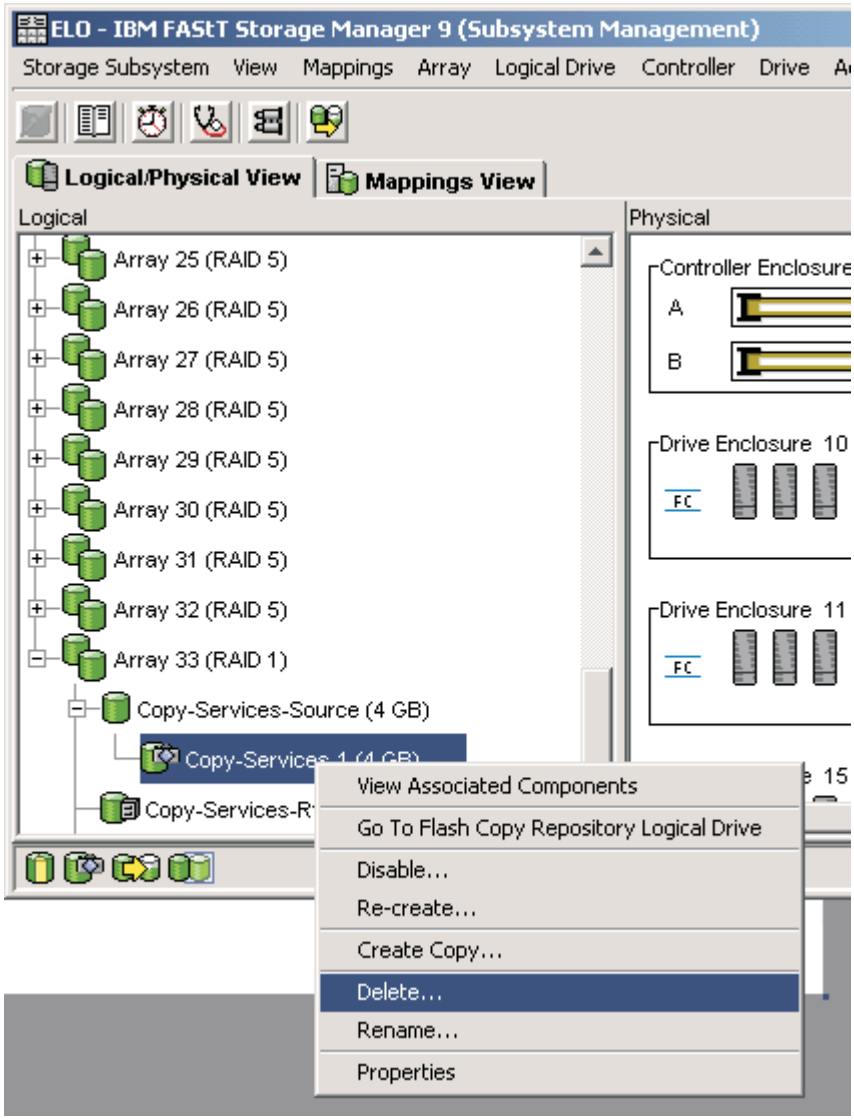


Figure 15. Deleting the FlashCopy logical drive

3. The Delete FlashCopy Logical Drive window opens, as shown in Figure 16 on page 40. Type Yes and click **OK**.

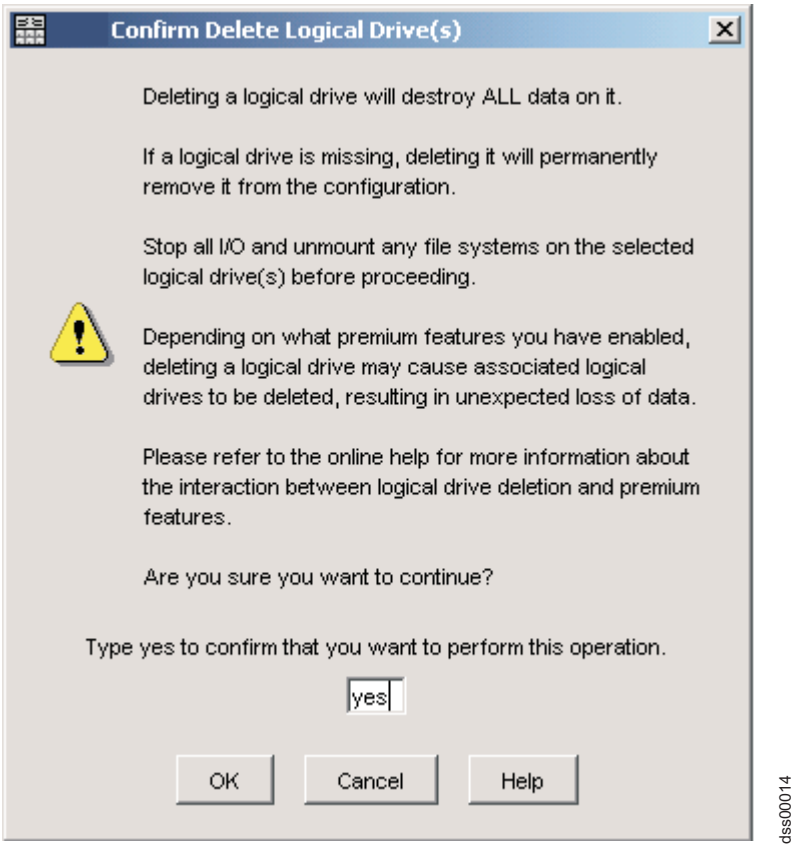


Figure 16. Delete FlashCopy Logical Drive window

The FlashCopy logical drive and the FlashCopy repository logical drive are deleted and all the data is destroyed.

Rollback of FlashCopy logical drive

Controller firmware versions 7.83.xx.xx or later support rollback of the FlashCopy logical drive. The base logical drive content can roll back to the point-in-time image that was captured when the FlashCopy logical drive was created. This rollback includes all the writes made to the FlashCopy logical drive, from the time the drives were created until they are rolled back. In other words, the rolled-back image might not be an exact image of the base logical drive, which was generated when the FlashCopy logical drive was created.

The base logical drive can perform I/O operations during rollback. It is immediately accessible for read and write operations (with the 'rolled-back content') after acceptance of the Rollback request by the controller firmware, even while the actual data transfer operation is still in progress. The controller performs only one rollback operation per base logical drive at a time; any additional rollback requests are rejected. While a Rollback is in progress, the FlashCopy logical drive that is being used for the Rollback cannot be deleted or disabled. You must first cancel the Rollback operation to delete or disable the FlashCopy logical drive.

CAUTION:
Deleting or disabling the FlashCopy logical drive while a rollback is in progress might leave the content of the base logical drive in an undetermined state.

Additional FlashCopy repository logical drive space might also be required for the rollback operations. The maximum required space can be twice as large as the size of the base logical drive. Storage Manager and controller firmware was modified to support repository drive with 220% capacity of the base logical drive. Therefore, to ensure that the worst-case scenario is addressed, when you create or expand a FlashCopy repository logical drive from the Storage Manager GUI or CLI, consider increasing the repository drive capacity to 220% of the capacity of the associated base logical drive or as close to that capacity limit as possible. In such a situation, a 'FlashCopy repository logical drive full' condition does not arise and a Host WRITE operation is not rejected during a Rollback operation. After the rollback operation is complete, the existing FlashCopy logical drive can be deleted and then re-created with a smaller capacity FlashCopy repository logical drive.

There are five levels of the rollback priority – lowest, low, medium, high, and highest. The higher the priority, the more the controller resources and time to be dedicated to the rollback operation, which can affect the performance of the inputs to other logical drives in the subsystem. The recommended level is Medium.

To start the rollback operation:

Right-click the FlashCopy logical drive in the **Storage & Copy Services** tab of the Subsystem Management window and select **Rollback** > **Start**. The Confirm rollback FlashCopy logical drive window opens. Read the caution statement, select the rollback modification priority, type `yes`, and click **OK** to start the rollback.

Chapter 3. Overview of Enhanced FlashCopy

Enhanced FlashCopy is a new chargeable premium feature that is supported by controller firmware version 7.83 and later. It is an enhanced version of the existing FlashCopy feature, which uses the same 'Copy-on-Write' algorithm to preserve an instance view of the thin or standard logical drive. This thin or standard logical drive is called as the 'base logical drive'. The Enhanced FlashCopy was designed to allow creation of many Enhanced FlashCopy images with minimum 'Copy-on-write' operations. Thus, the storage subsystem performance is maintained even in cases where many FlashCopy images of the same base logical drive are active at the same time. Currently, Enhanced FlashCopy is supported only on the DS3500 and DCS3700 storage subsystems, and the DCS3700 storage subsystems with Performance Module Controllers.

Contact IBM resellers or representatives for additional support.

Enhanced FlashCopy premium feature can be used with both arrays and disk pools. However, an array can not have both enhanced FlashCopy Images and FlashCopy Logical drives at he same time. Enhanced FlashCopy provides the following newer capabilities:

- "Enhanced FlashCopy image"
- "Enhanced FlashCopy logical drive" on page 45
- "Consistency group" on page 46
- "Rollback of Enhanced FlashCopy images" on page 47
- "Convert FlashCopy to Enhanced FlashCopy" on page 48

Enhanced FlashCopy image

Enhanced FlashCopy image is a logical drive image that represents a 'point-in-time' instance or content of a standard or thin logical drive, also called as base logical drive. Each base logical drive can have up to four Enhanced FlashCopy groups of 32 Enhanced FlashCopy images each. Each Enhanced FlashCopy group has a dedicated Enhanced FlashCopy group repository logical drive for storing the Enhanced FlashCopy images that belong to that Enhanced FlashCopy group. The repository logical drive can be created with capacity equal up to 220% of the base logical drive's capacity.

Note: Enhanced FlashCopy image and Enhanced FlashCopy group are sometimes referred to as Point in Time (**PiT**) and **PiT group**, respectively.

The Enhanced FlashCopy image can be created manually by using the DS Storage Manager GUI or CLI script, or automatically by creating a schedule. The Enhanced FlashCopy images within an Enhanced FlashCopy group are treated as a sequence of images, from the oldest (the first Enhanced FlashCopy image taken in an Enhanced FlashCopy group) to the newest (the last Enhanced FlashCopy image taken in an Enhanced FlashCopy group). The "Copy-on-write" operations occur only for the newest Enhanced FlashCopy image in an Enhanced FlashCopy group. Read operations of the older Enhanced FlashCopy images might require reading preserved data from newer Enhanced FlashCopy images. Using this operation, you can create multiple FlashCopies of a base logical drive, with only one

"Copy-on-write" operation for those FlashCopies. The Enhanced FlashCopy images cannot be mapped to the host for read or write operations. (see Enhanced FlashCopy logical drive.)

Because the Enhanced FlashCopy images in an Enhanced FlashCopy group are treated as a sequence of related images, you can delete Enhanced FlashCopy images in the order of creation only, starting with the oldest one. An error is displayed when deleting any other Enhanced FlashCopy image that is not the oldest one. No data movement is required to delete an Enhanced FlashCopy image. These images are deleted to free space in the repository drive for newer Enhanced FlashCopy images or to reduce the number Enhanced FlashCopy image usage. The Enhanced FlashCopy premium feature is entitled as the number of Enhanced FlashCopy images allowed per storage subsystems. If the total number of Enhanced FlashCopy images created is equal to the maximum Enhanced FlashCopy images allowed, no more Enhanced FlashCopy images can be created until some of the existing ones are deleted. The following figure shows Enhanced FlashCopy images and groups relationship to base logical drive.

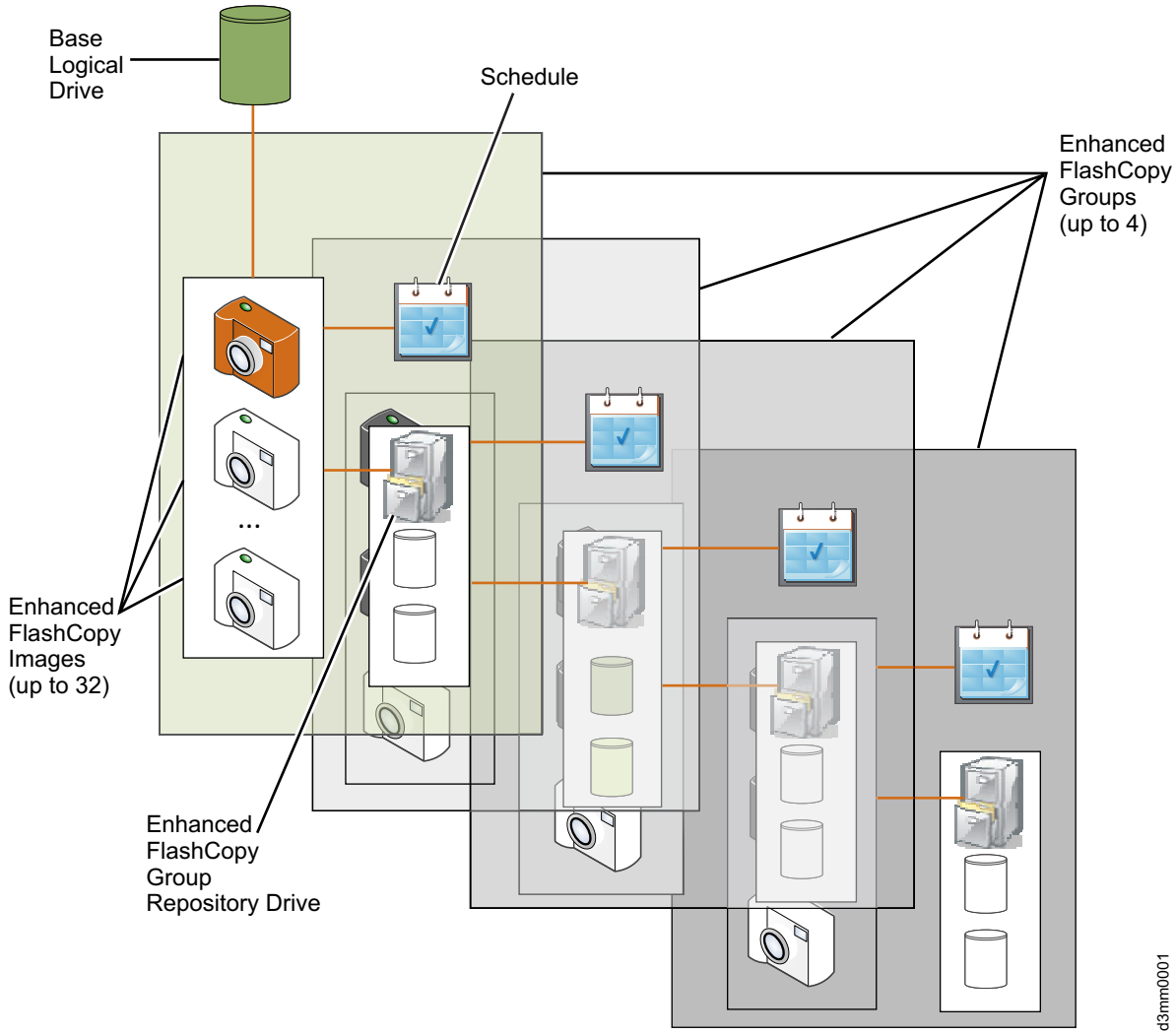


Figure 17. Enhanced FlashCopy Images and Groups

Enhanced FlashCopy logical drive

Because Enhanced FlashCopy images cannot be mapped to a host for I/O operations, an Enhanced FlashCopy logical drive must be created for every Enhanced FlashCopy image that you want to map to a host for read-only or read/write operations. No repository logical drive is required if the Enhanced FlashCopy logical drive is to be used as read-only. For read/write access, a repository logical drive is required to store any changes from the host to the Enhanced FlashCopy image, allowing the data in the original Enhanced FlashCopy image to remain unchanged. Up to 256 Enhanced FlashCopy logical drives can be created in a storage subsystem. Up to four Enhanced FlashCopy logical drives can be created for an Enhanced FlashCopy image to allow different host usages of the Enhanced FlashCopy image. Deleting the Enhanced FlashCopy image also deletes the content of any associated Enhanced FlashCopy logical drives. However, the Enhanced FlashCopy logical drive definitions that are associated with a deleted Enhanced FlashCopy image, are preserved so that they can be re-created for another Enhanced FlashCopy image. These Enhanced FlashCopy logical drive definitions are displayed with the status **Disable**. You must manually delete the Enhanced FlashCopy logical drive definitions if they are not needed.

Note: The Enhanced FlashCopy logical drive(s) is sometimes referred to as the view(s) of the Enhanced FlashCopy image or **PiT view**, in short.

The following figure shows two Enhanced FlashCopy logical drives created from an Enhanced FlashCopy image and mapped to two different hosts as read/write capable.

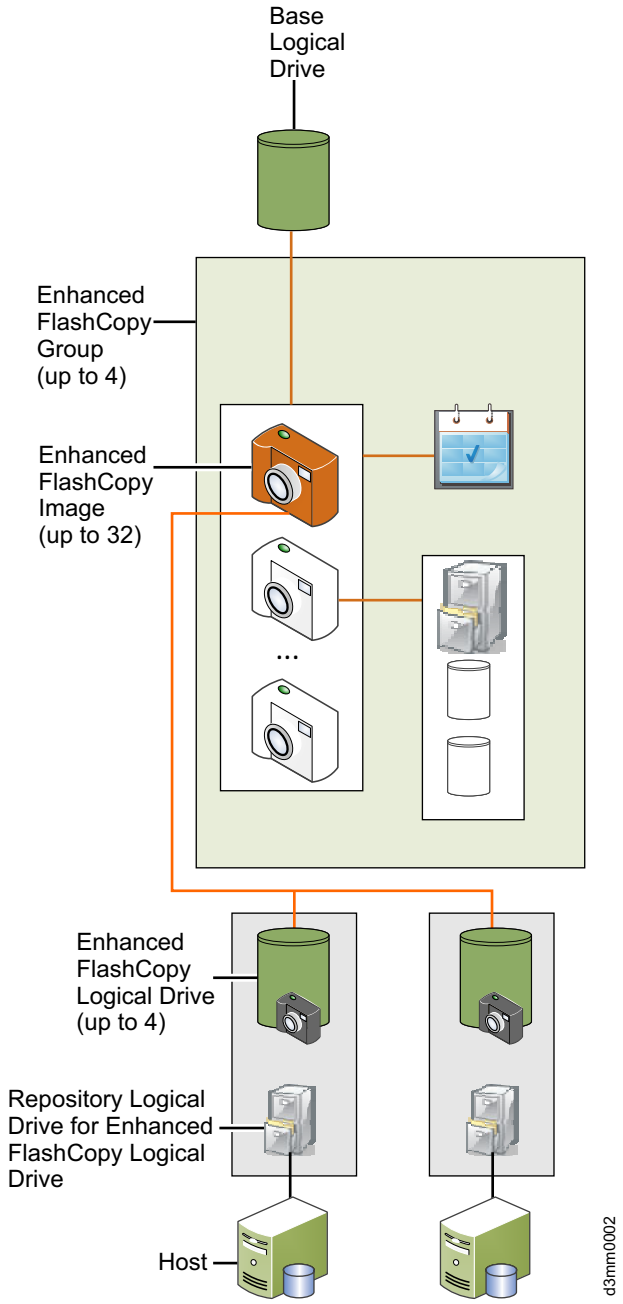


Figure 18. Enhanced FlashCopy Logical Drives

Status of the Enhanced FlashCopy feature

The status of Enhanced FlashCopy features such as Enhanced FlashCopy images, groups, or logical drives, are displayed in the table in the **Storage & Copy Service** tab of the Subsystem Management window.

Consistency group

Consistency group is a collection of base logical drives in a storage subsystem. These base logical drives, which are the source of a FlashCopy image, are also called as member logical drives of a consistency group. For m ore information, see Chapter 4, “Overview of consistency groups,” on page 59.

Rollback of Enhanced FlashCopy images

Any of the Enhanced FlashCopy images can be rolled back and the content of the base logical drive can be replaced at any time. The base logical drive can receive I/O operations during a rollback operation. However, performance might be affected because other defined Enhanced FlashCopy groups for that base logical drive processes “Copy-on-Writes”, which are caused by rolling back the base logical drive.

The rollback operation removes all data modifications that were made to a base logical drive after the specified Enhanced FlashCopy image was taken. The host can continue to access the base logical drive for I/O operations during the rollback operation. All of the created Enhanced FlashCopy images and groups for the base logical drive are preserved during the rollback. However, the managing of these images and groups will required additional space in the repository logical drive. Consider deleting unused Enhanced FlashCopy images and groups and increasing the amount of space before initiating a rollback operation.

You can start a rollback from an Enhanced FlashCopy image or a consistency group an Enhanced FlashCopy image. When you perform a rollback operation on an Enhanced FlashCopy image, the system rolls back the base logical drive that is associated with an Enhanced FlashCopy group to a previous state. The rollback operation does not change the content of the Enhanced FlashCopy images that are associated with the base logical drive. When you roll back a consistency group Enhanced FlashCopy image, the system rolls back all or select member logical drives of the consistency group to a previous state.

Before you use the Start Rollback option:

- Ensure that there is enough capacity in the repository to start a rollback operation. The minimum repository capacity is 32 MB + 0.5% of the base logical drive and the maximum repository capacity is 220% of the base logical drive capacity to as close to the 220% of the base logical drive capacity as possible. It is recommended that you add more repository logical drive capacity to prevent any failures during the rollback.
- Ensure that the selected Enhanced FlashCopy image is in an Optimal state. If the Enhanced FlashCopy image is in a Purged state or is automatically deleted due to the Auto-Delete Limit, the system displays an error message. Ensure that the selected logical drive is in an Optimal state. You cannot start a rollback operation on a failed logical drive.
- Ensure that the selected logical drive does not have a rollback operation already in progress. You cannot start more than one rollback operations for a base logical drive at a time.
- Rollback is not allowed when the specified Enhanced FlashCopy image has an associated Enhanced FlashCopy logical drives view(s), as the rollback operation deletes the specified Enhanced FlashCopy image.

Keep in mind these guidelines before you start a rollback operation:

- During a rollback operation, you cannot delete the Enhanced FlashCopy image that is being used for the rollback.
- During a rollback operation, you cannot create a new Enhanced FlashCopy image for a base logical drive that is participating in a rollback operation.
- During a rollback operation, you cannot change the Repository-Full Policy of the associated Enhanced FlashCopy group.

- You cannot start a rollback operation when a Dynamic Capacity Expansion (DCE), Dynamic Logical Drive Expansion (DVE), a Dynamic RAID Migration (DRM), or a Dynamic Segment Size (DSS) operation is in progress.
- You cannot start a rollback operation if the base logical drive is participating in a VolumeCopy or in a enhanced remote mirroring logical drive pair.
- You cannot start a rollback operation if the base logical drive is a secondary logical drive in a remote mirror. However, if the base logical drive is the primary logical drive in a remote mirror, you can start a rollback operation. Additionally, you cannot perform a role reversal in a remote mirror if the primary logical drive is participating in a rollback operation.
- A rollback operation fails if any of the used capacity in the associated Enhanced FlashCopy repository logical drive has unreadable sectors.

Convert FlashCopy to Enhanced FlashCopy

Use the **Convert to Enhanced FlashCopy Group** option to convert a FlashCopy logical drive and its associated repository to an Enhanced FlashCopy group. The system performs the following actions for each converted FlashCopy logical drive:

- Deletes the FlashCopy logical drive definition and creates an Enhanced FlashCopy group (the new Enhanced FlashCopy group is created empty with no Enhanced FlashCopy images). The current content of the FlashCopy logical drive is deleted.
- Converts the associated FlashCopy repository logical drive to an Enhanced FlashCopy group repository.
- Retains the same schedule (if a schedule is defined) for the new Enhanced FlashCopy group.
- Creates a read-only FlashCopy logical drive with a Paused status. The new Enhanced FlashCopy logical drive inherits the worldwide name (WWN) and host mappings as the converted FlashCopy logical drive.

Note: If the number of FlashCopies that exist for a base logical drive exceeds the maximum number of allowed Enhanced FlashCopy groups per base logical drive, a conversion request for that base logical drive is rejected. Any excess FlashCopy beyond the limit must be deleted before you can perform the conversion process.

Keep in mind the following guidelines when you use the **Convert to Enhanced FlashCopy Group** option:

- The conversion process is done on a base logical drive and applies to all Enhanced FlashCopies of a base logical drive.
- FlashCopy logical drive and Enhanced FlashCopy groups cannot exist on the same base logical drive; therefore, the FlashCopy logical drive for the base logical drive that you do not select for conversion will be deleted from the storage subsystem.
- If a base logical drive has FlashCopy images created as part of an online VolumeCopy operation, those VolumeCopy definitions must be deleted before you attempt to convert a FlashCopy image to an Enhanced FlashCopy image.
- You can perform the conversion operation only for those FlashCopy logical drives that are in the Stopped state.

Differences between FlashCopy and Enhanced FlashCopy

FlashCopy and Enhanced FlashCopy premium features can coexist in the same storage subsystem. Each feature can be used to create FlashCopy of the base logical drives. Differences between the FlashCopy and Enhanced FlashCopy premium features are as follows:

- Traditional arrays support both FlashCopy and Enhanced FlashCopy premium features. Disk pools support only Enhanced FlashCopy premium feature.
- FlashCopy logical drives, and Enhanced FlashCopy images and its associated logical drives cannot be created at the same time in an array. The array must have either FlashCopy logical drives or Enhanced FlashCopy images and its associated logical drives.
- Thin logical drive supports the Enhanced FlashCopy feature only.
- The creation of FlashCopy images of the base logical drives is not supported in FlashCopy. However, you can create up to 16 FlashCopy logical drives of a base logical drive, depending on the storage subsystem model and the premium feature. Each FlashCopy logical drive has its own repository drive. A "Copy-on-Write" operation is performed for each of the FlashCopy logical drive. FlashCopy logical drive can be deleted in any order.

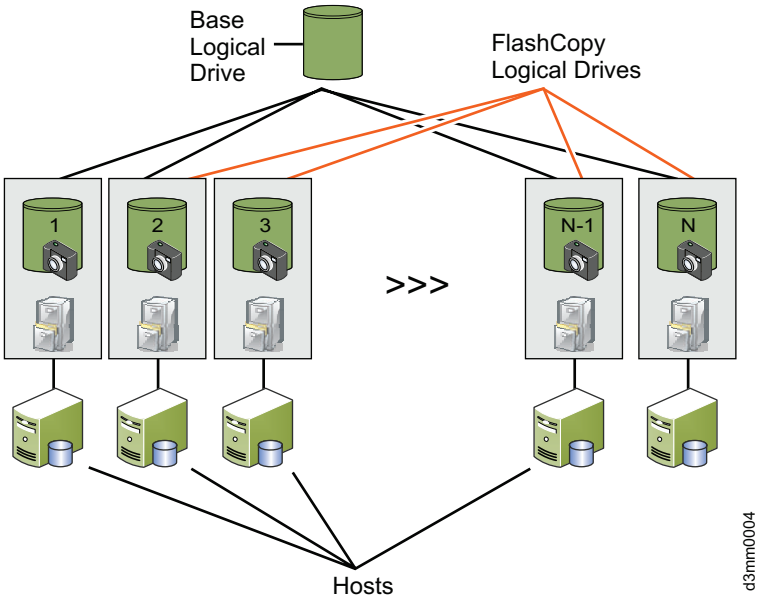


Figure 19. FlashCopy Logical Drives of a Base Logical Drive

In contrast, up to 32 Enhanced FlashCopy images can be created for a base logical drive in an Enhanced FlashCopy group. Only one '*Copy-on-write* (*CoW*)' operation is performed per Enhanced FlashCopy group of an Enhanced FlashCopy image, which improves FlashCopy operations when working with large amount of active FlashCopies for a base logical drive. In other words, in the current enhanced FlashCopy implementation, when a write is made to the base logical drive, 32 FlashCopy images in an enhanced FlashCopy group have only one 'CoW' operation as compared to having one 'CoW' for each of the defined FlashCopy images. However, because the FlashCopy images are built onto each other as they are captured in sequence of time, the Enhanced FlashCopy images must be deleted in the order of creation, starting with the oldest one. In addition, an additional repository logical drive must be created for Enhanced FlashCopy images that need to be mapped to the host for read/write

operations. The following figure shows the structure of the Enhanced FlashCopy.

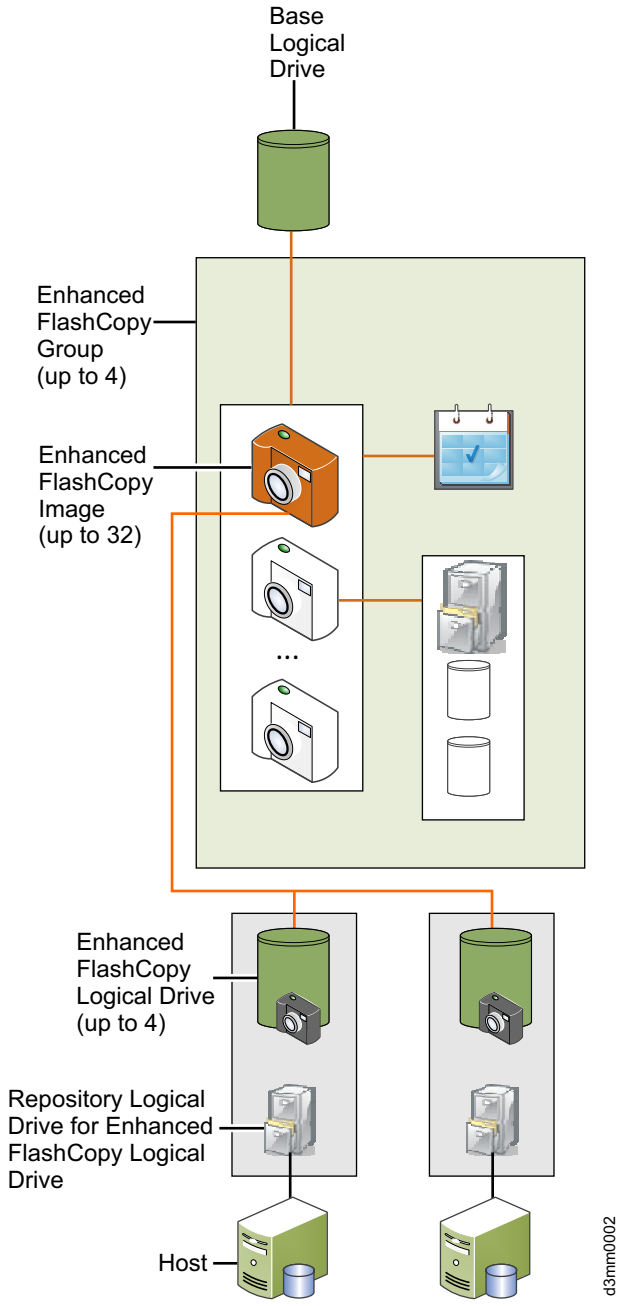


Figure 20. Enhanced FlashCopy Logical Drives

- The repository logical drive of the FlashCopy logical drive can be in the same array or in a different array than the one in which the base logical drive resides. The repository logical drive of the Enhanced FlashCopy logical drive can only be in the same array or disk pool in which the base logical drive resides. You must add capacity to the array or disk pool if there is not enough space to create the required repository drives.
- The Enhanced FlashCopy premium feature is entitled by the number of the Enhanced FlashCopy images that can be created in a storage subsystem. The FlashCopy premium feature is entitled by the number of FlashCopy logical

drives that can be created for a base logical drive and the maximum number of FlashCopy logical drives that can be created in a storage subsystem.

Enabling Enhanced FlashCopy premium feature

Before you begin, gather the following information:

- Your Feature Activation Code, which is printed on the IBM Enhanced FlashCopy premium feature web activation instructions.
- Your controller unit IBM serial number, machine type, and model number, which are printed on a black label on the front-left mounting flange of the controller.

  Note: To see the mounting flange, you must remove the front bezel.
- The 32 alphanumeric-character feature enable identifier (see "Obtaining the feature enable identifier using firmware version 7.xx.xx or later" on page 10).

To obtain the storage subsystem feature enable identifier, ensure that your controller unit and storage expansion enclosures are connected, powered on, and managed using the SMclient.

For information about how to view the list of premium features that are enabled on your storage subsystem, see "Verifying that the premium feature is enabled using firmware version 7.xx.xx or later" on page 12.

To enable Enhanced FlashCopy, you must complete the following tasks in the following order:

Generate the feature key file and enable Enhanced FlashCopy. This procedure is described in detail in "Generating the feature key file" on page 8 and "Enabling the premium feature or feature pack using firmware version 7.xx.xx or later" on page 11.

Planning an Enhanced FlashCopy logical drive

Before you create an Enhanced FlashCopy logical drive, ensure that you are familiar with the following concepts:

- Specifying Enhanced FlashCopy repository logical drive failure settings
- Estimating Enhanced FlashCopy repository logical drive capacity
- Estimating Enhanced FlashCopy repository life
- Overview of the FlashCopy Logical Drive wizard

For details, see "Planning a FlashCopy or an Enhanced FlashCopy logical drive" on page 65

Planning an Enhanced FlashCopy image

Before you create the first Enhanced FlashCopy image of a base logical drive, consider the following points:

- "Repository logical drive space" on page 52
- "Enhanced FlashCopy group repository logical drive full alert setting" on page 52
- "Policies for full Enhanced FlashCopy group repository logical drive" on page 52
- "Enhanced FlashCopy image schedule" on page 53

• “FlashCopy logical drives” on page 53

Repository logical drive space

The Enhanced FlashCopy group repository logical drive is created in the same array or disk pool as the base logical drive. You must “add capacity” to the array or disk pool if there is not enough space. The repository logical drive space depends on the number of locations in the base logical drive changed after the Enhanced FlashCopy images are taken. The default space allocation is 40% of the size of the base logical drive disk space. The maximum repository capacity is 220% of the base logical drive disk space. Assign extra space for the Enhanced FlashCopy group repository logical drive if several locations in the base logical drive are to be modified. You can also increase the repository logical drive space ‘on-the-fly’, as required. This information applies to the Enhanced FlashCopy logical drive repository drive too.

Enhanced FlashCopy group repository logical drive full alert setting

The default setting is 75% full. An alert is sent when the Enhanced FlashCopy group repository logical drive space usage reaches 75% of the total capacity. When the alert is generated, you can either change the alert setting to a higher value or increase the capacity of the repository logical drives. This information applies to the Enhanced FlashCopy logical drive repository drive too.

Policies for full Enhanced FlashCopy group repository logical drive

When the repository is full, select one of these options:

- Purge the oldest Enhanced FlashCopy images. By doing so, the oldest images are deleted to free up repository space. This instruction also applies when only one Enhanced FlashCopy image exists in the Enhanced FlashCopy group, which is the default setting.
- Reject writes to the base logical drives to ensure that Enhanced FlashCopy images are valid. But, it might cause problems in the host because of the failed writes, which is not the recommended full repository setting.

Attention: The 'Fail writes to base logical drive' option is not supported on AIX or IBM i. Selecting this option might cause data loss on the base logical drive. If you are using AIX or IBM i, select the 'Fail FlashCopy logical drive' option, which is the default. Ensure that you monitor the capacity of the FlashCopy repository logical drive, because you cannot access the FlashCopy if the repository logical drive becomes full.

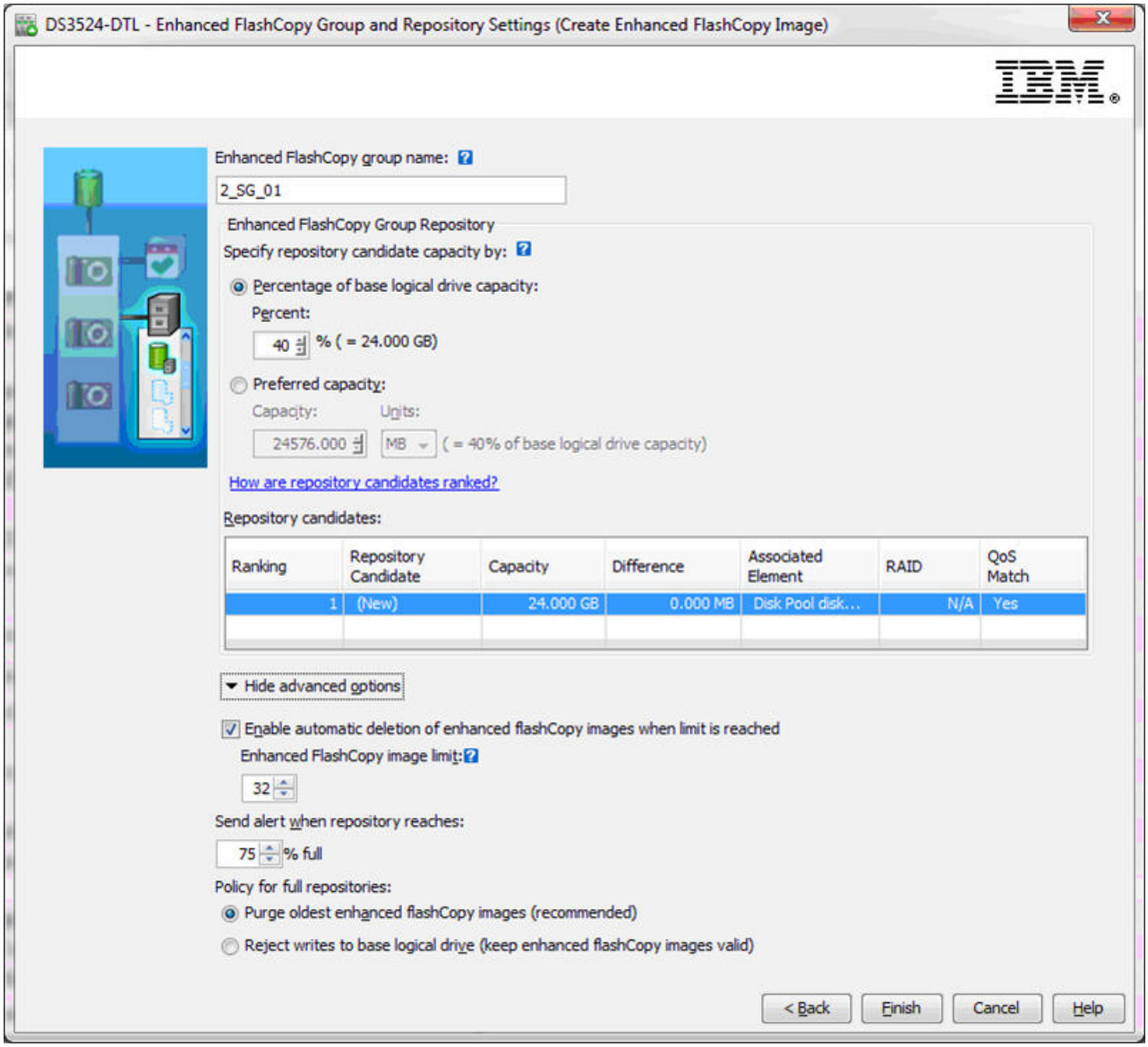


Figure 21. Create Enhanced FlashCopy Image

Enhanced FlashCopy image schedule

Determine whether a schedule is needed to automatically create Enhanced FlashCopy images. For information about creating schedules, see "Creating a schedule for a FlashCopy or an Enhanced FlashCopy logical drive" on page 90.

FlashCopy logical drives

If any FlashCopy logical drives are created, determine the course of action for these logical drives (backing up or rolling back to the base logical drive) and then delete them. FlashCopy logical drives and Enhanced FlashCopy images cannot be created on a the same array.

Creating an Enhanced FlashCopy logical drive

Overview

To create an Enhanced FlashCopy logical drive, complete the following procedures:

1. "Preparing the host operating system before creating FlashCopy logical drive or Enhanced FlashCopy image" on page 70
2. "Creating an Enhanced FlashCopy group"
3. "Creating an Enhanced FlashCopy image"
4. "Creating an Enhanced FlashCopy logical drive" on page 55
5. "Mapping the FlashCopy or Enhanced FlashCopy logical drive to the host" on page 72
6. "Configuring the host for the Enhanced FlashCopy logical drive" on page 56

Attention: Failure to complete the procedures that are required for your host operating system can result in an inaccurate point-in-time image of the base logical drive.

Creating an Enhanced FlashCopy group

To create the enhanced FlashCopy group, right-click the disk pool or array in the **Storage & Copy Services** tab and select **Create** -> **Enhanced FlashCopy Group**. Follow the instruction in the pop up wizard to create the Enhanced FlashCopy Group.

Creating an Enhanced FlashCopy image

To create the Enhanced FlashCopy image of a base logical drive:

1. In the **Storage & Copy Services** tab, right-click the base logical drive and from the menu, select **Create** > **Enhanced FlashCopy Image**.
2. If an Enhanced FlashCopy group is not created for this base logical drive, create a new Enhanced FlashCopy group. The Enhanced FlashCopy image is created in the newly created Enhanced FlashCopy group. If there are Enhanced FlashCopy groups already created for this base logical drive, you can create the Enhanced FlashCopy image in one of the existing groups.

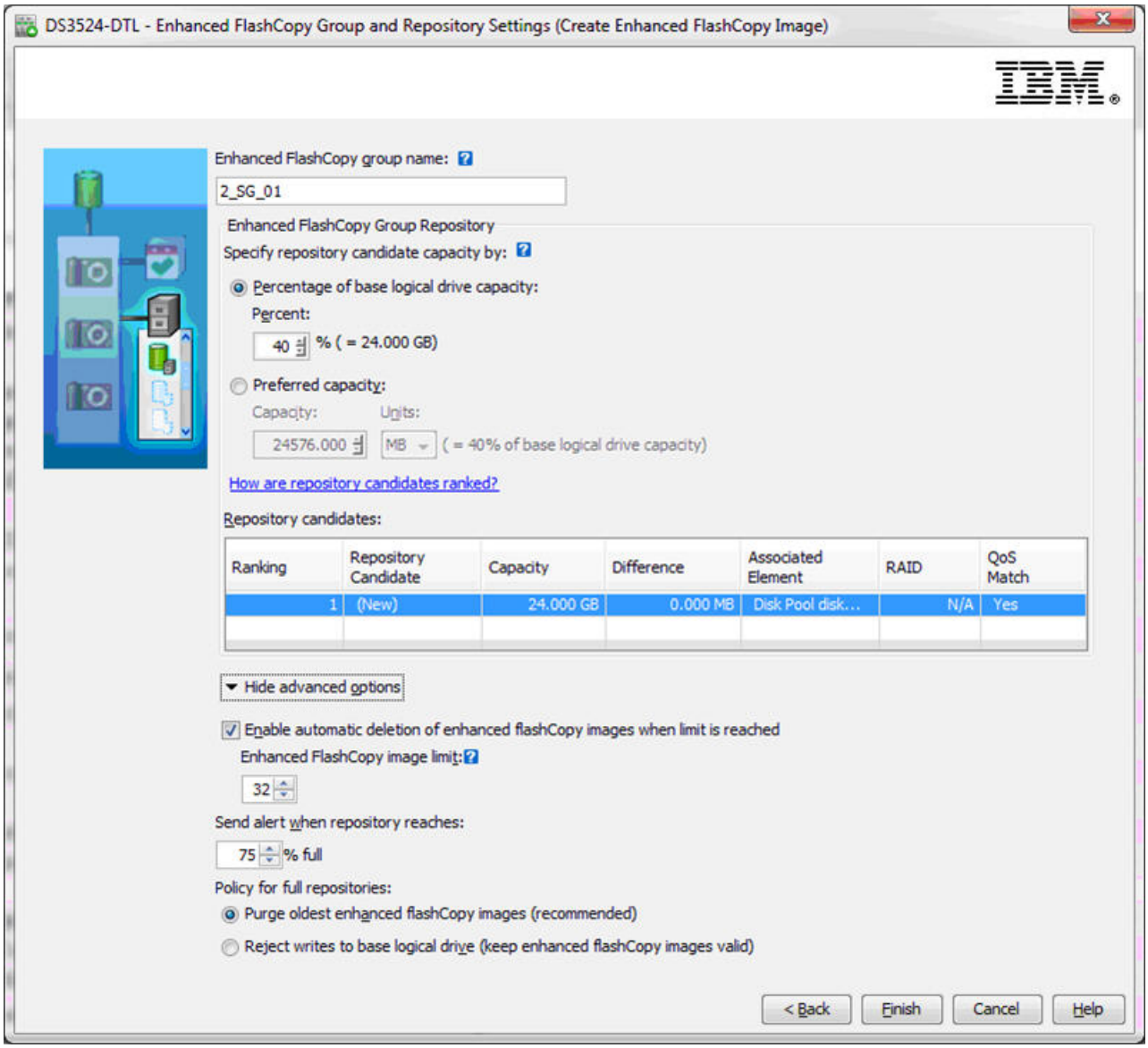


Figure 22. Create Enhanced FlashCopy Image

Creating an Enhanced FlashCopy logical drive

To create an Enhanced FlashCopy logical drive of an Enhanced FlashCopy image to map to a host for I/O operations:

1. Right-click the Enhanced FlashCopy image in the Enhanced FlashCopy images list for a base logical drive, and select **Create Enhanced FlashCopy logical drive**. The Enhanced FlashCopy logical Drive Settings window opens.
2. Specify the name of the Enhanced FlashCopy logical drive, the host to map the Enhanced FlashCopy logical drive to (or select to map to host at a later time), the access mode of the Enhanced FlashCopy logical drive, and the repository logical drive if the selected access-mode is read/write.

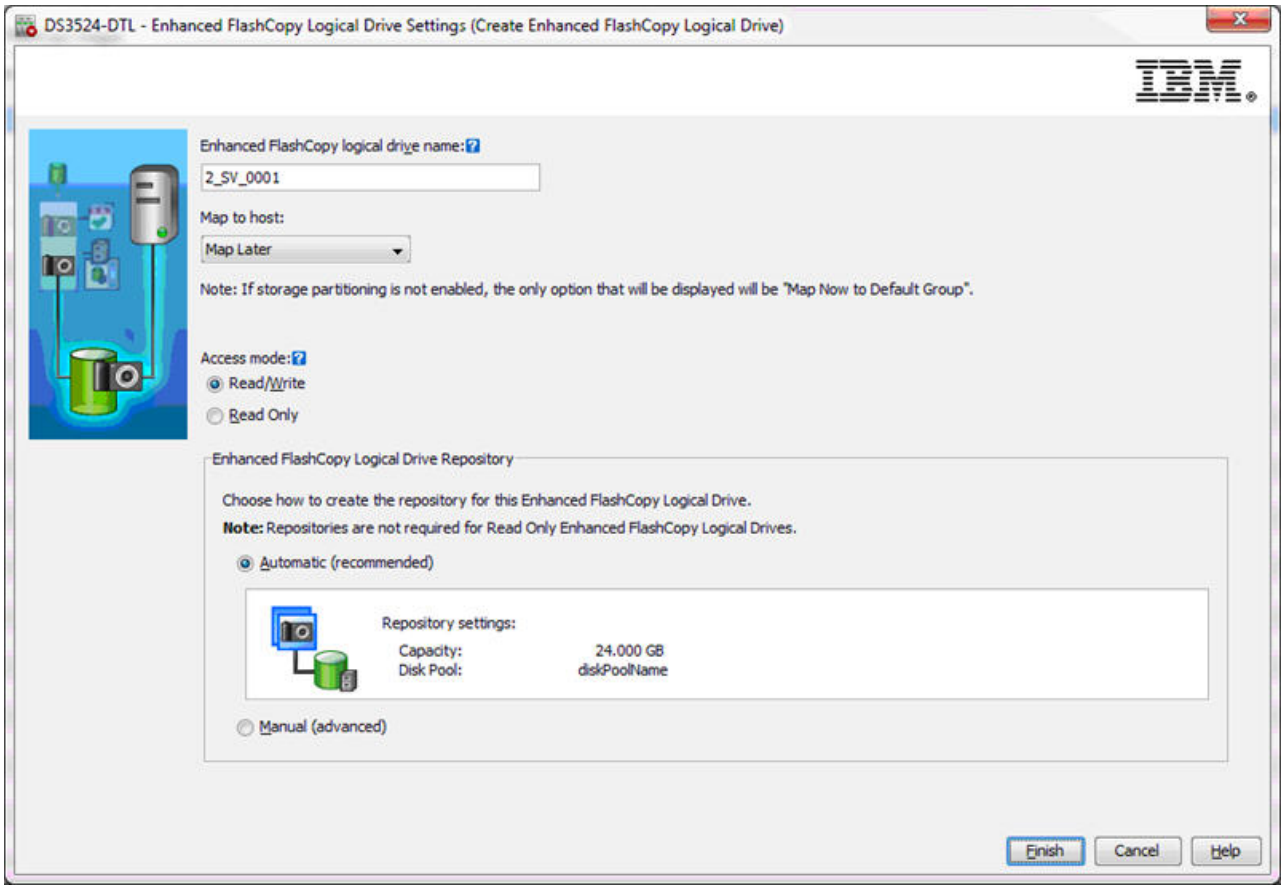


Figure 23. Create Enhanced FlashCopy Logical Drive

3. Click **Finish**.

Configuring the host for the Enhanced FlashCopy logical drive

After you create the Enhanced FlashCopy logical drive for the Enhanced FlashCopy image, and map the Enhanced FlashCopy logical drive to the host, you must complete some additional steps to configure the host operating system.

Complete the procedure that is applicable for your host operating system:

- "Instructions for AIX" on page 77
- "Instructions for HP-UX" on page 79
- "Instructions for Solaris" on page 81
- "Instructions for Windows" on page 82
- "Instructions for Novell NetWare" on page 83
- "Instructions for Linux" on page 83

Attention: You must complete the procedure described for your host operating system in this section. Failure to do so can result in an inaccurate point-in-time image of the base logical drive.

Reusing a FlashCopy logical drive

Typically, after an Enhanced FlashCopy logical drive for an Enhanced FlashCopy image is created, it is used to track changes to that Enhanced FlashCopy image, until it is reused to track changes to another Enhanced FlashCopy image, of the same base logical drive.

To re create a point-in-time image of the same base logical drive, complete the procedure that is applicable for your host operating system. For details, see "Reusing a FlashCopy or an Enhanced FlashCopy logical drive" on page 84.

What to do if the Enhanced FlashCopy repository logical drive becomes full

Depending on the usage, two types of Enhanced FlashCopy repository logical drives can become full - Enhanced FlashCopy group and Enhanced FlashCopy logical drive repository.

If any of the Enhanced FlashCopy repository logical drives becomes full, you must first view the current Enhanced FlashCopy logical drive properties, and then either raise the warning threshold, increase the repository logical drives, delete the Enhanced FlashCopy images, or specify automatic Enhanced FlashCopy image deletion policy when repository drive is full.

The status of the Enhanced FlashCopy images, groups, or logical drives are indicated by appropriate icons in the **Status** column under the **Storage & Copy Services** tab. For more information about the Enhanced FlashCopy images, groups, or logical drives, right-click the Enhanced FlashCopy image, group, or logical drive in the **Storage & Copy Services** tab and select **Properties**.

- To increase the Enhanced FlashCopy repository logical drive utilization alert threshold to a higher value: Right-click the Enhanced FlashCopy group or the Enhanced FlashCopy logical drive and select **Change Settings**. In the window that appears, change the alert threshold.

  Note: The default alert threshold is 75% of the repository logical drive capacity.
- To increase the Enhanced FlashCopy repository logical drive capacity: Right-click the Enhanced FlashCopy group or the Enhanced FlashCopy logical drive and select **Overall Repository** -> **Increase Capacity**. In the Increase Repository Capacity window, enter the appropriate information to increase the repository logical drive capacity.
- To enable automatic deletion of Enhanced FlashCopy images in an Enhanced FlashCopy group: Right-click the Enhanced FlashCopy group and select **Change Settings**. In the window that appears, enable automatic deletion of the Enhanced FlashCopy images.

Chapter 4. Overview of consistency groups

A consistency group is a feature of the enhanced FlashCopy premium feature. It is a collection of up to 32 base logical drives in your storage subsystem. These base logical drives, which are the sources of the Enhanced FlashCopy images are referred to as member logical drives of a consistency group.

The purpose of a consistency group is to take simultaneous Enhanced FlashCopy images of multiple base logical drives, thus ensuring consistent images of a collection of base logical drives at a particular point in time. For example, you can create a consistency group if you want to take a synchronized FlashCopy image of several logical drives that are in different arrays or disk pools in a storage subsystem. Using the consistency group mechanism is ideal for applications that span multiple logical drives. For example, a database application that has the logs on one logical drive and the database on another logical drive.

Every base logical drive that belongs to a consistency group is referred to as a member logical drive of the consistency group. A member logical drive is either a standard logical drive in a disk pool or an array, or a thin logical drive in a disk pool. A member logical drive must not have any FlashCopy logical drives defined. If any FlashCopy logical drives are defined in a member logical drive, then delete them before that logical drive is a part of a consistency group. This requirement does not apply to Enhanced FlashCopy logical drives. A consistency group member logical drive might have its own Enhanced FlashCopy images in addition to the Enhanced FlashCopy images as part of the consistency group.

A **consistency group Enhanced FlashCopy image**, which is sometimes referred to as **consistency group PiT**, is a logical point-in-time image of the content of each member logical drive in the consistency group at the same point in time. This action creates synchronized Enhanced FlashCopy images of all the logical drives in a consistency group. Consistency group Enhanced FlashCopy images are stored consecutively based on creation time, with the oldest Enhanced FlashCopy image at the top of the list.

Before creating an Enhanced FlashCopy image for each member in a consistency group, the controllers suspend all pending I/O operations for each member logical drive of the consistency group. If the controller software cannot create an Enhanced FlashCopy image for any one member logical drives, because of I/Os can't be suspended no new consistency group Enhanced FlashCopy image is created.

After Enhanced FlashCopy images are created for a consistency group, if you add a member logical drive, the existing member logical drives will have a different number of stored Enhanced FlashCopy images as compared to the newly added member logical drive. If you roll back an Enhanced FlashCopy image that was taken before new member logical drives were added to a consistency group, the rollback affects only the member logical drives that are in the consistency group only before the new logical drives are added to the consistency group.

The consistency group Enhanced FlashCopy image cannot be mapped to a host for I/O operations because the consistency group Enhanced FlashCopy image is used to save only the original data from the member logical drive. A consistency group Enhanced FlashCopy logical drive, which is sometimes referred to as **consistency**

group Enhanced FlashCopy view or **consistency group PiT view**, must be created for each consistency group Enhanced FlashCopy image that is mapped to the host. As in the case with the Enhanced FlashCopy image logical drive, the consistency group Enhanced FlashCopy logical drive does not need to have the associated repository drive created, if the host access is read-only. If the host access is read-write, a consistency group Enhanced FlashCopy logical drive repository logical drive must be created along with the consistency group Enhanced FlashCopy logical drive. The consistency group Enhanced FlashCopy logical drive repository is used to save any subsequent modifications made by the host application to the member logical drive, without affecting the referenced consistency group Enhanced FlashCopy image.

Guidelines to create a consistency group Enhanced FlashCopy image

- You cannot create an Enhanced FlashCopy image for a consistency group that has reached its maximum number of Enhanced FlashCopy images. You must enable auto-delete for the consistency group or manually delete one or more Enhanced FlashCopy images from the consistency group, and then try to create Consistency Group Enhanced FlashCopy images again.
- You cannot create an Enhanced FlashCopy image of a failed logical drive.
- If a logical drive is a member of a consistency group, then the storage management software creates an Enhanced FlashCopy group for that member logical drive. This Enhanced FlashCopy group counts towards the maximum number of Enhanced FlashCopy groups that are allowed on a base logical drive.
- Depending on the number of member logical drives in a consistency group, each consistency group Enhanced FlashCopy image creation increases the Enhanced FlashCopy image usage count for a storage subsystem by that amount. For example, the consistency group Enhanced FlashCopy image creation for a consistency group of 10 member logical drives increases the Enhanced FlashCopy image usage count by 10.

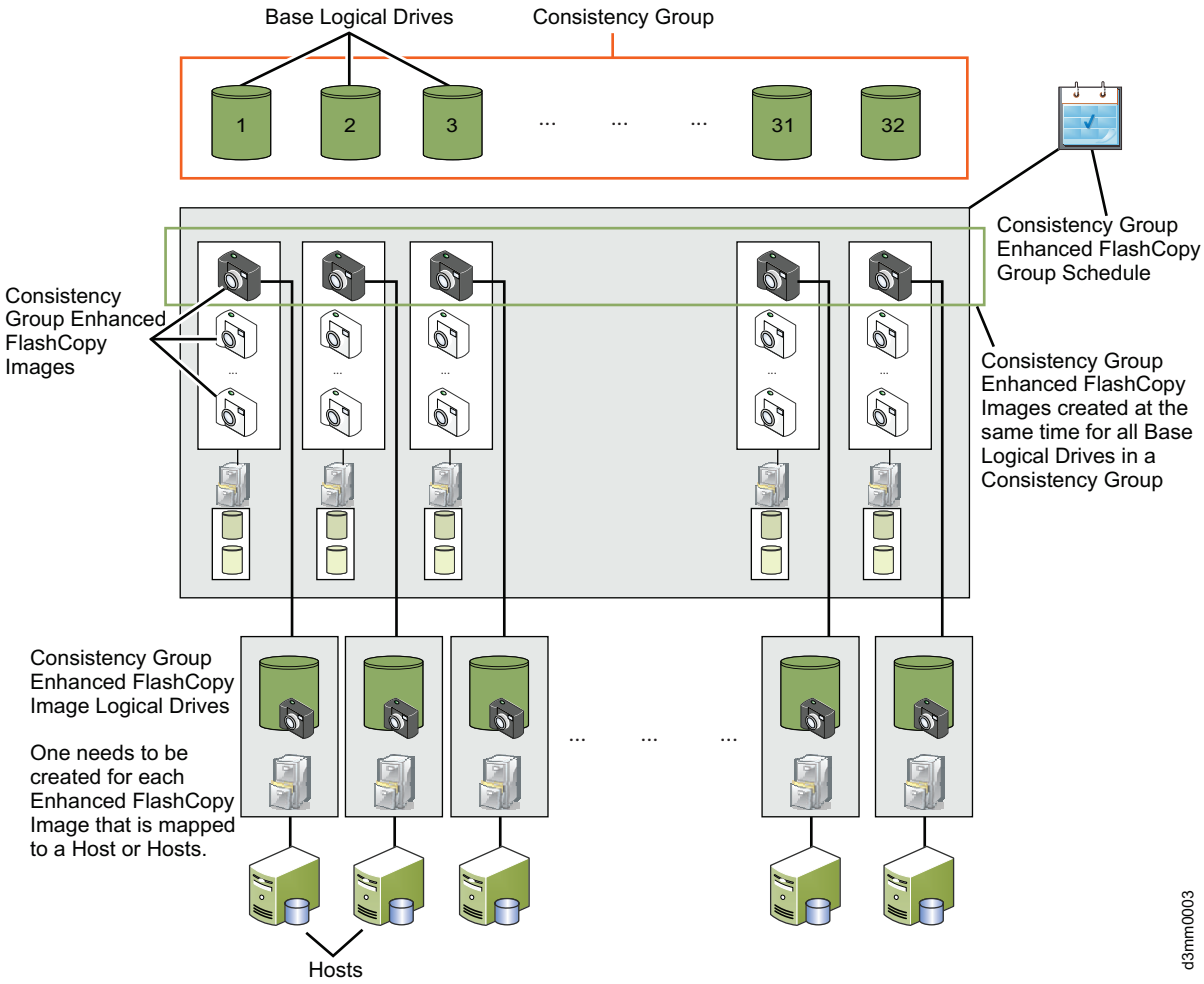


Figure 24. Consistency Group and its Components

- When you add a member logical drive to a consistency group, the system automatically creates an associated member repository and an Enhanced FlashCopy group for the member logical drive.

Characteristics of consistency groups

Some of the characteristics of consistency groups are:

- There is a maximum limit to the number of member logical drives that can belong to a consistency group (depending on the configuration). For DS3500 and DCS3700, it is 32. For the DCS3700 storage subsystem with Performance Module Controllers, it is 64.
- You can schedule the Enhanced FlashCopy image creation for all member logical drives of a consistency group.
- You can roll back member logical drives for a consistency group.
- A member logical drive can belong to several consistency groups.

Guidelines for creating a consistency group

- If a member logical drive resides in an array, the member repository for any associated consistency group can reside on either a disk pool or an array.

- If a member logical drive resides on a disk pool, the member repository for any associated consistency group must reside on the same disk pool as the member logical drive.
- You cannot add a failed member logical drive to a consistency group.
- An Enhanced FlashCopy group exists for each member logical drive that is associated with a consistency group. You cannot individually manage an Enhanced FlashCopy group that is associated with a consistency group. Instead, you must manage operations (for example, delete Enhanced FlashCopy image and roll back Enhanced FlashCopy image) at the consistency group level.
- The consistency group repository logical drive must have the same T10PI and Quality of Service (QoS) settings as the associated member logical drive. For example, if a member logical drive of a consistency group is T10PI enabled, then the associated consistency group repository logical drive must be T10PI enabled.

When you add a base logical drive, which is a member of a consistency group, to an Enhanced Global Remote Mirror group, the system automatically changes the Repository Full Policy to automatically purge the oldest Enhanced FlashCopy image and sets the auto-delete limit to the maximum Enhanced FlashCopy image limit for a consistency group. All member logical drives in a consistency group that also belong to an Enhanced Global Mirror Group must belong to the same Enhanced Global Mirror Group. You can use consistency groups for Enhanced FlashCopy and remote mirroring, so it is good practice to define separate and specific consistency groups for Enhanced FlashCopy images and remote mirroring.

Creating a consistency group

To create a consistency group:

1. Right-click the **Consistency Groups** node in the tree view of the **Storage & Copy Services** tab and select **Create** or select the menu option **Copy Services** > **Consistency group** > **Create**. The Consistency Group Setting window appears in which you can select member logical drives for the consistency group.
2. To select multiple logical drives, press the CTRL key or SHIFT key and select the logical drives from the Eligible logical drives list. An Enhanced FlashCopy logical drive repository is created for each of the selected logical drive using the following default criteria:
   - Capacity is 40% of the associated base logical drive
   - Undersized repositories are allowed
   - Mismatch in QoS attributes are allowed
   - Alert is sent when repository is 75% full
   - Automatic deletion of oldest images when the taken image limit per consistency group is reached. The current limit of images per consistency group is 32.

   Note: You can manually specify the repository drive characteristics.

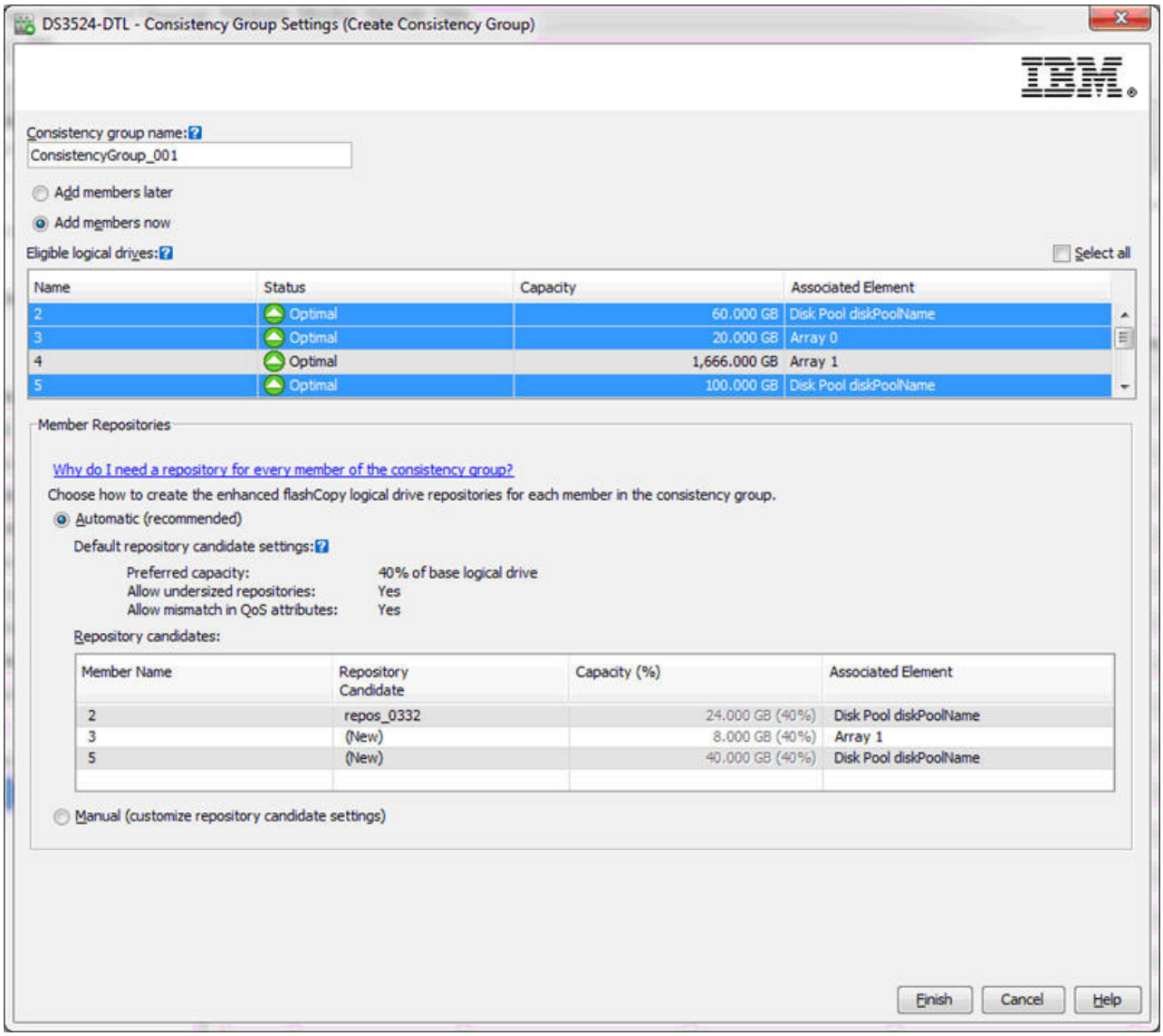


Figure 25. Consistency Group Settings Window

3. Click **Finish**.

The context menu after you right-click a consistency group also has following options: adding or removing member logical drives from a consistency group, renaming a consistency group, changing auto-delete settings and repository full policies, and deleting a consistency group. Similar subsystem window menu options are provided under Copy Services menu in conjunction with the selection of the consistency group name.

Working with consistency groups

Before you begin, prepare the host operating system. For details, see “Preparing the host operating system before creating FlashCopy logical drive or Enhanced FlashCopy image” on page 70.

After the consistency group is created, you can manually create or set up a schedule to automatically create the consistency group Enhanced FlashCopy images.

To create the consistency group Enhanced FlashCopy image manually:

1. In the tree view of the **Storage & Copy Services** tab, expand the **Consistency Groups** node.
2. Right-click the consistency group and from the context menu, select **Consistency Group Enhanced FlashCopy Image** > **Create**. The consistency group Enhanced FlashCopy image is created.

To set up a schedule to create the consistency group Enhanced FlashCopy image:

1. In the tree view of the **Storage & Copy Services** tab, expand the **Consistency Groups** node.
2. Right-click the consistency group and from the context menu, select **Consistency Group Enhanced FlashCopy Image** > **Create/Edit Schedule**. The Edit Enhanced FlashCopy Schedule window appears. You can then create, edit, and enable the schedule. For more information, see "Creating a schedule for a FlashCopy or an Enhanced FlashCopy logical drive" on page 90.

For a consistency group, you can use the context menu to add or delete member logical drives, rename the consistency group, delete the consistency group, and modify the auto-delete setting and policy for full repositories.

These options are also available from the **Copy Services** menu.

Chapter 5. Common procedures for FlashCopy and Enhanced FlashCopy premium features

This chapter describes the procedures that are common to FlashCopy and Enhanced FlashCopy premium features:

- "Planning a FlashCopy or an Enhanced FlashCopy logical drive"
- "Preparing the host operating system before creating FlashCopy logical drive or Enhanced FlashCopy image" on page 70
- "Mapping the FlashCopy or Enhanced FlashCopy logical drive to the host" on page 72
- "Configuring the host for the FlashCopy logical drive" on page 77
- "Reusing a FlashCopy or an Enhanced FlashCopy logical drive" on page 84
- "Creating a schedule for a FlashCopy or an Enhanced FlashCopy logical drive" on page 90

Planning a FlashCopy or an Enhanced FlashCopy logical drive

Note: This procedure refers to FlashCopy. It is also applicable for Enhanced FlashCopy.

Before you create a FlashCopy logical drive, ensure that you are familiar with the following concepts, which are described in this section:

- "Specifying FlashCopy or Enhanced FlashCopy repository logical drive settings"
- "Estimating a FlashCopy or an Enhanced FlashCopy repository logical drive capacity" on page 67
- "Estimating FlashCopy or an Enhanced FlashCopy repository life" on page 69

Specifying FlashCopy or Enhanced FlashCopy repository logical drive settings

When you create a FlashCopy logical drive or Enhanced FlashCopy group, you also create and define the parameters of a physical logical drive that is called the FlashCopy or Enhanced FlashCopy repository logical drive. The repository logical drive is where FlashCopy data and copy-on-write data are stored.

Because the repository logical drive is normally created with a fraction of the base logical drive capacity, there are repository logical drive settings that can be specified to either alert the user when the repository logical drive is getting full or tell the controllers how to act when the repository logical drive is full. You specify these settings when you create an Enhanced FlashCopy group or the FlashCopy Logical Drive.

Read this section before you create a FlashCopy logical drive, so that you have a better understanding of these settings when you create them initially.

For information about changing the properties of an existing FlashCopy repository logical drive, see "Changing FlashCopy repository logical drive properties" on page 31.

Repository capacity usage threshold warning level

When you create the FlashCopy or Enhanced FlashCopy repository logical drive, you can also specify its capacity usage threshold warning level. The storage subsystem controller uses this threshold to send a critical alert when the repository logical drive usage reaches the threshold level. The default values are 50% of the repository drive capacity for FlashCopy and 75% for Enhanced FlashCopy. This threshold level can also be modified at a later time by right-clicking on either the FlashCopy repository logical drive or the enhanced FlashCopy group and selecting Manage Settings for FlashCopy or Change Settings for Enhanced FlashCopy.

The threshold warning is the only warning that is given before the FlashCopy repository logical drive becomes full, so do not ignore it. When you receive the `Threshold Exceeded` warning, you can complete one of the following two actions:

- Increase the capacity of the FlashCopy repository logical drive
- Increase the FlashCopy repository logical drive threshold capacity warning level

Important: Increasing the threshold capacity warning level reduces the amount of time that you have to complete the necessary tasks to prevent the FlashCopy repository logical drive from becoming full when you receive a *Threshold Exceeded* warning.

See “Specifying FlashCopy or Enhanced FlashCopy repository logical drive settings” on page 65 for information about setting the capacity threshold warning level for the FlashCopy repository logical drive.

If you are not sure how high to set the threshold warning level, accept the default setting.

Repository full policy

When you create the repository logical drive, you can specify the action that you want the system to complete when the repository logical drive reaches its capacity and is full. The repository full policy is slightly different between the FlashCopy and Enhance FlashCopy repository logical drive. For the FlashCopy repository logical drive, you can choose from the following two options:

Fail FlashCopy logical drive

When the FlashCopy repository logical drive becomes full, FlashCopy logical drive data is not recoverable and the FlashCopy cannot be accessed. In this case, the only possible action is to delete the FlashCopy logical drive or re-create the FlashCopy logical drive to create a new point-in-time image.

This is the default option.

Fail writes to base logical drive

When the FlashCopy repository logical drive becomes full, the FlashCopy logical drive data is still accessible. However, all write requests to the base logical drive are rejected until the FlashCopy repository logical drive capacity is increased.

Attention: The `Fail writes to base logical drive` option is not supported on AIX or IBM i. Selecting this option might cause data loss on the base logical drive. If you are using AIX or IBM i, select the "Fail FlashCopy logical drive" option, which is the default. Be sure to monitor the capacity of the FlashCopy repository logical drive, because you cannot access the FlashCopy if the repository logical drive becomes full.

For Enhanced FlashCopy, you can specify -

Purge oldest Enhanced FlashCopy images. With this option, the controller will automatically delete the oldest Enhanced FlashCopy images to make room for the new Enhanced FlashCopy image.

This is the default option.

Fail writes to base logical drive
When the repository logical drive becomes full, all write requests to the base logical drive are rejected until the Enhanced FlashCopy repository logical drive capacity is increased. However, The Enhanced FlashCopy logical drive data is still accessible.

Attention: The `Fail writes to base logical drive` option is not supported on AIX or IBM i. Selecting this option might cause data loss on the base logical drive. If you are using AIX or IBM i, select the "Fail Enhanced FlashCopy logical drive" option, which is the default. Be sure to monitor the capacity of the Enhanced FlashCopy repository logical drive, because you cannot access the Enhanced FlashCopy if the repository logical drive becomes full.

For more information about increasing the storage capacity of an existing FlashCopy repository logical drive, see “Resizing a FlashCopy repository logical drive” on page 36. In addition, to help manage the space usage in the Enhanced FlashCopy repository logical drive, you can specify automatic deletion of the oldest Enhanced FlashCopy image when certain number of the Enhanced FlashCopy images were taken in a Enhanced FlashCopy group.

Estimating a FlashCopy or an Enhanced FlashCopy repository logical drive capacity

If numerous I/O requests are written to the base logical drive, the repository logical drive can eventually exceed the base logical drive capacity if all the original data blocks are changed.

Note: Different operating systems might deal with data modifications, such as deleting, replacing, adding only, or deleting only, differently. For example, if you continuously delete and re-create a 10 MB file, the operating system might use only new disk blocks each time the file is created which causes the FlashCopy repository logical drive to become full with the original data. So, instead of generating the 10 MB worth of data in the FlashCopy repository logical drive, it might generate data up to the size of the base logical drive in the FlashCopy repository logical drive.

You can estimate the FlashCopy repository logical drive capacity by calculating the amount of expected management overhead and the space required for copy-on-write data.

Note: You must re-estimate the repository logical drive capacity periodically. You can estimate the FlashCopy repository logical drive capacity by calculating the following figures:

- The amount of expected management overhead
- The space required for copy-on-write data
- The rate that the FlashCopy repository logical drive is filled up with the copy-on-write data

Considerations

The following information can help you to determine the appropriate capacity of the FlashCopy repository logical drive:

- The minimum capacity of a FlashCopy repository logical drive is 8 MB and Enhanced FlashCopy is 32MB (+0.5% of the base logical drive capacity).
- The amount of write activity to the base logical drive that takes place after the FlashCopy logical drive has been created determines the size of a repository logical drive. As the amount of write activity to the base logical drive increases, the number of original data blocks that need to be copied from the base logical drive to the repository logical drive also increases.
- The longer a FlashCopy logical drive remains enabled, the higher the risk of the repository logical drive reaching its maximum capacity. For more information, see "Estimating FlashCopy or an Enhanced FlashCopy repository life" on page 69.
- There is not necessarily a one-to-one correlation between the number of data blocks that change on the base logical drive and the amount of copy-on-write data that is stored on the FlashCopy or Enhanced FlashCopy repository logical drive. The controller might copy over a full set of 32 blocks for performance reasons, even if only one set of blocks has changed. Keep this in mind when determining the percentage of the capacity of the base logical drive that can be copied to the repository logical drive. Rollback operation might require the repository logical drive capacity to be 220% of the base logical drive capacity.

Calculating estimated repository capacity

The following formula can be used merely as a guide. When you estimate the FlashCopy repository logical drive capacity, keep in mind the information listed in "Considerations."

Note: When completing this calculation, you must convert the bytes to kilobytes, the kilobytes to megabytes, and the megabytes to gigabytes.

Use the following formula to calculate the amount of expected management overhead:

`192 KB + (X / 2000)`

where *X* is the capacity of the base logical drive in bytes.

Then, add this amount to the amount of space that is required for copy-on-write data. The result is the estimated FlashCopy repository logical drive capacity.

About Enhanced FlashCopy:
The management overhead for Enhanced FlashCopy repository logical drive is 32MB + (0.5% of the base capacity for roll-back processing) + (0.5% of the base capacity for each Enhanced FlashCopy image taken)

Sample logical drive capacity calculation for Enhanced FlashCopy repository logical drive:

On a base logical drive of 5GB, 30% of the data blocks on the base logical drive are expected to change, up to 10 Enhanced FlashCopy images will be taken.

1. Calculate the amount of management overhead:
   a. Overhead for 10 Enhanced FlashCopy images: 0.5 % of 10 Enhanced FlashCopy images of 5 GB each = 0.25 GB

b. Overhead for roll-back processing: 0.5 % of 5 GB = 0.025 GB
c. Total Management overhead: 32 MB + 25 MB + 250 MB = 307 MB

2. Determine the amount of space (in gigabytes) that is required for copy-on-write data, using the percentage of the base logical drive that is expected to change (30%). 30% of 5 GB = 1.5 GB
3. Adding the two 1.5 GB and 0.307 GB is 1.807 GB.

Sample logical drive capacity calculation for FlashCopy repository logical drive::
On a base logical drive of 5 GB, 30% of the data blocks on the base logical drive are expected to change.

1. Calculate the amount of management overhead that is required.
   a. Convert the capacity of the base logical drive to bytes.
      `5 GB = 5 368 709 120 bytes`
   b. Divide the capacity of the base logical drive (in bytes) by 2000.
      `5 368 709 120 / 2000 = 2 684 354.56 bytes`
   c. Convert the result from step 1b (in bytes) to kilobytes (KB).
      `2 684 354.56 bytes = 2621.44 KB`
   d. Add 192 KB to the results from step 1c.
      `192 KB + 2621.44 KB = 2813.44 KB`
   e. Convert the result from step 1d to megabytes (MB), then to gigabytes (GB).
      `2813.44 KB = 2.75 MB = 0.002686 GB`

   Result: The amount of required management overhead is 0.002686 GB.
2. Determine the amount of space (in gigabytes) that is required for copy-on-write data, using the percentage of the base logical drive that is expected to change (30%).
   `30% of 5 GB = 1.5 GB`

   Result: The amount of space that is required for copy-on-write data is 1.5 GB.
3. Add the result from step 2 to the result from step 1e.
   `1.5 GB + 0.002686 GB = 1.502686 GB`

Result: The estimated FlashCopy repository logical drive capacity is 1.502686 GB.

For more information about estimating the FlashCopy repository logical drive capacity, see "Learn About Estimating FlashCopy Repository Logical Drive Capacity" in the FlashCopy online help.

Estimating FlashCopy or an Enhanced FlashCopy repository life

When you initially define the properties of the FlashCopy or Enhanced FlashCopy repository logical drive, keep in mind the kind of usage that is planned for the FlashCopy logical drive or the Enhanced FlashCopy logical drive group or images. Understanding how the FlashCopy logical drive or the Enhanced FlashCopy logical drive group or images will be used can help you to estimate the life expectancy of the repository logical drive.

After you have created the FlashCopy or Enhanced FlashCopy repository logical drive and some usage data is available, you can estimate its life expectancy using the following procedure as a guide. You can then change the properties of the FlashCopy or Enhanced FlashCopy repository logical drive, if necessary.

Note: The life expectancy of a repository logical drive must be reestimated periodically.

1. In the Subsystem management window, use the appropriate menu function to retrieve the current capacity usage of the repository drive. Depending on the controller firmware version, the menu function to display the current repository logical drive usage differs. Refer to the subsystem management window online help.
2. Record the creation timestamp day and time. If not available online, use your records.
3. Record the capacity used (GB) and the available capacity (GB).
4. Determine the elapsed time (t) by subtracting the creation time from the current time, expressing the elapsed time in either minutes, hours, or days.
5. The total time (Tr) that the repository is available for copy-on-write data can now be estimated, based on the current usage. Multiply the elapsed time (t) by the available capacity (Ct), and then divide the resultant number by the capacity used (Cu).

   Use the following formula:

   ```
   Tr =(t *Ct)/Cu
   ```

   Where:

   Tr Total time available

   t Elapsed time

   Ct Available capacity

   Cu Capacity used

Note: The total time available (Tr) indicates the total usage time for the FlashCopy repository logical drive.

Using the result of these calculations, you can decide whether to increase the capacity of the FlashCopy repository logical drive. If the repository capacity becomes 100% full during the expected lifetime of the FlashCopy, then you must increase the capacity of the FlashCopy repository logical drive.

For more information, see "Resizing a FlashCopy repository logical drive" on page 36.

Preparing the host operating system before creating FlashCopy logical drive or Enhanced FlashCopy image

Before you create the FlashCopy logical drive or Enhanced FlashCopy images, you must prepare the host operating system. Read the following information, then complete the "Steps for preparing the host operating system" on page 71.

Flushing the operating system cached I/Os to disk

The FlashCopy function provides fast replication of data from the base logical drive to the target logical drive, and copies all data that has been successfully written to the storage subsystem by the host. In some environments, data is stored in server memory cache and written to disk at some later time. Two examples of these types of environments are:

- Buffers for a database management subsystem (DBMS)
- Metadata for a journaled file system (JFS)

If buffers from the DBMS or metadata from the journaled file system are not flushed before a FlashCopy operation copies a base to a target, you might have to re-create the FlashCopy. In addition, you might also need to back out of current transactions (for DBMS), or run the fsck utility (for JFS).

To avoid these types of restart actions, ensure that all of the data that is related to the FlashCopy source logical drive is written to disk before you complete the FlashCopy operation. For a DBMS, you can accomplish this by quiescing the subsystem or with a DBMS command such as DB2® **LOG SUSPEND**. For a journaled file system, you can accomplish this by unmounting the FlashCopy base logical drive.

Stopping I/O to the base logical drive

In the following procedure, "Steps for preparing the host operating system," you will need to stop I/O by either stopping the host application that is accessing the base logical drive, or by placing the application in backup mode.

If you choose to place the application in backup mode, make sure that the application recovery files, such as rollback and redo logs, reside in different physical disk storage or on different logical drives from the FlashCopy base logical drive. Then, back up the application recovery files.

Note: If the recovery files are on the base logical drive, placing the application in backup mode will not stop I/O to the base logical drive.

Steps for preparing the host operating system

Note: This procedure refers to FlashCopy. It is also applicable for Enhanced FlashCopy.

Complete the following steps to prepare the host operating system immediately before you create a FlashCopy logical drive. If you plan to use the FlashCopy logical drive at a later date, wait to complete these steps until immediately prior to creating the FlashCopy.

1. Stop the host application that is accessing the base logical drive, or place the application in backup mode.

   Note: Placing the application in backup mode requires some additional preparation. For more information, see the "Stopping I/O to the base logical drive" section of "Preparing the host operating system before creating FlashCopy logical drive or Enhanced FlashCopy image" on page 70.
2. Synchronize the file system and flush the operating system cached I/Os to disks by unmounting the base logical drive. For more information, see the "Flushing the operating system cached I/Os to disk," section of "Preparing the host operating system before creating FlashCopy logical drive or Enhanced FlashCopy image" on page 70.

   Note: In Microsoft Windows environments, you can use the SMrepassist utility to flush the operating system cache I/Os, instead of unmounting the base logical drive. For more information on the SMrepassist utility, see the "SMrepassist" topic in the Storage Manager online help.

The Microsoft Windows operating system also provides a means for applications to issue calls to flush I/Os and to make FlashCopy without having to shut down the

applications. The Microsoft Virtual Disk Service (VDS) and Microsoft Volume Shadow-copy Service (VSS) are storage management interfaces for Microsoft Windows. VDS and VSS enable your storage array to easily interact with third-party applications that use the VDS or VSS Application Programming Interface (API). Microsoft VDS/VSS is included in the Windows installation. The Storage Manager VDS hardware provider is a Windows Dynamic Linked Library (DLL). It is loaded by VDS and used as a communication channel to your storage array. With the Storage Manager VDS hardware provider installed, third-party applications can send management commands to your storage array. Creating logical drives, deleting logical drives, and unmasking logical drives are some the commands supported. It is also possible for third-party applications to obtain status and configuration information on the storage array. The Storage Manager VSS hardware provider is a Windows service (.exe). VSS attaches to the service and uses it to coordinate the creation of FlashCopy logical drives on the storage array. VSS-initiated FlashCopy logical drives can be triggered through third-party backup tools. For information on installing and using Storage Manager VDS/VSS, see the readme file. See "Finding Storage Manager software, controller firmware, and readme files" on page xxi to learn how to access the storage subsystem readme files on the web.

Additional information for hosts that use ADT/AVT: Make sure that the base logical drive and its associated FlashCopy logical drives are both on the same controller ownership/preferred path in host operating system environments that use the automatic logical drive transfer (ADT) feature to failover and failback logical drives. Otherwise, the base logical drive and its associated FlashCopylogical drives can move back and forth between controllers, causing logical unit number (LUN) access problems.

Note: ADT is sometimes also referred to as automatic volume transfer (AVT).

The preferred path can be either Controller A or Controller B, if you ensure that the base logical drive, FlashCopy logical drive, and FlashCopy repository logical drive are owned by the same controller, and that the controller owner is configured as the preferred path from the hosts.

Note: If a path failure causes one of the logical drives to fail over to the other controller, so that the base and FlashCopy logical drives are no longer on the same controller, complete one of the following steps:

- Manually move either the base or the FlashCopy logical drive so that both are on the same controller again.
- Correct the failing path immediately.

After you have prepared the host operating system, you can create a FlashCopy logical drive using the wizard.

Mapping the FlashCopy or Enhanced FlashCopy logical drive to the host

Note: This procedure refers to FlashCopy. It is also applicable for Enhanced FlashCopy.

Use the Mappings view in the SMclient to assign logical drive-to-LUN mappings between the FlashCopy logical drive and the host that will access the FlashCopy logical drive.

Note: Because the FlashCopy logical drive is an exact copy of the original base logical drive, if you map both a base logical drive and its associated FlashCopy logical drives to the same host, it can result in conflicts if the host operating systems or the logical volume manager software depend on the data in the logical drive to identify it. For more information on how to properly configure your host operating system, see "Configuring the host for the FlashCopy logical drive" on page 77.

Complete the following steps to map the FlashCopy logical drive to a host:

1. In the SMclient, open the Mappings view of the Subsystem Management window, as shown in Figure 26. The newly created FlashCopy logical drive displays in the undefined mapping section.

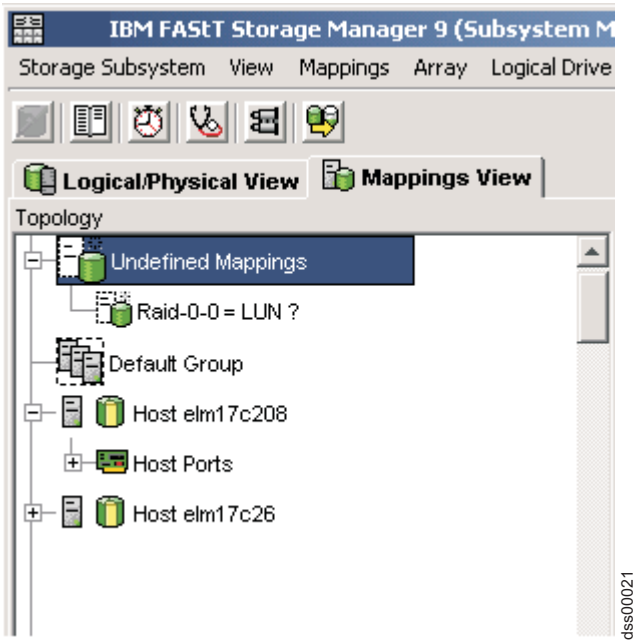


Figure 26. Undefined FlashCopy disk

2. Right-click the host or host group to which you want to map the drive, click **Define Additional Mapping**, or **Add LUN Mapping**, as shown in Figure 27 on page 74, depending on the installed configuration firmware version.

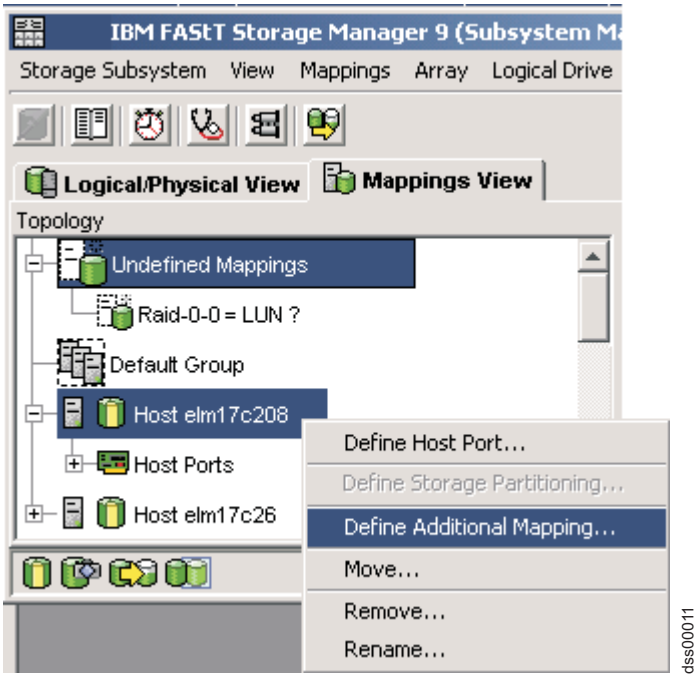


Figure 27. Define Additional Mapping

3. In the Define Additional Mapping window, specify the following options, as shown in Figure 28 on page 75.
   - Select the host or host group.
   - Set the LUN number.
   - Select the FlashCopy logical drive.
   - Click **Add**.

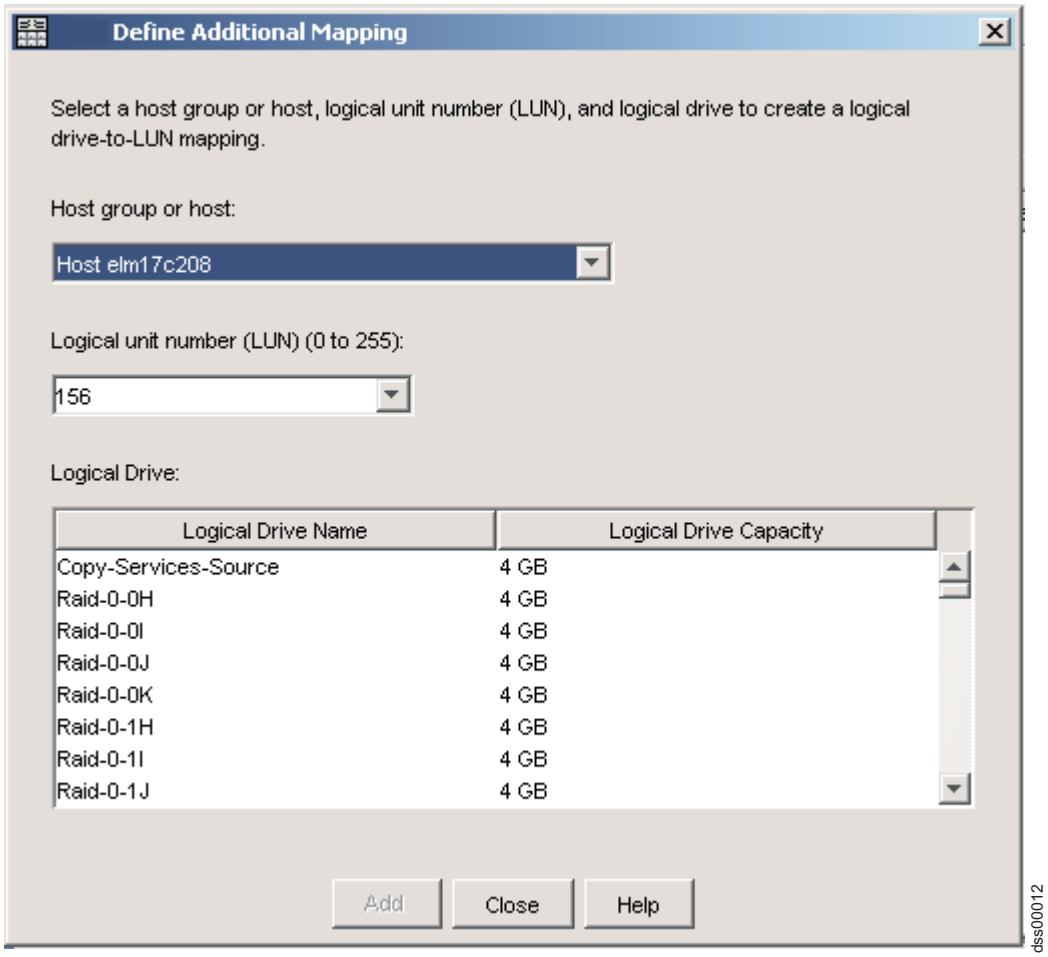


Figure 28. The Define Additional Mapping window

When you are finished, the FlashCopy logical drive is available to the host or host group, as shown in Figure 29 on page 76.

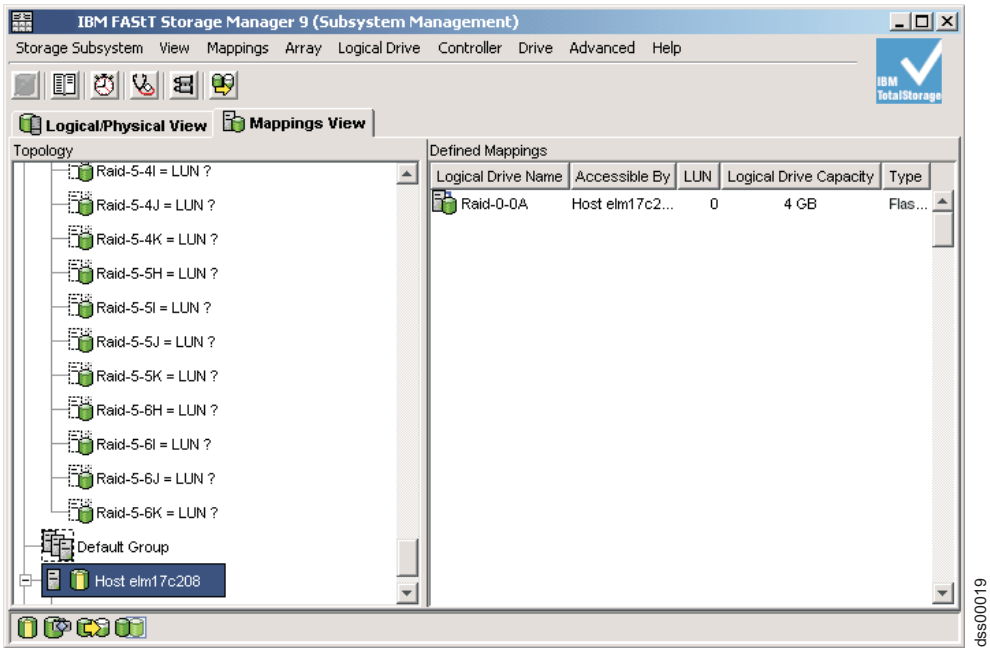


Figure 29. Mapped FlashCopy logical disk

In the mapping example shown in Figure 28 on page 75 and Figure 29, the FlashCopy logical drive named DataVol-1 is made available to the backup server host group. This enables the backup server to access and mount the drive as part of its own file system. It also allows a local backup to be completed by the backup application software.

It is possible to map the FlashCopy logical drive to the same server that owns the base logical drive. However, immediately after you create the FlashCopy, the two logical drives are exactly the same (a block-by-block copy). Many operating systems do not tolerate seeing an exact duplicate logical drive. You might need to complete other steps, such as restarting your computer or running the Hot_Add utility, before you can access the FlashCopy logical drive. For more information about DS Storage Manager V10.77 or earlier, see the *IBM System Storage DS Storage Manager Version 10 Installation and Host Support Guide* for your operating system. For more information about DS Storage Manager V10.83 or later, see the *IBM System Storage DS Storage Manager Version 10.8 Installation and Host Support Guide* for your operating system.

Note: If you use this FlashCopy on a regular basis (for example, for backup purposes), use the Disable FlashCopy and Re-Create FlashCopy options to reuse the FlashCopy. Using these options preserves the existing mappings to the FlashCopy logical drive. For more information, see "Disabling a FlashCopy logical drive" on page 32 and "Recreating a FlashCopy logical drive" on page 34.

After you have mapped the FlashCopy logical drive, configure the host, as described in "Configuring the host for the FlashCopy logical drive" on page 77.

Configuring the host for the FlashCopy logical drive

After you use the Create FlashCopy Logical Drive wizard to create the FlashCopy logical drive and map the FlashCopy logical drive to the host, you must complete some additional steps to configure the host operating system.

Complete the procedure that is applicable for your host operating system:

- "Instructions for AIX"
- "Instructions for HP-UX" on page 79
- "Instructions for Solaris" on page 81
- "Instructions for Windows" on page 82
- "Instructions for Novell NetWare" on page 83
- "Instructions for Linux" on page 83

Attention: You must complete the procedure described for your host operating system in this section. Failure to do so can result in an inaccurate point-in-time image of the base logical drive.

Using the script editor and the command-line interface

If you are using an AIX, HP-UX, Linux or Solaris host, you must use the script editor or command line interface (SMcli) to configure your host for the new FlashCopy logical drive.

You can use the script editor to create or edit a script file, save a script file to the local disk of the management station, or load a script file from disk. You can also use SMcli to issue individual commands to the scripting engine from the host operating system command shell or to call complete pre-written scripts.

For more information about how to use SMcli and the script editor, click the **Help** tab on the Enterprise Management window.

Instructions for IBM i

Instructions for using IBM i are provided in the *IBM i and IBM System Storage: A Guide to Implementing External Disks* Redbook. To download a copy of this Redbook, go to http://www.redbooks.ibm.com/abstracts/sg247120.html?Open.

Instructions for AIX

Note: This procedure refers to FlashCopy. It is also applicable for Enhanced FlashCopy.

Use the following procedures on a host that is running AIX using Logical Volume Manager (LVM).

Restrictions:

- FlashCopy logical drives can be created only for AIX arrays. If an array has more than one logical drive, you must create a FlashCopy logical drive for each logical drive in the array.
- AIX does not support the "Fail writes to base logical drive" option of the repository full policy. Selecting this option might cause data loss on the base logical drive. You must make sure that the repository full policy is set to the default option, "Fail FlashCopy logical drive."

For information about how to set the repository full policy, see "Changing FlashCopy repository logical drive properties" on page 31.

Before you begin, complete the following:

- Read the information in "Planning a FlashCopy logical drive" on page 16 and "Using the script editor and the command-line interface" on page 77.
- Complete the procedures that are described in the previous sections:
  1. "Preparing the host operating system before creating FlashCopy logical drive or Enhanced FlashCopy image" on page 70
  2. "Creating a FlashCopy logical drive by using the FlashCopy Logical Drive wizard" on page 27
  3. "Mapping the FlashCopy or Enhanced FlashCopy logical drive to the host" on page 72

To configure the AIX host for the new FlashCopy logical drives, complete the following steps:

1. Log in to the host as `root`.
2. Ensure that the host operating system recognizes the FlashCopy logical drives. At the host prompt, type the following command, and then press Enter.

```
cfgmgr
```

   Several minutes might pass while the operating system accesses the drives. When the operation completes, a window opens with the following message:

```
Device nodes have been updated
```

   The new logical drives are now available from the operating system.
3. At the host prompt, type the following command, and then press Enter.

```
lspv
```

   A list of the physical drives that are recognized by the operating system displays.
4. Look for the operating system device name of your FlashCopy logical drive in the list. The list shows a physical logical drive ID (PVID) for the FlashCopy logical drive. This is the same as the PVID for the associated base logical drive, because the FlashCopy logical drive contains the same array data structures as the base logical drive.
5. Clear the PVID for the FlashCopy logical drives. At the host prompt, type the following command, and then press Enter.

```
chdev -l os_device_name -a pv=clear
```

   where *os_device_name* is the operating system device name of the FlashCopy logical drive.

   Repeat this step for each FlashCopy logical drive in the AIX array.
6. Re-create a new array using the **re-createvg** command. This command reads the array data structure inside a logical drive and reconstructs it. It also allocates new physical logical drive identifiers (PIDs) to the FlashCopy logical drives and enables access to the FlashCopy logical drive for the selected host.

   At the host prompt, type the following command, and then press Enter:

```
re-createvg -y logical drivegroupname -L /directoryname os_device_name
```

where:

- *logical drivegroupname* is the name that you want to assign to the FlashCopy array.
- *directoryname* is the name of the directory where you want to mount the FlashCopy logical drive.
- *os_device_name* is the operating system device name of the FlashCopy logical drive. If your AIX array contains more than one FlashCopy logical drive, add an *os_device_name* for each logical drive.

The array is re-created, and contains the FlashCopy logical drive or drives.

7. Mount the FlashCopy logical drive to its intended host. At the host prompt, type the following command, and then press Enter.

```
mount mount-point
```

where *mount-point* is the name of the file system that is being mounted. Include the *directoryname* that was used in step 6 on page 78.

8. Make sure that the logical drives are back online. At the host prompt, type the following command, and then press Enter.

```
df -k
```

A list of the mounted disks displays.

9. Use the FlashCopy logical drive with your backup application or with another application.
10. When the FlashCopy logical drive is no longer required, unmount the file system. At the host prompt, type the following command, and then press Enter.

```
umount mount-point
```

11. Disable or delete the FlashCopy logical drive after it is no longer needed.

    If you disable the FlashCopy logical drive instead of deleting it, you can retain the FlashCopy logical drive and its associated FlashCopy repository logical drive. Then, when you need to create a different FlashCopy of the same base logical drive, you can re-create the disabled FlashCopy logical drive. This takes less time than creating a new FlashCopy logical drive and avoids any reduction in performance that might occur if the FlashCopy logical drive remains available.

    To disable or delete a FlashCopy logical drive, in the Subsystem Management window, right-click the FlashCopy logical drive icon and select either **Disable** or **Delete**.

12. Delete the array that you created in step 6 on page 78, that contains the FlashCopy logical drives. At the host prompt, type the following commands, and then press Enter.

```
varyoffvg logical drivegroupname exportvg logical drivegroupname
```

where *logical drivegroupname* is the name of the FlashCopy array.

Instructions for HP-UX

Note: This procedure refers to FlashCopy. It is also applicable for Enhanced FlashCopy.

Use the following procedures on a host that is running HP-UX 11.0 (or later) and uses LVM (or later). Failure to complete the steps listed can result in an inaccurate point-in-time image of the base logical drive.

Before you begin, complete the following:

- Read the information in "Planning a FlashCopy logical drive" on page 16 and "Using the script editor and the command-line interface" on page 77.
- Complete the procedures that are described in the previous sections:
  1. "Preparing the host operating system before creating FlashCopy logical drive or Enhanced FlashCopy image" on page 70
  2. "Creating a FlashCopy logical drive by using the FlashCopy Logical Drive wizard" on page 27
  3. "Mapping the FlashCopy or Enhanced FlashCopy logical drive to the host" on page 72

To configure the HP-UX host for the new FlashCopy logical drives, complete the following steps:

1. At the host prompt, type the following command, and then press Enter.

```
ioscan -fn
```

   A list of the mapped devices that are recognized by the host displays.

   Note: If the required device names are not displayed with this command, type the following command at the host prompt, and then press Enter.

```
insf
```

2. Remount the base logical drive to its original host.

   Note: If I/O activity to the base logical drive was stopped or data transfer was suspended, resume I/O activity to the base logical drive or re-enable data transfer at this time.

3. Complete the following steps to import the FlashCopy logical drives into the LVM:
   a. Create a new directory for the new array, as shown in the following example.

```
mkdir /dev/vg02
```

   b. Create a group node for the new array, as shown in the following example.

```
mknod /dev/vg02/group c 64 -0x020000
```

   c. Import the FlashCopy logical drive LUNs. At the host prompt, type the following command, and then press Enter.

```
vgimport /dev/vg02 FlashCopy-block-node-1 FlashCopy-block-node-2
```

      The following example addresses how to handle redundancy with multiple paths. The two paths or nodes represent the primary and alternate paths of the FlashCopy logical drive.

```
vgimport /dev/vg02 /dev/dsk/c66t0d1 /dev/dsk/c69t0d1
```

Note: You must verify that the */dev/dsk* device files exist on the FlashCopy logical drive. Use the SMdevices utility or the HP-UX ioscan utility to complete the verification.

The system displays a warning indicating that a backup of the array that is being imported might not exist on the host. This message is only a warning and requires no response. The import operation continues and completes successfully.

The backup for this array is created later, when it is exported.

d. Activate the new array, as shown in the following example:

```
vgchange -a y /dev/vg02
```

4. If a file system existed on the base logical drive, then it also exists on the FlashCopy logical drive. Before you mount the FlashCopy logical drive, however, complete a file system check to make sure that the file system is consistent, for example:

```
fsck /dev/vg02/lvol01
```

5. Mount the FlashCopy logical drive to its intended host.
6. Use the FlashCopy logical drive with your backup application or with another application.
7. Unmount the FlashCopy logical drive.
8. Disable or delete the FlashCopy logical drive after it is no longer needed.

   If you disable the FlashCopy logical drive instead of deleting it, you can retain the FlashCopy logical drive and its associated FlashCopy repository logical drive. Then, when you need to create a different FlashCopy of the same base logical drive, you can re-create the disabled FlashCopy logical drive. This takes less time than creating a new FlashCopy logical drive and avoids any reduction in performance that might occur if the FlashCopy logical drive remains available.

   To disable or delete a FlashCopy logical drive, in the Subsystem Management window, right-click the FlashCopy logical drive icon and select either **Disable** or **Delete**.

Instructions for Solaris

Use the following procedure on a host that is running Solaris 7 and 8. Failure to complete the steps listed can result in an inaccurate point-in-time image of the base logical drive.

Before you begin, complete the following:

- Read the information in "Planning a FlashCopy logical drive" on page 16 and "Using the script editor and the command-line interface" on page 77.
- Complete the procedures that are described in the previous sections:
  1. "Preparing the host operating system before creating FlashCopy logical drive or Enhanced FlashCopy image" on page 70
  2. "Creating a FlashCopy logical drive by using the FlashCopy Logical Drive wizard" on page 27
  3. "Mapping the FlashCopy or Enhanced FlashCopy logical drive to the host" on page 72

To configure your operating system, complete the following steps:

1. At the host prompt, type the following command, and then press Enter.

```
/etc/raid/bin/hot_add
```

   This step makes sure that the operating system is aware of the newly-created logical drives, without having to restart the host.
2. Run the SMdevices utility to associate the LUN with a host operating system device and to make sure that the FlashCopy logical drive is recognized by the host.

   This step makes sure that the logical drive name and the operating system device name (assigned by the operating system) correlate.
3. If you plan to use the FlashCopy logical drive immediately, go to step 4. If you plan to use the FlashCopy logical drive at a later date, disable the FlashCopy logical drive now. Click **Logical Drive → FlashCopy → Disable** in the Subsystem Management window.

   Note: If I/O activity to the base logical drive was stopped or data transfer was suspended, resume I/O activity to the base logical drive or re-enable data transfer at this time.
4. Mount the FlashCopy logical drive to its intended host.
5. Use the FlashCopy logical drive with your backup application, for speculative testing, or with another application.
6. Unmount the FlashCopy logical drive.
7. Disable or delete the FlashCopy logical drive after it is no longer needed.

   If you disable the FlashCopy logical drive instead of deleting it, you can retain the FlashCopy logical drive and its associated FlashCopy repository logical drive. Then, when you need to create a different FlashCopy of the same base logical drive, you can re-create the disabled FlashCopy logical drive. This takes less time than creating a new FlashCopy logical drive and stops any performance reduction that might occur if the FlashCopy logical drive remains available.

   To disable or delete a FlashCopy logical drive, in the Subsystem Management window, right-click the FlashCopy logical drive icon and select either **Disable** or **Delete**.

Instructions for Windows

You cannot add the FlashCopy logical drive to the same Windows server that the FlashCopy base logical drive is mapped to. You must add the FlashCopy logical drive to another Windows server, or unmap the base logical drive from the server that it is mapped to.

Note: Making a FlashCopy of a Dynamic Disk type of logical drive is not supported on Windows operating systems.

Complete the following steps to configure your host for the new FlashCopy logical drives:

1. Run the hot_add utility to let the system recognize the newly-added FlashCopy logical drive.

   Note: If the system does not recognize the FlashCopy logical drive after you run the hot_add utility, restart the server.
2. In the System Management window, open the Disk Management directory and assign a drive letter or mount point to the new FlashCopy logical drive.

3. When you no longer need the FlashCopy logical drive, remove the drive letter or mount point from the Disk Management directory *before* you delete the FlashCopy logical drive.

Instructions for Novell NetWare

Note: This procedure refers to FlashCopy. It is also applicable for Enhanced FlashCopy.

You cannot add the FlashCopy logical drive to the same NetWare server where the FlashCopy base logical drive is located. You must add the FlashCopy logical drive to another NetWare server, or unmap the base logical drive from the server that it is mapped to.

Complete the following steps to configure your host for the new FlashCopy logical drive:

1. Run the hot_add utility to let the system recognize the newly-added FlashCopy logical drive.

   Note: If the system does not recognize the FlashCopy logical drive after you run the hot_add utility, restart the server.
2. Type the logical drive in the command window, or use the **Disk Management** menu in the ConsoleOne window to verify that the drive is added.

Instructions for Linux

Use the following procedure on a host that is running Linux. Failure to complete the steps listed can result in an inaccurate point-in-time image of the base logical drive.

Before you begin, complete the following:

- Read the information in "Planning a FlashCopy logical drive" on page 16 and "Using the script editor and the command-line interface" on page 77.
- Complete the procedures that are described in the previous sections:
  1. "Preparing the host operating system before creating FlashCopy logical drive or Enhanced FlashCopy image" on page 70
  2. For FlashCopy, see "Creating a FlashCopy logical drive by using the FlashCopy Logical Drive wizard" on page 27. For Enhanced FlashCopy, see "Creating an Enhanced FlashCopy logical drive" on page 54.
  3. "Mapping the FlashCopy or Enhanced FlashCopy logical drive to the host" on page 72

Note: This procedure refers to FlashCopy. It is also applicable for Enhanced FlashCopy.

To configure your operating system, complete the following steps:

1. Run the `hot_add` utility to allow the system to recognize the newly added FlashCopy logical drive. At the host prompt, type the following command, and then press **Enter**:

   ```
   /usr/sbin/hot_add
   ```

   Note: The `hot_add` utility is enabled after loading the Linux RDAC multipath driver.

This step makes sure that the operating system is aware of the newly created logical drives, without having to restart the host.

2. Run the SMdevices utility to associate the LUN with a host operating system device and to make sure that the FlashCopy logical drive is recognized by the host.

   This step makes sure that the logical drive name and the operating system device name (assigned by the operating system) correlate.

3. If you plan to use the FlashCopy logical drive immediately, go to step 4. If you plan to use the FlashCopy logical drive at a later date, disable the FlashCopy logical drive now. Click **Logical Drive → FlashCopy → Disable** in the Subsystem Management window.

   Note: If I/O activity to the base logical drive was stopped or data transfer was suspended, resume I/O activity to the base logical drive or re-enable data transfer at this time.

4. Mount the FlashCopy logical drive to its intended host.
5. Use the FlashCopy logical drive with your backup application, for speculative testing, or with another application.
6. Unmount the FlashCopy logical drive.
7. Disable or delete the FlashCopy logical drive after it is no longer needed.

   If you disable the FlashCopy logical drive instead of deleting it, you can retain the FlashCopy logical drive and its associated FlashCopy repository logical drive. Then, when you need to create a different FlashCopy of the same base logical drive, you can re-create the disabled FlashCopy logical drive. This takes less time than creating a new FlashCopy logical drive and stops any performance reduction that might occur if the FlashCopy logical drive remains available.

   To disable or delete a FlashCopy logical drive, in the Subsystem Management window, right-click the FlashCopy logical drive icon and select either **Disable** or **Delete**.

Reusing a FlashCopy or an Enhanced FlashCopy logical drive

Note: The following procedures refer to FlashCopy. They are also applicable for Enhanced FlashCopy.

Instructions for IBM i

Instructions for using IBM i are provided in the *IBM i and IBM System Storage: A Guide to Implementing External Disks* Redbook. To download a copy of this Redbook, go to http://www.redbooks.ibm.com/abstracts/sg247120.html?Open.

Instructions for AIX

Before you begin, stop all I/O activity to the base logical drive, or suspend data transfer. This makes sure that you capture an accurate point-in-time image of the

base logical drive. For more information, see “Preparing the host operating system before creating FlashCopy logical drive or Enhanced FlashCopy image” on page 70.

Note: This procedure refers to FlashCopy. It is also applicable for Enhanced FlashCopy.

To create a new point-in-time image of the same base logical drive, complete the following steps:

1. Unmount the file systems in the array on which the FlashCopy logical drive is to be based. At the host prompt, type the following command, and then press Enter.

```
umount mount-point
```

   where *mount-point* is the name of the file system that is being unmounted.

2. In the Storage Manager Subsystem Management window, re-create the FlashCopy logical drive. Click **Logical Drive → FlashCopy → Re-Create** in the Subsystem Management window.
3. Ensure that the host operating system recognizes the FlashCopy logical drive. At the host prompt, type the following command, and then press Enter.

```
cfgmgr
```

   Several minutes might pass while the operating system accesses the drives. When the operation completes, the host prompt displays again. The new logical drives are now available from the operating system.

4. Clear the PVID for the FlashCopy logical drives. At the host prompt, type the following command, and then press Enter.

```
chdev -l os_device_name -a pv=clear
```

   where *os_device_name* is the operating system device name of the FlashCopy logical drive.

   Repeat this step for each FlashCopy logical drive in the AIX array.

   Attention: Before specifying *clear* with the chdev command, verify that you are specifying the correct device name. If you specify a different device name, all of the data on that device becomes inaccessible. To verify the correct device name, use the **fget config** command.

5. Re-create a new array. At the host prompt, type the following command, and then press Enter:

```
re-createvg -y logical drivegroupname -L /directoryname os_device_name
```

   where:

   - *logical drivegroupname* is the name that you want to assign to the FlashCopy array.
   - *directoryname* is the name of the directory where you want to mount the FlashCopy logical drive.
   - *os_device_name* is the operating system device name of the FlashCopy logical drive. If your AIX array contains more than one FlashCopy logical drive, add an *os_device_name* for each logical drive.

   The array is re-created and contains the FlashCopy logical drive or drives.

6. Mount the file system to its intended host. At the host prompt, type the following command, and then press Enter:

```
mount mount-point
```

where *mount-point* is the name of the file system that is being mounted. Include the *directoryname* that was used in step 5 on page 85.

7. Ensure that the logical drives are back online. At the host prompt, type the following command, and then press Enter:

```
df -k
```

A list of the mounted disks displays.

8. Use the FlashCopy logical drive with your backup application or other application.
9. Disable the FlashCopy logical drive after it is no longer needed.

If you disable the FlashCopy logical drive instead of deleting it, you can retain the FlashCopy logical drive and its associated FlashCopy repository logical drive. Then, when you need to create a different FlashCopy of the same base logical drive, you can re-create the disabled FlashCopy logical drive. This takes less time than creating a new FlashCopy logical drive and stops any performance reduction that might occur if the FlashCopy logical drive remains available.

Instructions for HP-UX

Before you begin, stop all I/O activity to the base logical drive, or suspend data transfer. This makes sure that you capture an accurate point-in-time image of the base logical drive.

Note: This procedure refers to FlashCopy. It is also applicable for Enhanced FlashCopy.

To create a new point-in-time image of the same base logical drive, complete the following steps:

1. Start the storage management software. The Enterprise Management window opens.
2. Launch a Subsystem Management window using one of the following methods:
   - Select the storage subsystem in either the Device Tree view or from the Device Table. Then, click **Manage Device** on the toolbar or click **Tools→ Manage Device**.
   - Right-click the storage subsystem in the Device Tree view or from the Device Table, and click **Manage Device**.
   - Double-click a storage subsystem node in the Device Table.
   - Select the storage subsystem in the Device Tree view or from the Device Table, and then press Enter.

   The Subsystem Management window opens in a separate window.
3. Unmount the base logical drive.
4. In the storage management software, re-create the FlashCopy logical drive. Click **Logical Drive → FlashCopy → Re-Create** in the Subsystem Management window.
5. Remount the base logical drive to its original host.

Note: If you stopped I/O activity to the base logical drive or suspended a data transfer, resume I/O activity to the base logical drive or re-enable data transfer at this time.

6. Complete the following steps to import the FlashCopy logical drives into the Logical Volume Manager:
   a. Create a new directory for the new array, as shown in the following example.

```
mkdir /dev/vg02
```

   b. Create a group node for the new array, as shown in the following example.

```
mknod /dev/vg02/group c 64 -0x020000
```

   c. Import the FlashCopy logical drive LUNs. At the host prompt, type the following command, and then press Enter.

```
vgimport /dev/vg02 FlashCopy-block-node-1 FlashCopy-block-node-2 ...
```

   An alternate command can be used, as shown in the following example.

```
vgimport /dev/vg02 /dev/dsk/c66t0d1 /dev/dsk/c69t0d1
```

   Note: You must verify that the */dev/dsk* device files exist on the FlashCopy logical drive. Use the SMdevices utility or the HP-UX ioscan utility to complete this verification.

   A warning displays indicating that a backup of the array that is being imported might not exist on the host. This message is only a warning and can be ignored. The import operation continues and completes successfully.

   The backup for this array is created when it is exported later.

   d. Activate the new array, as shown in the following example.

```
vgchange -a y /dev/vg02
```

7. If a file system existed on the base logical drive, then it also exists on the FlashCopy logical drive. However, before you mount the FlashCopy logical drive, complete a file system check to make sure that the file system is consistent. For example

```
fsck /dev/vg02/lvol01
```

8. Mount the FlashCopy logical drive to its intended host.
9. Use the FlashCopy logical drive with your backup application or other application.
10. Unmount the FlashCopy logical drive.
11. Disable the FlashCopy logical drive after it is no longer needed.

    If you disable the FlashCopy logical drive instead of deleting it, you can retain the FlashCopy logical drive and its associated FlashCopy repository logical drive. Then, when you need to create a different FlashCopy of the same base logical drive, you can re-create the disabled FlashCopy logical drive. This takes less time than creating a new FlashCopy logical drive and stops any performance reduction that might occur if the FlashCopy logical drive remains available.

Instructions for Solaris

Note: This procedure refers to FlashCopy. It is also applicable for Enhanced FlashCopy.

To create a new point-in-time image of the same base logical drive, complete the following steps:

1. Unmount the base logical drive.
2. In the storage management software, re-create the FlashCopy logical drive. Click **Logical Drive → FlashCopy → Re-Create** in the Subsystem Management window.
3. Remount the base logical drive to its original host.
4. Mount the FlashCopy logical drive to its intended host.

   Note: If you stopped I/O activity to the base logical drive or suspended data transfer, resume I/O activity to the base logical drive or re-enable data transfer at this time.
5. Use the FlashCopy logical drive with your backup application or with another application.
6. Unmount the FlashCopy logical drive.
7. After the FlashCopy logical drive is no longer needed, disable the FlashCopy logical drive.

   If you disable the FlashCopy logical drive instead of deleting it, you can retain the FlashCopy logical drive and its associated FlashCopy repository logical drive. Then, when you need to create a different FlashCopy of the same base logical drive, you can re-create the disabled FlashCopy logical drive. This takes less time than creating a new FlashCopy logical drive and stops any performance reduction that might occur if the FlashCopy logical drive remains available.

Instructions for Windows

Note: This procedure refers to FlashCopy. It is also applicable for Enhanced FlashCopy.

To create a new point-in-time image of the same base logical drive, complete the following steps:

1. Stop the host application or suspend data transfer.
2. Run `SMrepassist -f` on the host where the FlashCopy logical drive resides.
3. Disable the FlashCopy logical drive.

   If you disable the FlashCopy logical drive instead of deleting it, you can retain the FlashCopy logical drive and its associated FlashCopy repository logical drive. Then, when you need to create a different FlashCopy of the same base logical drive, you can re-create the disabled FlashCopy logical drive. This takes less time than creating a new FlashCopy logical drive and stops any performance reduction that might occur if the FlashCopy logical drive remains available.

   To disable or delete a FlashCopy logical drive, right-click the icon for that FlashCopy logical drive in the Subsystem Management window, and select either **Disable** or **Delete**.
4. Run `SMrepassist -f` on the host where the base logical drive resides.

5. Re-create the FlashCopylogical drive. For instructions about how to re-create a FlashCopy logical drive, see “Recreating a FlashCopy logical drive” on page 34.
6. Restart the host application or re-enable data transfer. The FlashCopy logical drive is ready to use.
7. Disable the FlashCopy logical drive until it is required again.

Instructions for Novell NetWare

Note: This procedure refers to FlashCopy. It is also applicable for Enhanced FlashCopy.

Complete the following steps to create a new point-in-time image of the same base logical drive:

1. Stop the host application or suspend data transfer.
2. Unmount the base logical drive.
3. Re-create the FlashCopy logical drive. For instructions about how to re-create a FlashCopy logical drive, see “Recreating a FlashCopy logical drive” on page 34.
4. Remount the base logical drive.
5. Restart the host application.
6. Remount the FlashCopy logical drive. The FlashCopy logical drive is ready to use (for backup, speculative test, or upgrades).
7. Unmount the FlashCopy logical drive.
8. Disable the FlashCopy logical drive until it is required again.

   If you disable the FlashCopy logical drive instead of deleting it, you can retain the FlashCopy logical drive and its associated FlashCopy repository logical drive. Then, when you need to create a different FlashCopy of the same base logical drive, you can re-create the disabled FlashCopy logical drive. This takes less time than creating a new FlashCopy logical drive and stops any performance reduction that might occur if the FlashCopy logical drive remains available.

   To disable or delete a FlashCopy logical drive, in the Subsystem Management window, right-click the FlashCopy logical drive icon and select either **Disable** or **Delete**.

Instructions for Linux

Note: This procedure refers to FlashCopy. It is also applicable for Enhanced FlashCopy.

To create a new point-in-time image of the same base logical drive, complete the following steps:

1. Unmount the base logical drive.
2. In the storage management software, re-create the FlashCopy logical drive. Click **Logical Drive → FlashCopy → Re-Create** in the Subsystem Management window.
3. Remount the base logical drive to its original host.
4. Mount the FlashCopy logical drive to its intended host.

   Note: If you stopped I/O activity to the base logical drive or suspended data transfer, resume I/O activity to the base logical drive or re-enable data transfer at this time.

5. Use the FlashCopy logical drive with your backup application or with another application.
6. Unmount the FlashCopy logical drive.
7. After the FlashCopy logical drive is no longer needed, disable the FlashCopy logical drive.

   If you disable the FlashCopy logical drive instead of deleting it, you can retain the FlashCopy logical drive and its associated FlashCopy repository logical drive. Then, when you need to create a different FlashCopy of the same base logical drive, you can re-create the disabled FlashCopy logical drive. This takes less time than creating a new FlashCopy logical drive and stops any performance reduction that might occur if the FlashCopy logical drive remains available.

Creating a schedule for a FlashCopy or an Enhanced FlashCopy logical drive

Starting with controller firmware version 7.77.xx.xx, you can define a schedule to automatically re-create FlashCopy logical drives at specific intervals.

To define a schedule, you must specify the following parameters:

- Select days of the week: Select all days of the week or only specific days of the week
- Number of re-creates a day: Select a value between 1 - 24
- Time between re-creates: Select a value in increments of 0.5 hours, between 0.5 - 12 hours
- Start and end dates of the schedule: Select the start date and time, and the end date for the schedule.

A schedule can be disabled and enabled again, or modified, as needed.

Important: You must specify the start and end date for the schedule. For a schedule to be valid, the combination of the start time, the number of re-creates per day, and the time between re-creates must not result in any re-creates outside a 24-hour time-frame, starting at 00:00. Use the following formula to verify whether the schedule is valid:

((number of re-creates per day - 1) x (time between re-creates)) + (start time of the first re-create) < 24

Ensure that you specify the start time in the formula using the 24-hour clock. For example, for 1:00 PM use 13:00, for 6:00 PM use 18:00.

Consider these examples:

Table 6. Examples of Scheduling Scenarios.

Scheduling parameters	Result of schedule	Description
Re-create start time: 1 PM (13.00 in the 24-hour format) Number of re-creates: 2 Time between re-creates: 12 hours	This schedule is incorrect and must be revised.	((2-1) * 12) + 13 = 12 + 13 = 25, which is a value greater than 24.
Re-create start time: 9.30 AM Number of re-creates: 2 Time between re-creates: 8 hours	This schedule is correct.	((2-1) * 8) + 9.30 = 8 + 9.30 = 17.30, which is a value less than 24. **Note:** The re-creates will be performed at 9:30 AM and 5:30 PM.
Re-create start time: 8.00 AM Number of re-creates: 16 Time between re-creates: 0.5 hours	This schedule is correct.	((16-1) * 0.5) + 8.00 = 7.5 + 8.00 = 15.50, which is a value less than 24. **Note:** The re-creates will be performed starting at 8:00 AM with 0.5 hour intervals between re-creates.
Re-create start time: 8.00 AM Number of re-creates: 5 Time between re-creates: 5 hours	This schedule is incorrect and needs to be revised.	((5-1) * 5) + 8.00 = 20 + 8.00 = 28, which is a value greater than 24.

Note: If the specified schedule is incorrect, an error displays in the DS Storage Manager. Only after entering a valid schedule can you proceed to the next step in the wizard.

Chapter 6. Overview of VolumeCopy

VolumeCopy is a premium feature that comes with the Storage Manager software and is enabled by purchasing a premium feature key. VolumeCopy is used in conjunction with FlashCopy and, therefore, it can be purchased together with FlashCopy as a single copy service option, or at a later time as an enhancement to FlashCopy.

Depending on the version of the DS Storage Manager, the SMclient instructions and screen captures in this document might be different from the menu paths in the SMclient software GUI that you are using.

The VolumeCopy feature is a firmware-based mechanism that you use to copy data from one logical drive (the *source* logical drive) to another logical drive (the *target* logical drive) in a single storage subsystem. The source logical drive and the target logical drive in a VolumeCopy operation that are located on the same storage subsystem can also be referred to as a *VolumeCopy pair*.

Important: If the logical drive that you want to copy is used in a production environment, the FlashCopy feature must be enabled. A FlashCopy of the logical drive must be created, and then specified as the VolumeCopy source logical drive, instead of using the actual logical drive itself. This requirement allows the original logical drive to continue to be accessible during the VolumeCopy operation.

With VolumeCopy, you can also copy data from arrays that use smaller capacity drives to arrays that use larger capacity drives, back up data, or restore FlashCopy logical drive data to the base logical drive. The VolumeCopy feature includes a Create Copy wizard that you use to create a VolumeCopy operation, and a Copy Manager that you use to monitor logical drive copies after they have been created.

The VolumeCopy feature is useful for the following tasks:

Copying data for greater access
As your storage requirements for a logical drive change, you can use VolumeCopy to copy data to a logical drive in an array that uses larger capacity disk drives within the same storage subsystem. You can move data to larger drives (for example, 73 GB to 146 GB), change to drives with a higher data transfer rate (for example, 1 Gbps to 2 Gbps), or change to drives that use new technologies for higher performance.

Backing up data
With VolumeCopy you can create a backup of a logical drive by copying data from one logical drive to another logical drive in the same storage subsystem. You can use the target logical drive as a backup for the source logical drive, for system testing, or to back up to another device, such as a tape drive.

Restoring FlashCopy logical drive data to the FlashCopy base logical drive
If you need to restore data to the FlashCopy base logical drive from its associated FlashCopy logical drive, you can use the VolumeCopy feature to copy the data from the FlashCopy logical drive to another logical drive (the VolumeCopy target logical drive) first. Then, copy the data on the VolumeCopy target logical drive back to the FlashCopy base logical drive.

For more information about FlashCopy, see Chapter 2, “Overview of FlashCopy,” on page 15.

Using VolumeCopy with FlashCopy and Enhanced FlashCopy

VolumeCopy is used with FlashCopy or Enhanced FlashCopy. It can be purchased together with FlashCopy or Enhanced FlashCopy as a single copy service option, or at a later time as an enhancement to the FlashCopy or Enhanced FlashCopy premium feature.

Before you create a VolumeCopy, you first create a FlashCopy of the logical drive that you want to copy by using either the FlashCopy or the Enhanced FlashCopy functions. During the VolumeCopy operation, use the FlashCopy logical drive as the source logical drive of the VolumeCopy pair.

Note: A VolumeCopy operation will fail all FlashCopy or Enhanced FlashCopy logical drives that are associated with the target logical drive, if any exist. You must disable all FlashCopy or Enhanced FlashCopy logical drives that are associated with the base logical drive before you can select the base logical drive as a target logical drive. Otherwise, you cannot use the base logical drive as a target logical drive.

Using VolumeCopy and thin logical drive

This logical drive is a thin logical drive and is supported with controller firmware version 7.83.xx.xx or later. A thin logical drive cannot be used as a target of the VolumeCopy. It can be used only as a source of the VolumeCopy.

For migrating to another storage subsystem, it is recommended that you use the VolumeCopy feature to make a copy of the existing thin logical drive.

Enabling the VolumeCopy feature

Before you begin, gather the following information:

- Your Feature Activation Code, which is printed on the IBM VolumeCopy premium feature web activation instructions.
- Your controller unit IBM serial number, machine type, and model number, which are printed on a black label on the front-left mounting flange of the controller.

  Note: To see the mounting flange, you must remove the front bezel.
- The 32 alphanumeric-character feature enable identifier (see “Obtaining the feature enable identifier using firmware version 6.xx.xx or earlier” on page 7).

To enable VolumeCopy, follow the instructions that are applicable to your controller firmware version. For details, see “Enabling premium features using firmware version 6.xx.xx or earlier” on page 7 or “Enabling premium features using firmware version 7.xx.xx or later” on page 10.

To obtain the storage subsystem feature enable identifier, make sure that your controller unit and storage expansion enclosures are connected, powered on, and managed using the SMclient.

For information about how to view a list of those premium features that are enabled on your storage subsystem, see “Verifying that the premium feature is enabled using firmware version 6.xx.xx or earlier” on page 8.

If the VolumeCopy feature is disabled, but VolumeCopy pairs exist, all of the options in the Copy Manager (stop copy, remove copy pairs, start copy, enable and disable read-only) will still be available. However, you will not be permitted to create any new VolumeCopies.

Create Copy wizard

The Create Copy wizard guides you through the VolumeCopy process. The Create Copy wizard helps you to select a source logical drive from a list of available logical drives, select a target logical drive from a list of available logical drives, and set the copy priority for the VolumeCopy operation. When you have completed the wizard panels, the VolumeCopy operation starts and data is read from the source logical drive and written to the target logical drive.

Creating a VolumeCopy

The process of creating a VolumeCopy (copying data from the source logical drive to the target logical drive) is managed by the controllers and is transparent to host machines and applications. This section describes how you use the storage management software to copy data with VolumeCopy, and the actions taken by the controllers during the creation of a VolumeCopy.

The Create Copy wizard guides you through the steps to create a new VolumeCopy.

Before you begin, create a FlashCopy or an Enhanced FlashCopy of the logical drive that you want to copy. During the VolumeCopy operation, use the FlashCopy or Enhanced FlashCopy logical drive as the source logical drive of the VolumeCopy pair.

For information about how to create a FlashCopy, see “Creating a FlashCopy logical drive” on page 26. For information about how to create an Enhanced FlashCopy, see “Creating an Enhanced FlashCopy logical drive” on page 54.

Note: If you are using the Enhanced FlashCopy feature, you must first create the Enhanced FlashCopy image and then the Enhanced FlashCopy logical drive of that Enhanced FlashCopy image.

For DS Storage Manager version 10.77 or earlier

To create a VolumeCopy using the Create Copy wizard, complete the following steps:

1. Stop all I/O activity to the target logical drive.

   For more information about what types of logical drives are acceptable for source and target logical drives, see “Selecting the source logical drive” on page 97 and “Selecting the target logical drive” on page 98.
2. Unmount any file systems on the target logical drive.
3. Select the source logical drive (the FlashCopy that you just created) in the Logical view of the Subsystem Management window.
4. Click **Logical Drive → VolumeCopy → Create**.

   The Create Copy Wizard - Introduction panel displays.

   Select the source logical drive from the list of valid source logical drives on the storage subsystem.

Note: If the FlashCopy logical drive that you selected to start the wizard is a valid source logical drive, it is highlighted in the table.

5. Click **Next**. The Select Target Logical Drive and Copy Priority panel opens.
6. Select the target logical drive for the VolumeCopy operation and set the copy priority.

   The copy priority determines how much of the resources of the controller are used to complete the VolumeCopy operation versus to fulfill I/O activity. For more information about selecting a target logical drive, see "Selecting the target logical drive" on page 98. For more information about the copy priority, see "Setting the copy priority" on page 101.

   Click **Next**. The Preview panel opens.
7. Review the source logical drive, the target logical drive and copy priority that you specified in the previous steps. If all the information is correct, type `yes` and click **Finish** to start the VolumeCopy operation.

   Note: For more information about the Preview panel, see "The Preview panel of the Create Copy wizard" on page 102.

While a VolumeCopy operation has a status of `In Progress`, `Pending`, or `Failed`:

- The source logical drive is available for read I/O activity only.
- The target logical drive is not available for read or write I/O activity.

After the VolumeCopy operation completes:

- The source logical drive is available for both read and write I/O activity.
- The target logical drive is available for read I/O activity, unless the Read-Only attribute has been disabled. For more information about setting the Read-Only attribute on the target logical drive, see "Setting the target logical drive read-only attribute option" on page 114.

For DS Storage Manager version 10.83 or later

To create a VolumeCopy using the Create Copy wizard, complete the following steps:

1. Stop all I/O activity to the target logical drive.

   For more information about what types of logical drives are acceptable for source and target logical drives, see "Selecting the source logical drive" on page 97 and "Selecting the target logical drive" on page 98.
2. Unmount any file systems on the target logical drive.
3. Select the source logical drive (the FlashCopy that you just created) in the Logical view of the Subsystem Management window.
4. Click **Logical Drive → VolumeCopy → Create**.

   The Select Copy Type (Create Copy) screen displays.

   Note: The logical drive that you select before you clicking the **Create** menu option is the source of the VolumeCopy.
5. Select whether you want the source logical drive to be available for any I/O operations during the copy operation or not.
6. Click **Next**. The Select Target Logical Drive screen displays.
7. Select the target logical drive for the VolumeCopy operation and click **Next**.

8. If you select Online as the copy type in the first screen of the Wizard, then specify the settings to create the FlashCopy repository logical drive and click **Next**. The Confirmation screen displays.
9. Review the source and target logical drive details and specify the copy priority. If all the information is correct, type yes and click **Finish** to start the VolumeCopy operation.

   When the copy operation begins, an information message is displayed.

When you have completed the wizard tasks, the VolumeCopy operation starts and the preferred controller of the source logical drive reads data from the source logical drive and writes it to the target logical drive. **Operation in Progress** icons display on the source logical drive and target logical drive while the VolumeCopy operation completes.

Important: A maximum of eight VolumeCopy copies can be In Progress at one time. If you create more than eight VolumeCopy copies, they will have a status of Pending until one of the VolumeCopies with a status of In Progress completes.

While a VolumeCopy operation is In Progress, the same controller must own both the source logical drive and target logical drive. If the same controller does not own both the source logical drive and target logical drive before you begin the VolumeCopy operation, ownership of the target logical drive is automatically transferred to the controller owner of the source logical drive.

When the VolumeCopy operation completes or is stopped, ownership of the target logical drive is restored to its preferred controller. If ownership of the source logical drive changes during the VolumeCopy operation, ownership of the target logical drive also changes.

Selecting the source logical drive

Important: This section is applicable only if your controller firmware version is 7.77.xx.xx or earlier.

The first panel of the Create Copy wizard is the Introduction panel. The Introduction panel defines what a VolumeCopy is and allows you to select a source logical drive. The table that displays on the Introduction panel contains all the valid source logical drives on the storage subsystem, including the logical drive that you selected to start the wizard.

Note: Before you start the VolumeCopy operation, use the FlashCopy feature to create a FlashCopy of the logical drive that you want to copy, and use it as the source logical drive of the VolumeCopy pair.

The source logical drive is a FlashCopy logical drive that accepts host I/O requests and stores application data. When the VolumeCopy operation is started, all data from the source logical drive is copied to the target logical drive.

The source logical drive is available for read I/O activity only while a VolumeCopy operation has a status of In Progress, Pending, or Failed. Write requests are allowed after the VolumeCopy operation is completed.

All valid source logical drives on the storage subsystem are displayed in the list in the Introduction panel. The logical drive that you selected to start the wizard is highlighted.

Note: In addition to the FlashCopy logical drives that are listed in the Introduction panel, standard logical drives and Remote Mirror primary logical drives are also displayed. However, do not use standard or Remote Mirror primary logical drives as source logical drives for a VolumeCopy.

The following logical drives are not valid source logical drives and do not display on the list:

- A Remote Mirror secondary logical drive
- A Remote Mirror repository logical drive
- A FlashCopy repository logical drive or Enhanced FlashCopy repository logical drive
- A failed logical drive
- A missing logical drive
- A logical drive that is currently in a modification operation
- A logical drive that is holding a legacy or persistent reservation
- A logical drive that is a source logical drive or target logical drive in another VolumeCopy operation with a status of `In Progress`, `Failed`, or `Pending`
- An Enhanced FlashCopy logical drive

From the Introduction panel, you can open the View Drives window to view drive, slot, and capacity of the selected source logical drive. You can use this information to copy high-access logical drives to different arrays for increased accessibility, or to copy logical drives to an array that uses larger capacity drives.

Note: After the VolumeCopy operation completes for a VolumeCopy pair, you do not need to complete any additional processing or synchronization between the source and the target logical drives. If you recopy, it causes the VolumeCopy to start copying from the beginning of the source logical drive. Therefore, a source logical drive can be in as many VolumeCopy pairs as there are eligible target logical drives in the storage subsystem.

Selecting the target logical drive

Important: The instructions and screen captures provided in this section vary depending on the version of your controller firmware.

In the Create Copy wizard: Select Target Logical Drive and Copy Priority panel, you can select the target logical drive for the VolumeCopy and set the copy priority. For more information about setting the copy priority, see “Setting the copy priority” on page 101.

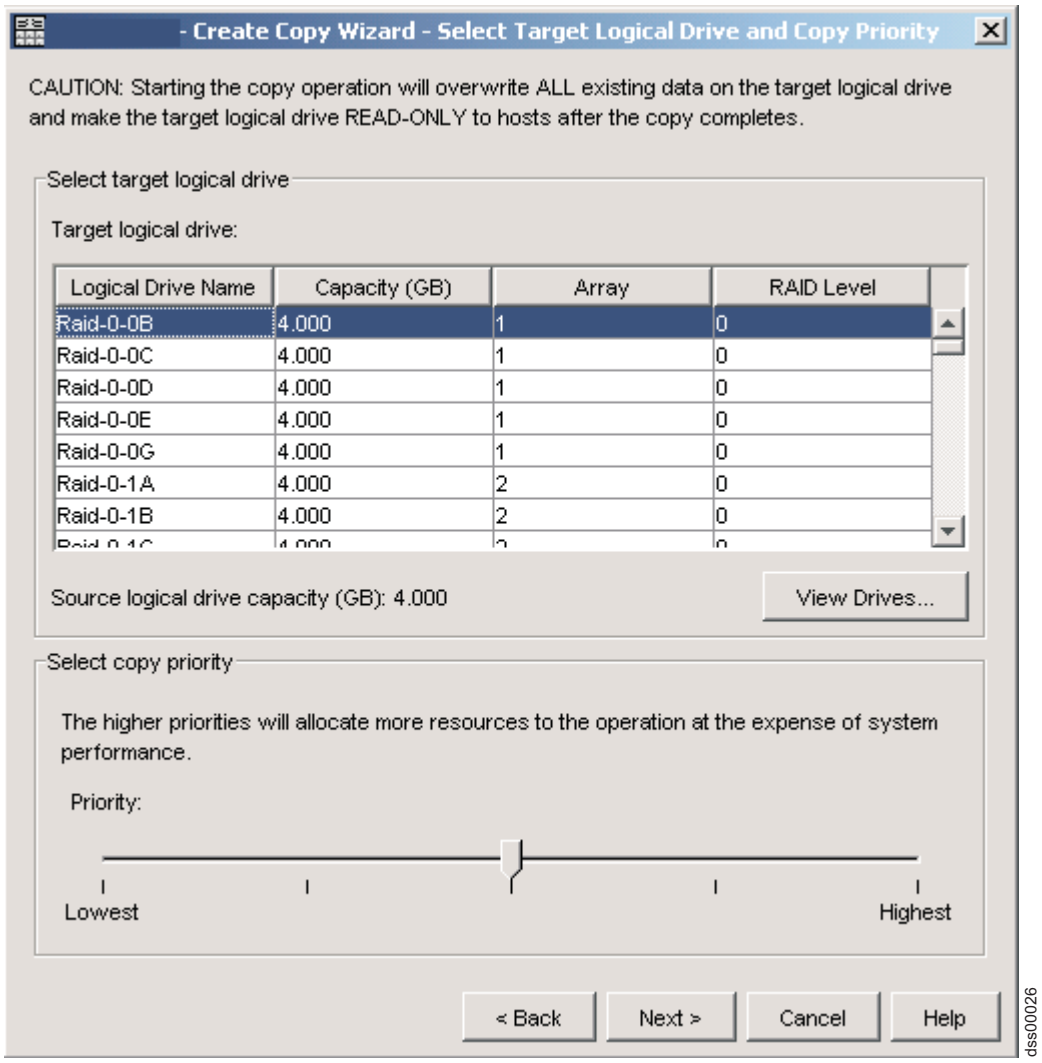


Figure 30. Select Target Logical Drive and Copy Priority panel of the Create Copy wizard

A target logical drive is a standard logical drive in a VolumeCopy logical drive pair that contains a copy of the data from the source logical drive. Read and write requests to the target logical drive do not take place while the VolumeCopy operation has a status of `In Progress`, `Pending`, or `Failed`.

Note: The target logical drive capacity must be equal to or greater than the usable capacity of the *original* source logical drive (not the FlashCopy of the original logical drive).

Important: A VolumeCopy overwrites data on the target logical drive and automatically makes the target logical drive read-only to hosts.

When a VolumeCopy operation is started, the data from the source logical drive is written to the target logical drive. However, if the VolumeCopy operation is stopped, and then restarted by using the Re-Copy option, the data on the source logical drive might not be the same as the data on the target logical drive. If hosts are mapped to the source logical drive before the VolumeCopy operation was restarted, the data that is copied to the target logical drive when you recopy might change since the previous VolumeCopy was created. So the VolumeCopy operation

always copies the image of the source logical drive at the time the copy operation starts, not a second earlier or a second later.

Important: A VolumeCopy operation overwrites data on the target logical drive and automatically make the target logical drive read-only to hosts. After the VolumeCopy operation completes, use the Copy Manager to disable the read-only attribute for the target logical drive. If you used the target logical drive in a VolumeCopy operation before, ensure that you no longer need that data or create its backup. For more information about the read-only attribute, see "Setting the target logical drive read-only attribute option" on page 114.

All valid target logical drives on the storage subsystem are displayed in the list in the Select Target Logical Drive window.

The following drives can be used as a target logical drive:

- A standard logical drive
- A Remote Mirror primary logical drive
- A base logical drive of a disabled or failed FlashCopy logical drive. A base logical drive that has no Enhanced FlashCopy group or images defined can be used as a VolumeCopy target logical drive.

  Note: You must disable all FlashCopy logical drives that are associated with the base logical drive before you can select it as a target logical drive. Otherwise, the base logical drive cannot be used as a target logical drive.

The following logical drives are not valid target logical drives and do not display on the list:

- A Remote Mirror secondary logical drive
- A Remote Mirror repository logical drive
- A FlashCopy or an Enhanced FlashCopy logical drive
- A FlashCopy or an Enhanced FlashCopy repository logical drive
- A base logical drive of an optimal FlashCopy logical drive
- A base logical drive with Enhanced FlashCopy features defined
- A failed logical drive
- A missing logical drive
- A logical drive with a status of `Degraded`
- A logical drive that is currently in a modification operation
- A logical drive that is holding a legacy or persistent reservation
- A logical drive that is a source logical drive or target logical drive in another VolumeCopy operation that has a status of `In Progress`, `Failed`, or `Pending`
- A logical drive that is already defined as a target logical drive for another VolumeCopy pair
- A thin logical drive from a disk pool
- An Enhanced FlashCopy logical drive

A thin logical drive can be used as a source logical drive in a VolumeCopy logical drive pair. It cannot be used as a target of a VolumeCopy logical drive pair.

You can also create a target logical drive specifically for the VolumeCopy operation. For more information, see "Creating a Storage Subsystem Logical Drive" in the Subsystem Management online help.

Note: After you select or create a target logical drive, give it a unique name so that it is easily recognizable in the Logical view. For example, if the source logical drive name is `Accounting`, name the target logical drive `Accounting-Copy`. That way you can quickly identify the source logical drives and target logical drives that are available on the storage subsystem.

From the Select Target Logical Drive and Copy Priority panel, you can open the View Drives window to view drive, slot, and capacity of the target logical drive. You can use this information to copy high-access logical drives to different arrays for increased accessibility, or to copy logical drives to an array that uses larger capacity drives.

For more information about source logical drives and target logical drives, see "Restrictions" on page 109.

Setting the copy priority

In the Select Target Logical Drive and Copy Priority panel you can set the copy priority for the VolumeCopy operation as shown in Figure 30 on page 99.

Several factors contribute to system performance including the following factors:

- I/O activity

  VolumeCopy diverts controller processing resources from I/O activity. The copy priority defines how much of the system resources are used to complete a VolumeCopy operation versus fulfill I/O requests.
- The logical drive RAID level
- The logical drive configuration

  The number of drives in the array or cache parameters
- The logical drive type

  FlashCopy logical drives might take more time to copy than standard logical drives.
- The source logical drive capacity

  All the data in the source logical drive copies to the target logical drive.
- The number of other VolumeCopy operations being performed at the same time
- The hard drive family type
- The number of hard drives that make up the logical drive

You can set the priority of each active VolumeCopy operation in the Create Copy wizard with respect to other tasks in the storage subsystem. You can use the Copy Manager to change the copy priority after it is set and you can change the priority of the VolumeCopy operation while it is actively copying.

The following copy priority rates are available:

- Lowest
- Low
- Medium
- High
- Highest

The Highest priority rate supports the VolumeCopy operation, but I/O activity might be affected. The Lowest priority rate supports I/O activity, but the VolumeCopy operation will take longer.

For more information, see “Changing Copy Priority” on the **How To** tab in the Subsystem Management window online help.

The Preview panel of the Create Copy wizard

The Preview panel provides an overview of the selected source logical drive, target logical drive, and copy priority for the VolumeCopy operation as shown in Figure 31.

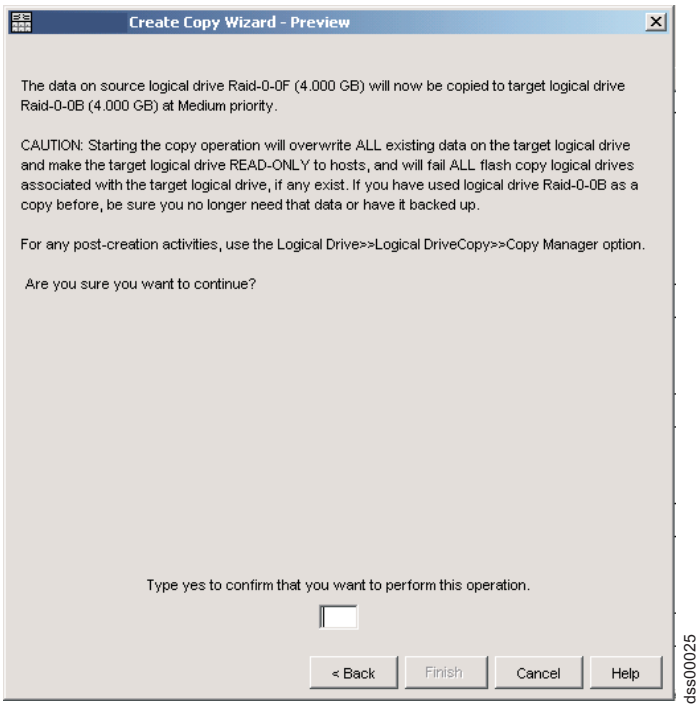


Figure 31. The Preview panel of the Create Copy wizard

You can also return to previous panels to edit the parameters you have chosen.

When you type `Yes` in the text box and click **Finish**, the Copy Started window opens to verify that the VolumeCopy operation has begun.

Note: You can also click **Back** to change your choices.

You can create a new VolumeCopy operation or exit the wizard. To close the Copy Started window, you must select one of the following options:

- Yes - Create a new VolumeCopy
- No - Exit the wizard

Icons that show the progress of the operation display on the source logical drive and target logical drive while the VolumeCopy operation has a status of `In Progress` or `Pending`. For more information about copy status, see “Copy status” on page 110.

The progress of the VolumeCopy operation displays in the status bar at the bottom-right of the Copy Manager. The status bar shows the estimated time remaining for the VolumeCopy operation to complete. You can view the progress of a VolumeCopy operation in the Copy Manager only when a VolumeCopy

operation has a status of `In Progress`. For more information about the Copy Manager and how to access it, see Chapter 7, "Managing VolumeCopy," on page 109.

Viewing drives

The View Drives panel displays the drive enclosure, slot, and capacity information for the selected source logical drive or target logical drive. The View Drives panel is available in the Create Copy Wizard - Introduction and Create Copy Wizard - Select Target Logical Drive panels.

Content for this panel will automatically update dynamically if you select a different source logical drive or target logical drive in the Copy Wizard panel while the View Drives panel is open.

The information presented in the View Drives panel can be used to copy high-access logical drives to different logical arrays for increased accessibility, or to copy logical drives to a logical array that uses drives with a greater capacity.

Accessing the VolumeCopy target logical drive on the host

To access the target logical drive after you have created the VolumeCopy, you must complete some steps on the host, as described in the following sections:

- "Accessing the VolumeCopy target logical drive on an AIX host"
- "Accessing the VolumeCopy target logical drive on an HP-UX or Solaris host" on page 105
- "Accessing the VolumeCopy target logical drive on a Windows NT host" on page 105
- "Accessing the VolumeCopy target logical drive on a Novell NetWare host" on page 106

Accessing the VolumeCopy target logical drive on an IBM i host

Instructions for using IBM i are provided in the *IBM i and IBM System Storage: A Guide to Implementing External Disks* Redbook. To download a copy of this Redbook, go to http://www.redbooks.ibm.com/abstracts/sg247120.html?Open.

Accessing the VolumeCopy target logical drive on an AIX host

To access the target logical drive after you have created the VolumeCopy, you must first change the target permissions, then mount the target logical drive to a directory.

Complete the following steps to change the target permissions to `Disable read-only`:

1. In the Logical view of the SMclient Subsystem Management window, right-click the icon for target logical drive and click **Copy Manager**. The Copy Manager Window opens.
2. From the top menu, select **Change → Target Volume Permissions → Disable read-only**.

Complete the following steps to configure the AIX host for the new VolumeCopy logical drive:

1. Log in to the host as `root`.

2. Make sure that the host operating system recognizes the VolumeCopy logical drive. At the host prompt, type the following command, and then press Enter.

```
cfgmgr
```

   Several minutes might pass while the operating system accesses the drive. When the operation completes, the host prompt displays again.The new logical drive is now available from the operating system.

3. At the host prompt, type the following command, and then press Enter.

```
lspv
```

   A list of the physical drives that are recognized by the operating system displays.

4. Look for the operating system device name of your VolumeCopy logical drive in the list. The list shows a physical logical drive ID (PVID) for the VolumeCopy logical drive. This is the same as the PVID for the associated base logical drive, because the VolumeCopy logical drive contains the same array data structures as the base logical drive.

5. Clear the PVID for the VolumeCopy logical drives. At the host prompt, type the following command, and then press Enter.

```
chdev -l os_device_name -a pv=clear
```

   where *os_device_name* is the operating system device name of the VolumeCopy logical drive.

   Repeat this step for each VolumeCopy logical drive in the AIX array.

   Attention: Before specifying *clear* with the chdev command, verify that you are specifying the correct device name. If you specify a different device name, all of the data on that device becomes inaccessible. To verify the correct device name, use the **fget** config command.

6. Re-create a new array using the **re-createvg** command. This command reads the array data structure inside a logical drive and reconstructs it. It also allocates new physical logical drive identifiers (PIDs) to the VolumeCopy logical drive and enables access to the VolumeCopy logical drive for the selected host.

   At the host prompt, type the following command, and then press Enter:

```
re-createvg -y logical drivegroupname -L /directoryname
os_device_name
```

   where:

   - *logical drivegroupname* is the name that you want to assign to the VolumeCopy array.
   - *directoryname* is the name of the directory where you want to mount the VolumeCopy logical drive.
   - *os_device_name* is the operating system device name of the VolumeCopy logical drive. If your AIX array contains more than one VolumeCopy logical drive, add an *os_device_name* for each logical drive.

   The array is re-created, and contains the VolumeCopy logical drive or drives.

7. Mount the VolumeCopy logical drive to its intended host. At the host prompt, type the following command, and then press Enter.

```
mount mount-point
```

   where *mount-point* is the name of the file system that is being mounted. Include

the *directoryname* that was used in step 6 on page 104.

8. Make sure that the logical drives are back online. At the host prompt, type the following command, and then press Enter.

```
df -k
```

A list of the mounted disks displays.

Accessing the VolumeCopy target logical drive on an HP-UX or Solaris host

To access the target logical drive after you have created the VolumeCopy, you must first change the target permissions, then mount the target logical drive to a directory.

Complete the following steps to change the target permissions to `Disable read-only`:

1. In the Logical view of the SMclient Subsystem Management window, right-click the icon for target logical drive and click **Copy Manager**. The Copy Manager Window opens.
2. From the top menu, select **Change → Target Volume Permissions →Disable read-only**.

Next, complete the following steps on your HP-UX or Solaris host to access the VolumeCopy target logical drive:

Create a directory for the mount point (the target logical drive) in the root directory. At the command prompt, type the following command:

```
#mkdir /target_directory
```

where *target_directory* is the name of the directory that you want to create. Mount the target logical drive to the new directory, using the following command:

```
#mount /target_logical_drive/target_directory /target_directory
```

where *target_logical_drive* is the target logical drive for the VolumeCopy, and *target_directory* is the name of the directory that you created in step 105.

Accessing the VolumeCopy target logical drive on a Windows NT host

To access the target logical drive after you have created the VolumeCopy, you must first change the target permissions, and then mount the target logical drive to a drive letter or mount point.

Complete the following steps to change the target permissions to `Disable read-only`:

1. In the Logical view of the SMclient Subsystem Management window, right-click the icon for target logical drive and click **Copy Manager**. The Copy Manager Window opens.
2. From the top menu, select **Change → Target Volume Permissions → Disable read-only**.

Complete the following steps to configure your host for the new VolumeCopy target logical drive:

1. Run the hot_add utility to let the system recognize the newly added VolumeCopy target logical drive.

   Note: If the system does not recognize the VolumeCopy target logical drive after you run the hot_add utility, restart the server.
2. Resolve duplicate logical drive signatures by navigating to the following directory: *C:\Program Files\IBM_DS4000\util* and typing the following command in the Windows command line window:

```
SMrepassist -r
```

3. In the NT4 Disk Administrator window, assign a drive letter to the new VolumeCopy target logical drive.
4. When you no longer need the VolumeCopy target logical drive, open the NT4 Disk Management window and remove the drive letter *before* you delete the VolumeCopy target logical drive.

Accessing the VolumeCopy target logical drive on a Novell NetWare host

You cannot map the VolumeCopy target logical drive to the same Novell NetWare servers that the VolumeCopy source logical drive is mapped to. You must use another server, or unmap the VolumeCopy source logical drive from the server.

To access the target logical drive after you have created the VolumeCopy, you must first change the target permissions, and then mount the target logical drive to a drive letter or mount point.

Complete the following steps to change the target permissions to `Disable read-only`:

1. In the Logical view of the SMclient Subsystem Management window, right-click the icon for target logical drive and click **Copy Manager**. The Copy Manager Window opens.
2. From the top menu, select **Change → Target Volume Permissions → Disable read-only**.

Complete the following steps to configure your host for the new VolumeCopy target logical drive:

1. Run the hot_add utility to let the system recognize the newly added VolumeCopy target logical drive.

   Note: If the system does not recognize the VolumeCopy target logical drive after you run the hot_add utility, restart the server.
2. Type the logical drive in the command window, or use the **Disk Management** menu in the ConsoleOne window to verify that the drive is added.

SMrepassist utility for Windows

SMrepassist (replication assistance) is a host-based utility for Windows. It must be used before you create a VolumeCopy on Windows.

Running the SMrepassist utility makes sure that all the memory-resident data for file systems on the target logical drive are flushed. If you are creating a VolumeCopy on Windows NT, you also use this utility after you map the VolumeCopy target logical drive to the same Windows NT server that the

VolumeCopy source logical drive is mapped to. This resolves the duplicate disk signatures and system partition table information.

Important: You cannot map the VolumeCopy target logical drive to the same Windows 2000, Windows Server 2003, or Windows Server 2008 servers that the VolumeCopy source logical drive is mapped to. You must use another server, or unmap the VolumeCopy source logical drive from the server.

The command to run this utility is:

```
SMrepassist -f [filesystem-identifier] | -r [filesystem-identifier]- list
```

where:

- `-f` flushes all the memory-resident data for the file system indicated by `[filesystem-identifier]`
- `[filesystem-identifier]` specifies a unique file system in the following syntax:

  `drive-letter: [mount-point-path]`

  The file system might include only a drive letter, or a drive letter plus a mount point
- `-r` (Windows NT operating system only) resolves any duplicate signatures and partition table information. You must write a unique boot block signature to each logical drive that has a duplicate signature. Make sure that the driver rereads the partition table for the logical drive to avoid a restart of the operating system.

  The `-r` option by itself causes the utility to find and resolve all FlashCopy logical drive and VolumeCopies on the storage array having duplicate signatures. The utility will only modify the signature on a FlashCopy logical drive or a VolumeCopy, not the base logical drive or standard logical drive, even where there are more than two logical drives that share a common signature.

An error message is provided in the command line and the logical drives are listed as a logical drive set when the utility cannot distinguish between the following logical drives:

- Base logical drive and FlashCopy logical drive (for example, if the FlashCopy logical drive has been removed)
- Standard logical drive and VolumeCopy (for example, if the VolumeCopy has been removed)

Locating associated logical drives

The Go To option can be used to quickly jump to an associated source logical drive or target logical drive displayed in the Logical view of the Subsystem Management Window.

Important: The Go To option is available only if the VolumeCopy feature has been enabled, or if VolumeCopy copies currently exist on the storage array. It is not accessible using the Mappings view of the Subsystem Management Window.

To locate an associated source logical drive or target logical drive, complete the following steps:

1. Select a source logical drive or target logical drive in the Logical view of the Subsystem Management window.

2. Complete one of the following actions, based on the logical drive type that you have selected:

   Source logical drive
   Click **View → Go To → Source Logical Drive**.

   The selection jumps to the associated source logical drive in the Logical view of the Subsystem Management window.

   Target logical drive
   Click **View →Go To →Target Logical Drive**.

   The selection jumps to the associated target logical drive in the Logical view of the Subsystem Management window.

Chapter 7. Managing VolumeCopy

After you create a VolumeCopy with the Create Copy wizard, you can monitor the VolumeCopy operation through the Copy Manager. You can complete the following tasks from the Copy Manager:

- Recopy, stop, or remove a VolumeCopy
- Modify the attributes of a logical drive, including the copy priority and the target logical drive read-only attribute
- View the status of a VolumeCopy operation
- Determine what logical drives are involved in a VolumeCopy operation. You can also use the Storage Subsystem Profile to determine what logical drives are involved in a VolumeCopy operation.

Copy Manager displays information for all of the logical drive copies on the storage subsystem. This information includes the following items:

- The source logical drive
- The target logical drive
- The status of the VolumeCopy operation
- A timestamp for any completed copies
- The VolumeCopy priority assigned to the VolumeCopy

If a target logical drive is read-only to hosts, a **lock** icon displays in the Target Logical Drive column.

Complete the following steps to access and use the Copy Manager:

1. Click **Select Logical Drive → Copy → Copy Manager**.

   The Copy Manager window opens.
2. Click the VolumeCopy pair or press Enter to select the VolumeCopy pair in the table.
3. Select an option from the menu.

Restrictions

The following restrictions apply to the source logical drive, target logical drive, and the storage subsystem:

- The source logical drive is available for read I/O activity only while a VolumeCopy operation has a status of `In Progress` or `Pending`. Write requests are allowed after the VolumeCopy operation is completed.

  Before you start the VolumeCopy operation, create a FlashCopy of the logical drive that you want to copy, and then use the FlashCopy as the source logical drive of the VolumeCopy pair.
- A logical drive can be used as a target logical drive in only *one* VolumeCopy operation at a time.
- The maximum number of VolumeCopies that are allowed per storage subsystem depends on the number of target logical drives that are available on your storage subsystem.
- A storage subsystem can have up to eight logical drive copies running at any given time.

- The target logical drive capacity must be equal to or greater than the source logical drive capacity.
- The target logical drive capacity must be equal to or greater than the usable capacity of the original source logical drive.
- A target logical drive can be a standard logical drive, a base logical drive of a disabled or failed FlashCopy logical drive, or a Remote Mirror primary logical drive.

  Note: You must disable all FlashCopy logical drives that are associated with the base logical drive before you can select it as a target logical drive. Otherwise, the base logical drive cannot be used as a target logical drive.

Logical drives that have the following statuses cannot be used as a source logical drive or target logical drive:

- A logical drive that is reserved by the host
- A logical drive that is in a modification operation
- A logical drive with a status of `Failed` or `Degraded`
- A thin logical drive can be used as a source logical drive in a VolumeCopy logical drive pair. It cannot be used as a target of a VolumeCopy logical drive pair.

Note: A logical drive can be defined as the source logical drive of multiple VolumeCopy logical drive pairs even when the status of the VolumeCopy logical drive pair is `In Progress` or `Failed`. After a logical drive is defined as a target logical drive in a VolumeCopy logical drive pair, it is not available to participate in any other VolumeCopy logical drive pairs as a target logical drive regardless of the VolumeCopy logical drive pair status. After a VolumeCopy operation is completed, the logical drive, which is defined as a target logical drive in a VolumeCopy logical drive pair, is available to participate in any other VolumeCopy logical drive pairs as the source logical drive role only.

Copy status

The progress of the VolumeCopy operation displays in the status bar at the bottom-right of the Copy Manager. The status bar shows the estimated time remaining for the VolumeCopy operation to complete. You can view the progress of a VolumeCopy operation in the Copy Manager only when a VolumeCopy operation has a status of `In Progress`.

There are three possible copy statuses:

Copy Pending

The `Copy Pending` status displays in the Copy Manager when a VolumeCopy operation has been created, but system resources do not allow it to start. For example, if there are already eight logical drive copies with a status of `In Progress`, any subsequent VolumeCopy that you create will have a status of `Pending` until one of the other eight logical drive copies has completed. In addition, a modification operation on another logical drive in the array might need to complete before the VolumeCopy operation can begin.

While in the `Copy Pending` status, the host has read-only access to the source logical drive, and read and write requests to the target logical drive do not take place until the VolumeCopy operation has completed.

Copy In Progress

The Copy In Progress status displays in the Copy Manager while data on the source logical drive is being read, and then written to the target logical drive. While in the Copy In Progress status, the host has read-only access to the source logical drive, and read and write requests to the target logical drive do not take place until the VolumeCopy operation has completed.

Copy Failed

The Copy Failed status displays in the Copy Manager when an error occurs while the VolumeCopy is being created. A status of Copy Failed can occur because of a read error from the source logical drive, a write error to the target logical drive, or a failure on the storage subsystem that affects the source logical drive or target logical drive (such as a Remote Mirror role reversal). A critical event is logged in the Major Event Log (MEL) and a **Needs-Attention** icon displays.

While a VolumeCopy operation has the Copy Failed status, the host has read-only access to the source logical drive, and read and write requests to the target logical drive will not take place until the failure is fixed.

When a VolumeCopy operation fails, you must use the Stop Copy option in the Copy Manager to stop the operation and use the Recovery Guru to fix the problem.

You can use the Re-Copy option to restart the VolumeCopy operation from the beginning.

Note:

1. If there are eight logical drive copies with a status of In Progress, any subsequent VolumeCopy operation will have a status of Pending until one of the eight logical drive copies completes.
2. If a modification operation is running on a source logical drive or target logical drive, and the VolumeCopy operation has a status of In Progress, Pending, or Failed, then the VolumeCopy operation will not take place.
3. If a modification operation is running on a source logical drive or target logical drive after a VolumeCopy has been created, then the modification operation must complete before the VolumeCopy operation can start. If a VolumeCopy operation has a status of In Progress, then any modification operation will not take place.

Viewing VolumeCopy properties

Important: This section is applicable for storage subsystems with controller firmware versions earlier than 7.xx.xx.xx. For storage subsystems with controller firmware version 7.xx.xx.xx and later: Click the source or target logical drive in the tree view of the **Logical** or the **Storage & Copy Service** tabs and view the information about the VolumeCopy operation in the **Properties** pane.

Use the Logical Drive Properties window, shown in Figure 32 on page 112, to view the following information about a selected source logical drive or target logical drive:

- The role of the logical drive: either source or target
- The copy status: Pending, In Progress, Completed, Stopped, Failed
- The copy priority: Lowest, Low, Medium, High, Highest
- The start timestamp: in the format MM/DD/YY HH/MM/SS

- Completion timestamp: in the format MM/DD/YY HH/MM/SS
- The read-only attribute: `Enabled` or `Disabled` (only if a target logical drive is selected)
- Source or target logical drive ID: WWN
- Source or target logical drive name
- The online or offline status for subsystems that support online and offline VolumeCopy operations

Note: You can only view the progress of a VolumeCopy operation with a status of `In Progress`.

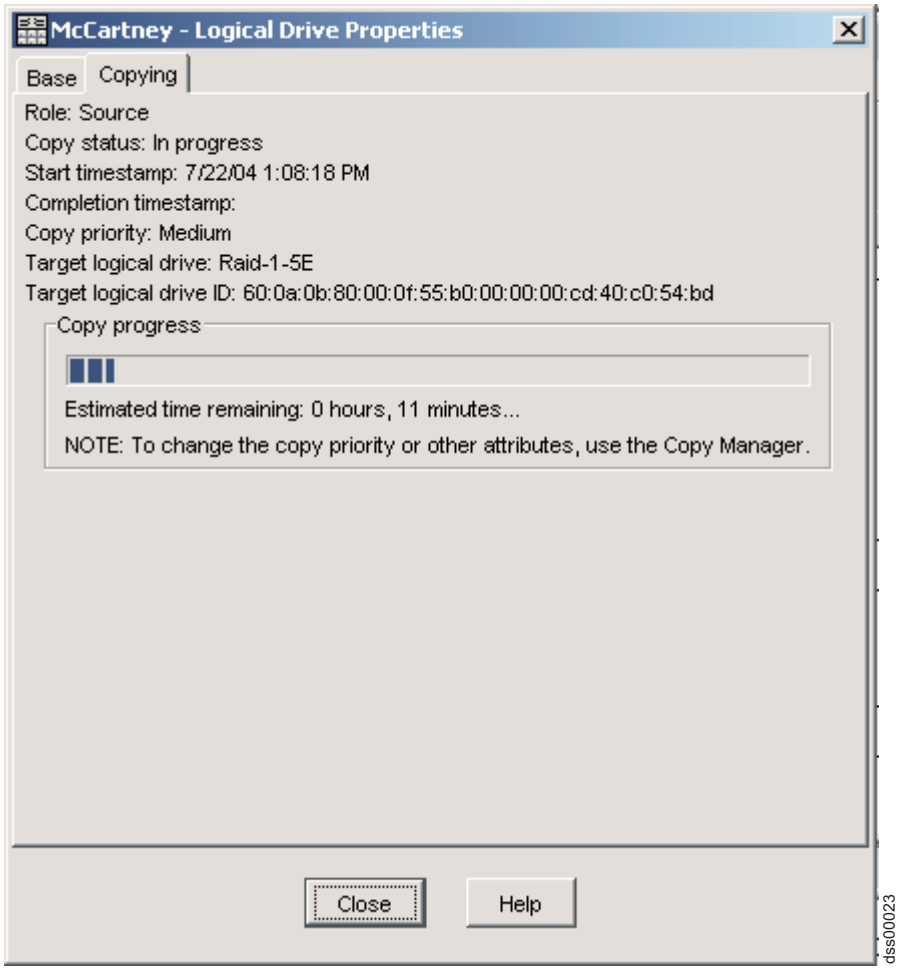


Figure 32. The Logical Drive Properties window

Complete the following steps to view the VolumeCopy properties:

1. Select the source logical drive or target logical drive in the Logical view.
2. Click **Logical Drive → Properties**.
   The Logical Drive Properties window opens.
3. Click the **Copying** tab.
   The **Copy Properties** tab displays.
   If a source logical drive has multiple target logical drives, then the details will be repeated for each target logical drive.
4. Click **Close** to close the window.

Changing copy priorities

You can change the copy priority to balance I/O activity with VolumeCopy operation activity on a storage subsystem. You can set the copy priority to a rate that will have the least impact on I/O activity. There are five copy priority rates available: lowest, low, medium, high, and highest. If the copy priority is set at the lowest rate, I/O activity is prioritized and the VolumeCopy operation will take longer. If the copy priority is set to the highest priority rate, the VolumeCopy operation is prioritized, but I/O activity for the storage subsystem might be affected.

You can change the copy priority for a VolumeCopy pair before the VolumeCopy operation begins, while the VolumeCopy operation has a status of `In Progress`, or after the VolumeCopy operation has completed (for a recopy). Complete the following steps to change the copy priority:

1. For DS Storage Manager version 10.77 or earlier, click **Select Logical Drive → Copy → Copy Manager**. The Copy Manager window opens as shown in Figure 33.

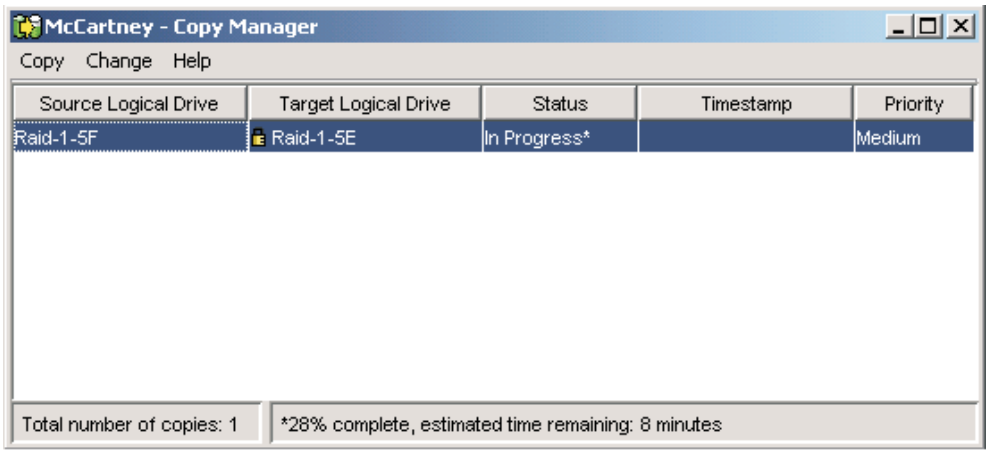


Figure 33. Copy Manager window

For DS Storage Manager version 10.83 or later, click **Copy services** > **VolumeCopy** > **Manage Copies**. The Copy Manager window opens.

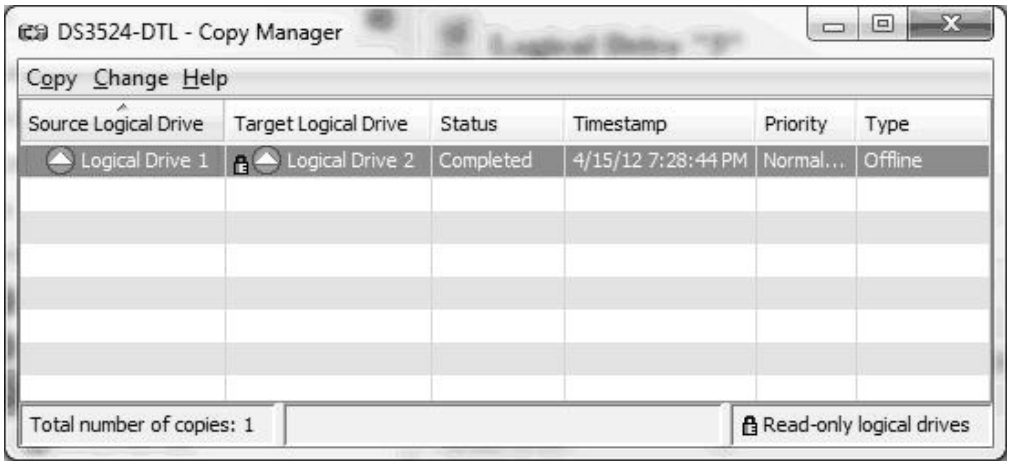


Figure 34. Copy Manager window

2. Select one or more VolumeCopy pairs in the table. You can select more than one VolumeCopy pair by pressing Ctrl and the left mouse button.
3. Click **Change → Copy Priority**.

   The Change Copy Priority window opens.
4. In the **Copy Priority** field, use the slider bar to select the appropriate copy priority, depending on your system performance needs.

   For more information about the copy priority, see "Setting the copy priority" on page 101.
5. Click **OK**.

   The Change Copy Priority - Progress window opens.
6. Click **OK**.

   The copy priority for the selected VolumeCopy pair is changed.

Setting the target logical drive read-only attribute option

The target logical drive read-only attribute determines how read and write requests to the target logical drive are handled after a VolumeCopy operation is complete or if the VolumeCopy operation fails before it completes. After the VolumeCopy operation has completed, the target logical drive automatically becomes read-only to hosts, and write requests to the target logical drive do not take place. You might want to keep this attribute enabled in order to preserve the data on the target logical drive. The following situations are examples of when you might want to keep the read-only attribute enabled:

- If you are using the target logical drive for backup purposes
- If you are copying data from one array to a larger array for greater accessibility
- If you are using the data on the target logical drive to copy back to the base logical drive of a disabled or failed FlashCopy logical drive

If you decide not to preserve the data on the target logical drive after the VolumeCopy operation is completed, use the Copy Manager to disable the read-only attribute for the target logical drive.

Complete the following steps to enable the read-only attribute:

1. For DS Storage Manager version 10.77 or earlier, click **Select Logical Drive → Copy → Copy Manager**.

For DS Storage Manager version 10.83 or later, click **Copy services** > **VolumeCopy** > **Manage Copies**.

The Copy Manager window opens.

2. Select one or more VolumeCopy pairs in the table. You can select more than one copy pair by pressing Ctrl and the left mouse button.
3. Click **Change → Target Logical Drive Permissions → Enable Read-Only**.

   The read-only attribute is enabled on the target logical drive. Write requests to the target logical drive are rejected.

Complete the following steps to disable the read-only attribute:

1. Click **Select Logical Drive → Copy → Copy Manager**.

   The Copy Manager window opens.
2. Select one or more VolumeCopy pairs in the table. You can select more than one VolumeCopy pair by pressing Ctrl and the left mouse button.
3. Click **Change → Target Logical Drive Permissions → Disable Read-Only**.

   The read-only attribute is disabled on the target logical drive. Write requests to the target logical drive are permitted.

When the read-only attribute for a target logical drive is enabled, a **lock** icon displays in the Target Logical Drive column of the Copy Manager. The read-only attribute can be changed in the Copy Manager only after the VolumeCopy operation completes.

Recopying the source logical drive in a VolumeCopy pair

When you recopy the source logical drive in a VolumeCopy Pair, you create a new copy of the source logical drive data on an associated target logical drive. You can use Re-Copy to create a new copy from the beginning if the original VolumeCopy operation fails, was stopped, or has completed. You can also use Re-Copy for backup purposes; for instance, if the data on the source logical drive changes, you can use Re-Copy to duplicate any new data to the target logical drive.

Attention: Recopying overwrites existing data on the target logical drive and makes the target logical drive read-only to hosts until you disable the read-only attribute in the Copy Manager.

Important: Note the following points before you recopy logical drives:

- If hosts have been mapped to the source logical drive, the data that is recopied to the target logical drive might have changed since the previous VolumeCopy was created.
- To use Re-Copy, select only one VolumeCopy in the Copy Manager.
- See “Selecting the source logical drive” on page 97 and “Selecting the target logical drive” on page 98 for information about what types of logical drives you can use as source and target logical drives.

Complete the following steps to create a new VolumeCopy of the data on a selected VolumeCopy pair:

1. Stop all I/O operations to the source logical drive and target logical drive.
2. Unmount any file systems on the source logical drive and target logical drive.
3. For DS Storage Manager version 10.77 or earlier, click **Select Logical Drive → Copy → Copy Manager**.

For DS Storage Manager version 10.83 or later, click **Copy services** > **VolumeCopy** > **Manage Copies**.

The Copy Manager window opens.

4. Click the VolumeCopy pair or press Enter to select the VolumeCopy pair in the table.
5. Click **Copy → Re-Copy**.

   The Re-Copy window opens.
6. Set the copy priority.

   See "Setting the copy priority" on page 101 for more information.
7. Type `Yes` and click **OK**.

   The VolumeCopy operation begins.

   Note: You can view the progress of a VolumeCopy operation in the Copy Manager only when a VolumeCopy operation has a status of `In Progress`.

Stopping a VolumeCopy operation

You can stop a VolumeCopy operation with a status of `Pending`, `In Progress`, or `Failed`. If you decide not to use a particular logical drive as a source logical drive or target logical drive, you can stop the VolumeCopy operation before it completes. Then after you delete the VolumeCopy pair definition, the logical drives can be used in a new VolumeCopy pair.

Note: If you stop a VolumeCopy operation with a status of `Failed`, the `Needs-Attention` condition on a storage subsystem is cleared.

Important: Note the following points before you stop a VolumeCopy operation:

- If the copying process was stopped prematurely, there is no guarantee that the target logical drive will be in a usable state.
- Select only one copy pair in the Copy Manager.
- When the VolumeCopy operation is stopped, all mapped hosts will have write access to the source logical drive. If data is written to the source logical drive, the data on the target logical drive will no longer match the data on the source logical drive.

Complete the following steps to stop a VolumeCopy operation:

1. For DS Storage Manager version 10.77 or earlier, click **Select Logical Drive → Copy → Copy Manager**.

   For DS Storage Manager version 10.83 or later, click **Copy services** > **VolumeCopy** > **Manage Copies**.

   The Copy Manager window opens.
2. Click the VolumeCopy pair or press Enter to select the VolumeCopy pair in the table.
3. Click **Copy → Stop**.

   The Stop Copy window opens.
4. Click **Yes**.

   The VolumeCopy operation stops.

Removing copy pairs

You can remove one or more VolumeCopies from the Copy Manager. Any VolumeCopy copy-related information for the source and target logical drive is removed from the Logical Drive Properties and Storage Subsystem Profile windows. After you remove the VolumeCopy, you can use the source logical drive and target logical drive in a new VolumeCopy. When you remove the VolumeCopy, the read-only attribute for the target logical drive is also removed.

After the VolumeCopy is removed from the Copy Manager, you can select the target logical drive as a source logical drive or target logical drive for a new VolumeCopy.

If you remove a VolumeCopy, the source logical drive and target logical drive are no longer displayed in the Copy Manager.

Important: Note the following points before you remove VolumeCopy pairs:

- This action does not delete the data on the source logical drive or target logical drive.
- If the VolumeCopy operation has a status of `In Progress`, it must be stopped before you can remove the VolumeCopy pair from the Copy Manager.

Complete the following steps to remove VolumeCopy pairs from the Copy Manager:

1. For DS Storage Manager version 10.77 or earlier, click **Select Logical Drive → Copy → Copy Manager**.

   For DS Storage Manager version 10.83 or later, click **Copy services** > **VolumeCopy** > **Manage Copies**.

   The Copy Manager window opens.
2. Select one or more VolumeCopy pairs in the table. You can select more than one VolumeCopy pair by pressing Ctrl and using the left mouse button to select multiple VolumeCopy pairs.
3. Click **Copy → Remove Copy Pairs**.

   The Remove Copy Pairs window opens.
4. Click **Yes** to confirm that you want to continue with the VolumeCopy pair removal.

   The VolumeCopy pair is removed.

VolumeCopy and other premium features

This section describes how VolumeCopy can be used with other premium features that are available with Storage Manager. This section covers Storage Partitioning, FlashCopy, and the Remote Mirroring Option premium features. Although Storage Partitioning is not covered in this guide, it is a premium feature that is offered with Storage Manager. For more information about Storage Partitioning, see your operating system installation and user's guide or see the Storage Manager online help.

Storage Partitioning and VolumeCopy

Note: Storage Partitioning is not a copy services premium feature. This guide does not describe how to enable and use the storage partitioning feature. For more

information about Storage Partitioning, see the *IBM System Storage DS Storage Manager Version 10 Installation and Support Guide* for your operating system.

Storage Partitioning is a feature that enables hosts to share access to logical drives in a storage subsystem. A storage partition is created when you define a collection of hosts (a host group) or a single host, and then define a logical drive-to-LUN mapping.

This mapping allows you to define what host group or host will have access to a particular logical drive in the storage subsystem.

After a VolumeCopy has been created, the target logical drive automatically becomes read-only to hosts to make sure that the data is preserved. Hosts that have been mapped to a target logical drive do not have write access to the logical drive, and any attempt to write to the read-only target logical drive results in a host I/O error.

If you want hosts to have write access to the data on the target logical drive, use the Copy Manager to disable the read-only attribute for the target logical drive. For more information about changing the target logical drive read-only attribute, see "Setting the target logical drive read-only attribute option" on page 114.

FlashCopy, Enhanced FlashCopy, and VolumeCopy

A FlashCopy or Enhanced FlashCopy logical drive is a point-in-time image of a standard or base logical drive and is typically created so that an application, such as a backup application, can access the FlashCopy logical drive and read the data while the base logical drive remains online and accessible to hosts.

Always use a FlashCopy or an Enhanced FlashCopy logical drive as the source logical drive for a VolumeCopy. The Enhanced FlashCopy images cannot be the source or target of a VolumeCopy pair. To create a VolumeCopy of the Enhanced FlashCopy image, you must create an Enhanced FlashCopy logical drive of the Enhanced FlashCopy image first and then select it as the source logical drive. The Enhanced FlashCopy logical drive of the Enhanced FlashCopy image cannot be the target logical drive in a VolumeCopy pair.

Important: If you choose the base logical drive of a FlashCopy logical drive as your target logical drive, you must disable all FlashCopy logical drives that are associated with the base logical drive before you can select it as a target logical drive.

When you create a FlashCopy logical drive, a FlashCopy repository logical drive is automatically created. The FlashCopy repository logical drive stores information about the data that has changed since the FlashCopy logical drive was created. FlashCopy repository logical drives cannot be selected as source logical drives or target logical drives in a VolumeCopy pair.

FlashCopy can be used with VolumeCopy to back up data on the same storage array, and to restore the data on the FlashCopy logical drive back to its original base logical drive.

You can perform an online VolumeCopy operation.

The Remote Mirror Option and VolumeCopy

The Remote Mirror Option is used for online, real-time replication of data between storage subsystems over a remote distance. In the event of a disaster or a catastrophic failure of one storage subsystem, you can promote a second storage subsystem to take over responsibility for computing services.

When you create a remote mirror, a mirrored logical drive pair is created, consisting of a primary logical drive at the primary storage subsystem and a secondary logical drive at a secondary, remotely located storage subsystem. The mirroring process and I/O completion notification to the host is different, depending on whether the write mode selected is synchronous or asynchronous. The description below is for mirroring with Metro Mirror selected. See "Metro Mirroring" on page 133 and "Asynchronous write mode (Global Copy and Global Mirroring)" on page 134 for more information on the differences between the two modes.

The primary logical drive is the logical drive that accepts host I/O and stores data. When the mirror relationship is initially created, data from the primary logical drive is copied in its entirety to the secondary logical drive. This process is known as a full take synchronization and is directed by the controller owner of the primary logical drive. During a full synchronization, the primary logical drive remains fully accessible for all normal I/O activity.

The controller owner of the primary logical drive initiates remote writes to the secondary logical drive to keep the data on the two logical drives synchronized. Whenever the data on the primary logical drive and the secondary logical drive becomes unsynchronized, the controller owner of the primary logical drive initiates a full synchronization.

The secondary logical drive maintains a mirror of the data on its associated primary logical drive. The controller owner of the secondary logical drive receives remote writes from the primary logical drive controller owner. It will accept host read requests, but all host write requests will be blocked by the controller.

Note: The Host OS file I/O caching might briefly give the impression that one can write to the secondary logical drive. However, these attempted writes will be rejected when the Host OS tries to flush them from server cache memory to the logical drive.

The secondary logical drive remains unavailable (except for read requests in servers that can mount the secondary logical drive as read-only) to host applications while mirroring is in progress. In the event of a disaster or catastrophic failure at the primary site, you can complete a role reversal to promote the secondary logical drive to a primary role. Hosts are then able to access the newly promoted logical drive and business operations can continue.

A primary logical drive in a remote mirror relationship can be selected as the source logical drive for a VolumeCopy. However, a secondary logical drive in a remote mirror relationship cannot be selected as a source logical drive or target logical drive and is not available in the Create Copy wizard when you create a VolumeCopy. If a copy of a secondary logical drive is required, you can complete a role reversal to change the secondary logical drive to a primary logical drive. For more information about remote mirror role reversals, see "Role reversals" on page 146.

Note: Another method you can use to produce a copy of the secondary logical drive is to create a FlashCopy of the secondary logical drive, then create a VolumeCopy of the FlashCopy logical drive. This method eliminates the need to complete a role reversal on the secondary logical drive.

If a primary logical drive in a remote mirror is selected as the source logical drive for a VolumeCopy, any VolumeCopies that have a status of `In Progress` or `Pending` when a role reversal takes place fail, and cannot be started again until the primary logical drive is demoted back to its original remote mirror secondary logical drive role.

For more information about the Remote Mirror Option, see Chapter 9, "Overview of the Enhanced Remote Mirroring Option," on page 127 or the Subsystem Management window online help.

Chapter 8. Troubleshooting VolumeCopy

This chapter provides information about troubleshooting some of the more common problems encountered when you use the VolumeCopy feature. The troubleshooting topics that are included are general VolumeCopy problems and premium feature troubleshooting topics. Locate the section that is directly related to your problem, or consult the section that describes general troubleshooting techniques. If your problem is not discussed in any of the sections in this chapter, contact technical support.

General troubleshooting

Table 7 describes some of the typical problems you might encounter when you use the VolumeCopy feature. The information in this section is presented in sequence, from the time the feature is enabled to problems that you might encounter when you use the VolumeCopy feature.

Information about the probable cause and suggested resolution for each problem are provided. If your problem is not addressed in this chapter, contact technical support.

Table 7. General troubleshooting for the VolumeCopy feature

Problem	Cause	Resolution
The VolumeCopy menu options in the Subsystem Management window are not available.	The VolumeCopy feature is not enabled.	Enable the VolumeCopy feature. You must use a Feature Key File to enable premium features. If one has not been supplied, contact your storage supplier. For step-by-step instructions about enabling the VolumeCopy feature, see "Enabling the VolumeCopy feature" on page 94 or the Subsystem Management Window online help.
The VolumeCopy icon in the premium status area is marked with a red line and is not available.	The VolumeCopy feature is not enabled.	Enable the VolumeCopy feature. You must use a Feature Key File to enable premium features. If one has not been supplied, contact your storage supplier. For step-by-step instructions about enabling the VolumeCopy feature, see "Enabling the VolumeCopy feature" on page 94 or the Subsystem Management Window online help.

Table 7. General troubleshooting for the VolumeCopy feature (continued)

Problem	Cause	Resolution
The wizard failed to start an online VolumeCopy operation.	The FlashCopy premium feature or the Enhanced FlashCopy premium feature is not enabled or the feature is enabled but the FlashCopy usage has reached the maximum limit for that storage subsystem.	Enable the FlashCopy or Enhanced FlashCopy premium feature, if it is disabled. Delete the existing FlashCopy logical drives. If the storage subsystem has both FlashCopy and Enhanced FlashCopy premium features enabled, then the wizard uses the Enhanced FlashCopy logical drives. Hence, delete the Enhanced FlashCopy images to reduce the number of FlashCopies that are used in the subsystem.
The Create Copy option is not available after selecting a source logical drive in the Logical view.	The logical drive that you have chosen to be the source logical drive for the VolumeCopy is not a valid source logical drive. See "Selecting the source logical drive" on page 97 for more informations on source logical drives.	Select a valid source logical drive, which can be one of the following: • A standard logical drive • A FlashCopy logical drive • A base logical drive of a FlashCopy logical drive • A primary logical drive that is participating in a Remote Mirror
The source logical drive or target logical drive displays as being a missing logical drive.	A physical drive on which the VolumeCopy depends (such as a source logical drive or target logical drive) has been removed, and the logical drive is now displayed under the Missing Logical Drive node in the Logical view of the Subsystem Management window.	If logical drives are missing because of a power loss to the drive enclosures or because drives have accidentally been removed, you can recover these logical drive by completing the following steps: 1. Reinsert the drives into the drive enclosure. 2. Make sure that the power supplies for the drive enclosure are properly connected to an operating power source and have an Optimal status. **Important:** Deleting a missing logical drive is a permanent action. Any associated logical drives or logical drive-to-LUN mappings will also be deleted. For more information about troubleshooting missing logical drives, use the Recovery Guru or contact technical support. If the missing logical drive is no longer required, it can be deleted.

Table 7. General troubleshooting for the VolumeCopy feature (continued)

Problem	Cause	Resolution
The controller owner for the source logical drive or target logical drive changes after the VolumeCopy operation has completed.	When the VolumeCopy operation started, the preferred controller did not have ownership of both the source logical drive and target logical drive.	During a VolumeCopy operation, the same controller must own both the source logical drive and the target logical drive. If both logical drives do not have the same preferred controller when the VolumeCopy operation starts, the ownership of the target logical drive automatically transfers to the preferred controller of the source logical drive. When the VolumeCopy operation completes or is stopped, ownership of the target logical drive is restored to its preferred controller. If ownership of the source logical drive changes during the VolumeCopy operation, ownership of the target logical drive also changes.
A VolumeCopy that includes a source logical drive that is participating in a remote mirror has a status of `In Progress`, `Pending`, or `Completed`, but has failed.	In response to a catastrophic failure at the primary storage subsystem, a role reversal has occurred. The secondary logical drive in the mirrored pair was promoted to the primary logical drive role, while the primary logical drive was demoted to the secondary logical drive role.	After the preferred controller of the primary logical drive can be contacted, a role reversal will automatically take place and you can then restart the VolumeCopy operation. For more information about role reversals, see “Role reversals” on page 146.

Table 7. General troubleshooting for the VolumeCopy feature (continued)

Problem	Cause	Resolution
The error message indicates that the VolumeCopy feature is out of compliance.	The VolumeCopy feature is out of compliance. This normally occurs if an array with existing VolumeCopies has been moved into a storage subsystem where the feature is not authorized, or if you have disabled the feature on a storage subsystem where the feature is authorized, and you have existing VolumeCopies present.	• If the VolumeCopy feature is not authorized for this storage subsystem and you want to authorize it, or the VolumeCopy feature is authorized for this storage subsystem but you have disabled it, complete the following steps to clear the error: 1. Obtain a new Feature Key File for this feature, or retrieve the existing Feature Enable Identifier by clicking **Storage Subsystem → Premium Features → List** in the Subsystem Management window. 2. Enable the VolumeCopy feature. For step-by-step instructions, see "Enabling the VolumeCopy feature" on page 94 or the Subsystem Management window online help. • If the VolumeCopy feature is not authorized for this storage subsystem and you do not want to authorize it, disable the VolumeCopy feature by clicking **Storage Subsystem → Premium Features → Disable** in the Subsystem Management window. For more information about disabling premium features, see to the Subsystem Management window online help.

Table 7. General troubleshooting for the VolumeCopy feature (continued)

Problem	Cause	Resolution
The error message indicates that the selected source logical drive has a reservation placed on it.	Logical drives that are configured with a legacy or persistent reservation cannot be selected as a source logical drive or a target logical drive for a VolumeCopy.	Clear the reservation for the selected logical drive, and then re-create the VolumeCopy. 1. Click **Advanced → Persistent Reservations** to open the Persistent Reservations window. Make sure that the **View Associated Registrations** check box is deselected in the upper left corner of the Persistent Reservations window. 2. clicke or more desired logical drives. To select all logical drives, click **Select All**. The selected logical drives or all logical drives are highlighted, depending on your selection. 3. Click **Clear**. The Clear Registrations/ Reservations window opens. 4. Type `Yes` in the confirmation field. The **OK** button is enabled. 5. Click **OK**, or click **Cancel** to return to the main Persistent Reservations window without clearing any reservations. The reservations and registrations that are associated with the logical drives that you highlighted in the upper pane are cleared.

VolumeCopy critical events

Critical major event Log (MEL) events are generated when an error occurs that can affect data availability or that results in a degraded mode of operation. The storage management software responds by alerting the appropriate administrators by email, SNMP trap, or other configured mechanisms.

Because administrative action is required to correct the problem, the storage subsystem generally enters a Needs Attention status. Therefore, the appropriate indications are presented through the storage management software and an associated Recovery Guru procedure displays when requested.

Table 8 on page 126 provides a description of critical MEL events, with a brief explanation of what caused the event, and the event resolution. If your critical MEL event is not included in this section, contact technical support.

Table 8. VolumeCopy critical events

Problem	Cause	Resolution
Event 6600 - VolumeCopy Operation Failed	This event is logged when a VolumeCopy with a status of In `Progress` or `Pending` fails. A `Needs Attention` status is also reported for the storage subsystem. This failure can be caused by a read error on the source logical drive, a write error on the target logical drive, or because of a failure that occurred on the storage subsystem that affects the source logical drive or target logical drive.	For specific recovery procedures, see the Recovery Guru.

Chapter 9. Overview of the Enhanced Remote Mirroring Option

The Enhanced Remote Mirroring is supported with controller firmware 06.xx.xx.xx or later. The supported storage subsystems are:

- The DS3500 with firmware version 07.70.xx.xx or later
- The DCS3700 with firmware 07.77.xx.xx or later
- The DCS3700 storage subsystem with Performance Module Controllers with firmware version 07.83.xx.xx or later
- The DS4100 standard option with firmware version 06.12.xx.xx or later
- The DS4300 with Turbo option, DS3950, DS4200, DS4400, DS4500, DS4700, DS4800, DS5020, DS5100, and DS5300 versions.

The maximum number of mirror pairs is 32 for the DS4100 standard dual controller model and DS4300 Turbo models. The maximum number of mirror pairs is 16 for the DS3500, DCS3700, and DCS3700 storage subsystem with Performance Module Controllers; 64 for the DS3950, DS4200, DS4400, DS4500, DS4700, and DS5020; and 128 for the DS4800, DS5100, and DS5300 models.

Enhanced Remote Mirroring Implementation Requirement

- The Bandwidth Estimator Tool is required to architect an Enhanced Remote Mirroring solution. To acquire the Bandwidth Estimator Tool, please contact your IBM Marketing representative or IBM Business Partner.
- In addition, have an IBM SAR (Solutions Assurance Review) performed on your Enhanced Remote Mirroring solution, before implementation.
- In certain conditions and environments, Enhanced Remote Mirroring has been shown to support link speeds as low as 2 Mbps.

Note: Link speeds as low as 2 Mbps are not supported in every environment.

Basic concepts of the Enhanced Remote Mirroring Option

The Remote Mirror Option is a premium feature that comes with the Storage Manager software and is enabled by purchasing a premium feature key. The Remote Mirror Option is used for online, real-time replication of data between storage subsystems over a remote distance. In the event of a disaster or unrecoverable error at one storage subsystem, the Remote Mirror Option enables you to promote a second storage subsystem to take over responsibility for normal I/O operations.

Remote Mirroring supports only 10 km maximum distance synchronous (metro mirroring) Remote Mirroring pairs. Remote Mirroring is supported with controller firmware versions 05.20.xx.xx (DS4400 only), 05.30.xx.xx and 05.40.xx.xx (DS4400 and DS4500), and 05.41.xx.xx (DS4500). The DS4400 and DS4500 are supported storage subsystems. The maximum number of mirror pairs is 32 for DS4400 and DS4500.

Enhanced Remote Mirroring is an enhanced version of Remote Mirroring; therefore providing an enhancement of the existing 10 km maximum distance synchronous Remote Mirror Option. The Enhanced Remote Mirroring supports the 10 km

maximum distance synchronous Remote Mirroring pairs. The Enhanced Remote Mirroring also supports Enhanced Global Remote Mirroring with the write consistency (Global Mirroring) option or without the write consistency (Global Copy) option.

The Enhanced Remote Mirroring is supported with controller firmware 06.xx.xx.xx or later. The supported storage subsystems are the DS3500 with firmware version 07.70.xx.xx or later, the DCS3700 with firmware 07.77.xx.xx or later, DS4100 standard option with firmware version 06.12.xx.xx or later, DS4300 with Turbo option, DS3950, DS4200, DS4400, DS4500, DS4700, DS4800, DS5020, DS5100, and DS5300. The maximum number of mirror pairs is 32 for the DS4100 standard dual controller model and DS4300 Turbo models. The maximum number of mirror pairs is 16 for the DS3500 and DCS3700; 64 for the DS3950, DS4200, DS4400, DS4500, DS4700, and DS5020; and 128 for the DS4800, DS5100, and DS5300 models.

Enhanced Remote Mirroring is not supported on single-controller models. It is supported on dual-controller storage subsystems only.

The maximum number of storage subsystems that can participate in a remote mirror configuration is two. The two storage subsystems are called *primary* and *secondary* storage subsystems or *local* and *remote* storage subsystems. These names are used interchangeably to describe remote mirror setups or concepts. The names do not describe the location of storage subsystems or to the role that storage subsystems have in a remote mirror relationship.

Primary and secondary logical drives on a remote mirror setup

This section introduces you to primary and secondary logical drives, and describes how they interact to replicate data between storage subsystems using the Remote Mirror Option. When you create a remote mirror, a mirrored logical drive pair is defined and consists of a primary logical drive at the primary storage subsystem, and a secondary logical drive at a secondary storage subsystem. A standard logical drive might only be defined in one mirrored logical drive pair. The maximum number of supported mirrored logical drive pairs is determined by the storage subsystem model.

The primary and secondary role in a remote mirror setup is implemented at the logical drive level instead of at the storage subsystem level. All logical drives that participate in a remote mirror relationship on a storage subsystem can be in either a primary or secondary role only. The storage subsystem can also have a combination of logical drives in a primary role and logical drives in a secondary role. Whether the logical drive is in a primary or secondary role, it counts towards the maximum number of mirror logical drive pairs that can be defined in a storage subsystem.

There are no requirements for having a certain number of logical drives be of a certain role in a remote mirror relationship for a given storage subsystem. For example, a storage subsystem with a maximum of 16 remote mirror relationship pairs might have logical drives in any one of the remote mirror relationship combinations shown in Table 9 on page 129.

Table 9. Remote Mirror drives in primary and secondary roles

Remote mirror drives in a primary role	Remote mirror drives in a secondary role	Description
16	0	This local storage subsystem has data in 16 logical drives mirrored in 16 logical drives in a separate (remote) storage subsystem.
8	8	This local storage subsystem has data in eight logical drives mirrored in eight logical drives in a remote storage subsystem. It also has eight logical drives that are used to store the mirrored data from eight logical drives in a remote storage subsystem.
4	12	There are four logical drives that are used to store the mirrored data from four logical drives in a remote storage subsystem. It also has 12 logical drives that are used to store the mirrored data from 12 logical drives in a remote storage subsystem.
0	16	This local storage subsystem has 16 logical drives that are used to store the mirrored data from 16 logical drives in a remote storage subsystem.

Note:

1. With the Enhanced Remote Mirroring premium feature, there is a maximum of 16 remote mirror pairs for the DS3500, DCS3700, and DCS3700 storage subsystem with Performance Module Controllers, 32 remote mirror pairs for DS4100 and DS4300 Turbo models, and 64 remote mirror pairs for the DS3950, DS4200, DS4400, DS4500, DS4700, and DS5020. The DS4800, DS5100, and DS5300 support 128 remote mirror pairs.
2. For firmware version 05.3x.xx.xx or later, the maximum number of logical drives include the FlashCopy repository logical drives, the VolumeCopy target logical drive, and the Remote Mirror logical drives, in addition to the standard data logical drives. If the Remote Mirror Option is enabled, two logical drives are reserved for use by the system.
3. There is no Remote Mirror support for DS4100 single controller models, or DS4300 base/standard and single controller unit.
4. There is a maximum of eight remote mirror pairs for the DS4400 and DS4500, with the Remote Mirroring premium feature option.
5. When using firmware version 05.xx.xx or later, the firmware reserves one logical drive for the system to use.
6. There is a maximum of four FlashCopy logical drives for each standard logical drive.
7. The host-agent management method uses a special logical drive, called an *access logical drive*, to communicate with the controllers on the storage subsystem. The access logical drive uses one of the available LUNs. Therefore, managing storage subsystems with the host-agent software limits you to one fewer LUN than the maximum number that is supported by the operating system and the host adapter.

   For controller firmware 05.4x.xx.xx or later the maximum number of logical drives per storage mapping partition is 256. However, depending on the operating system limitations, the actual number of supported LUNs logical drives per storage mapping partition is less than 256.

The primary logical drive is the drive that accepts host computer I/O and stores program data. When you first create the mirror relationship, data from the primary logical drive is copied (becomes a mirror image) in its entirety to the secondary logical drive. This process is known as a *full synchronization* and is directed by the controller owner of the primary logical drive. During a full synchronization, the primary logical drive remains fully accessible for all normal I/O operations.

When a write request is made to the primary logical drive, the controller owner of the primary logical drive also initiates a remote write request to the secondary logical drive. The timing of the write I/O completion indication that is sent back to the host depends on the write mode option that is selected. Metro Mirror requires the primary-side controller to wait for the acknowledgment of the write operation from the secondary-side controller before returning the write I/O request completion to the host. Global Copy, which is a new Remote Mirror feature, allows the primary-side controller to return the write the I/O request completion to the host server before data has been successfully written by the secondary-side controller. See "Write options" on page 133 for more information.

The secondary logical drive is used to store data that is copied from its associated primary logical drive. The controller owner of the secondary logical drive receives remote writes from the controller owner of the primary logical drive and will not accept host write requests. The Enhanced Remote Mirror Option allows the host server to issue read requests to the secondary logical drive.

Note: In some instances, you can map the secondary logical drive to a host to make read-only access possible. Many operating systems, such as Microsoft Windows and AIX, write a signature or "dirty bit" when they mount a logical drive; when this occurs, no direct access is possible. To manage this situation, you can create a FlashCopy of the secondary logical drive.

The secondary logical drive is normally unavailable to host computer programs while mirroring is performed. In the event of a disaster or unrecoverable error of the primary storage subsystem, a role reversal is performed to promote the secondary logical drive to the primary logical drive. Host computers will then be able to access the newly-promoted logical drive and normal operations can continue.

Figure 35 on page 131 shows the primary and secondary logical drives displayed in the Subsystem Management window for the primary storage subsystem and the secondary storage subsystem.

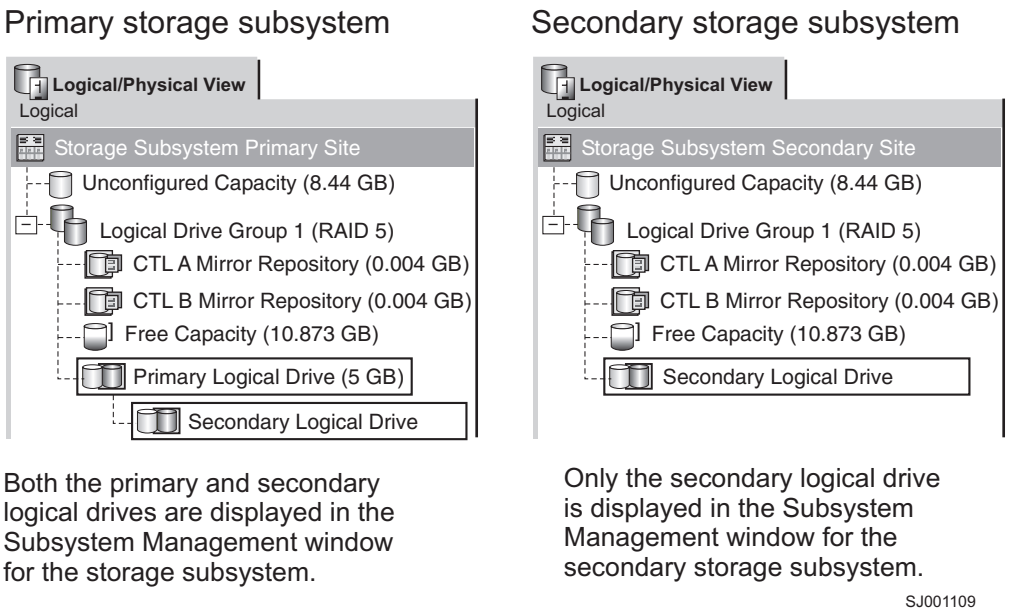


Figure 35. Primary and secondary logical drives displayed in the Subsystem Management window

Mirror repository logical drives

A mirror repository logical drive is a special logical drive in the storage subsystem. It is created as a resource for the controller owner of the primary logical drive in a remote logical drive mirror. The controller stores mirrored information on this logical drive, including information about remote write requests that are not yet written to the secondary logical drive. The controller can use this information to recover from controller resets or if the storage subsystems are accidentally turned off.

When you activate the Remote Mirror Option on the storage subsystem, two mirror repository logical drives are created, one for each controller in the storage subsystem. An individual mirror repository logical drive is not needed for each mirror logical drive pair.

When you create the mirror repository logical drives, you specify their location. You can either use existing free capacity (shown in Figure 36 on page 132) or you can create an array for the logical drives from the unconfigured capacity, and then specify the RAID level.

Because of the critical nature of the data that is stored, the RAID level of mirror repository logical drives must be nonzero. The required size of each logical drive is 128 MB for each mirror repository logical drive (256 MB total). If you are upgrading from the previous version of Remote Mirror, you must upgrade the size of the repository logical drive from 4M to 128M (see “Upgrading mirror repository logical drives” on page 175) in order to support a maximum of 64 Remote Mirror pairs. A maximum of only 32 Remote Mirror pairs is supported with the 4M repository logical drive.

Important: For each mirrored pair that you create, leave a minimum of 0.25 GB free capacity in the same array as the mirror repository logical drives. If you someday deactivate the mirrored pair, this will make sure that you have enough

capacity to reestablish the mirrored pair from the deactivated state. Otherwise, if there is no free capacity available on the storage subsystem, you might not be able to reestablish the mirrored pair.

Figure 36 shows mirror repository logical drives displayed in the Subsystem Management window for the primary storage subsystem.

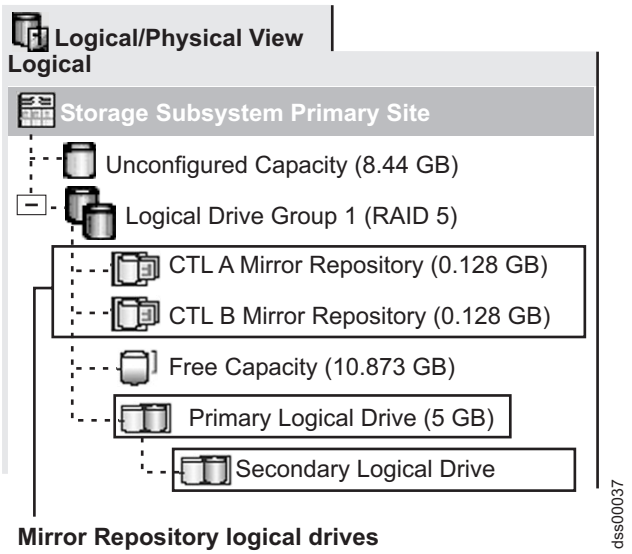


Figure 36. Mirror repository logical drives displayed in the Subsystem Management window

Using arrays and logical drives with T10PI functionality

For Controller firmware 7.77.xx.xx, logical drives can be created with T10PI functionality using T10PI drives.

If you want to remote mirror logical drives with T10PI functionality, ensure that the T10PI functionality of both the primary and secondary logical drives is enabled.

The performance of the Remote mirroring logical drives with T10PI functionality depends on the IOs pattern to the primary logical drive. There is no impact on the performance if the IOs pattern to the primary logical drive is of small and random workload (for example, 4 Kbyte random IO). However, the performance can degrade up to 20% if the IO pattern to the primary logical drive is of large and sequential workload (for example, 256 Kbyte sequential IO) as compared to the remote mirrors using logical drives without T10PI functionality. Contact IBM Solution Assurance Review (SAR) if you have any concerns or questions about using logical drives with T10PI functionality in remote mirroring environment.

Note: If you use local T10PI-capable drives but do not have the T10PI functionality enabled, you will not have the previously mentioned performance degradation in a remote mirroring environment.

Using thin logical drives

For controller firmware version 7.83.xx.xx or later, thin logical drives can be created in a disk pool. Thin logical drives are not supported as the primary or secondary logical drives in a remote mirrored relation.

Mirror relationships

Before you define a mirror relationship, the Remote Mirror Option must be enabled on both the primary and secondary storage subsystems. A secondary standard logical drive candidate must be created on the secondary storage subsystem if one does not already exist. It must be a standard logical drive and be at least the same size or larger than the primary logical drive.

When secondary logical drive candidates are available, you can define a mirror relationship in the storage management software by identifying the storage subsystem that contains the primary logical drive and the storage subsystem that contains the secondary logical drive.

When you set up the mirror relationship, a full synchronization occurs as data from the primary logical drive is copied in its entirety to the secondary logical drive. For more information about establishing mirror relationships, see"Creating mirror relationships" on page 177.

Data replication

This section describes how data is replicated between storage subsystems that are participating in remote logical drive mirroring, and the actions that are taken by the controller owner of the primary logical drive if a link interruption occurs between storage subsystems. Data replication between the primary logical drive and the secondary logical drive is managed by the controllers and is transparent to host computers and programs.

Note: When a read request is received from a host computer, the controller owner of either the primary or secondary logical drive manages the request, depending on whether the read is issued to the primary or secondary logical drive, respectively. No communication takes place between the primary and secondary storage subsystems.

Write options

When the controller owner of the primary logical drive receives a write request from a host computer, the controller first logs information about the write request to its mirror repository logical drive, and then writes the data to the primary logical drive. The controller then initiates a remote write operation to copy the affected data blocks to the secondary logical drive at the secondary storage subsystem.

There are two write mode options that affect the timing that the I/O completion indication is sent back to the host:

- "Metro Mirroring"
- "Asynchronous write mode (Global Copy and Global Mirroring)" on page 134

Metro Mirroring

When Metro Mirroring (also known as Synchronous Write Mode) is selected, any host write requests are written to the primary logical drive, and then copied to the secondary logical drive. After the host write request has been written to the primary logical drive and the data is successfully copied to the secondary logical drive, the controller removes the log record on the mirror repository logical drive and sends an I/O completion indication back to the host computer.

In the event of a communication failure, Metro Mirror offers the best chance of full data recovery from the secondary logical drive. In Metro Mirror, host I/O performance is slower than it is in Global Copy.

Metro Mirror is selected by default and is the preferred write mode when the maximum distance between the storage subsystems in an Enhanced Remote Mirroring configuration is 10 km.

Figure 37 shows the data replication process for Metro Mirror.

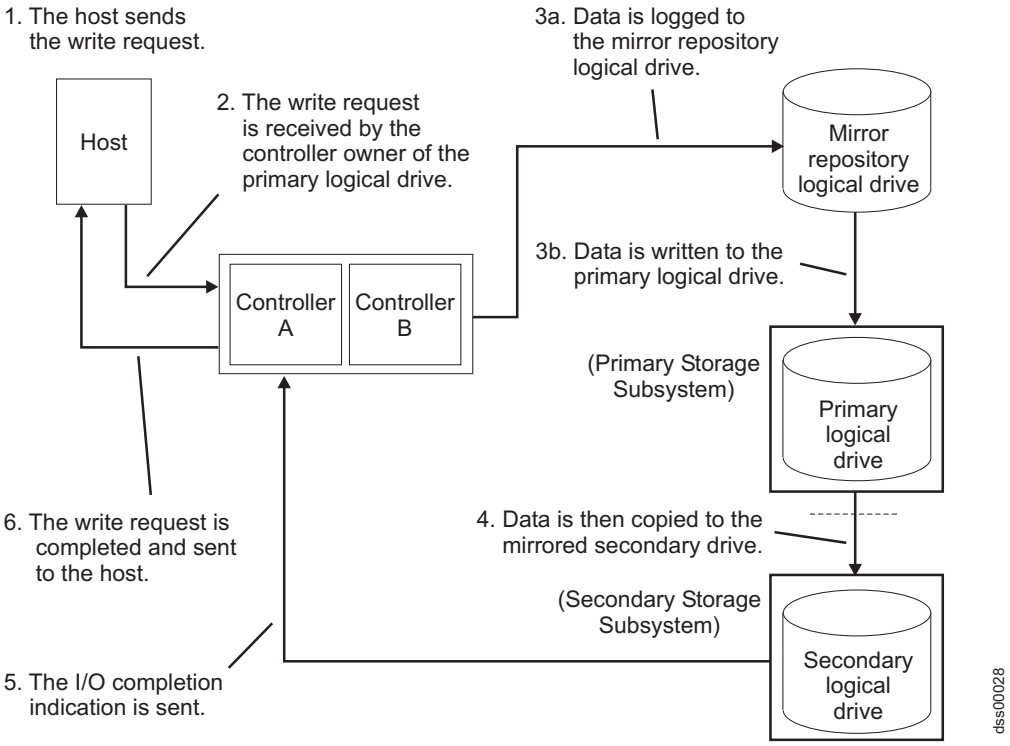


Figure 37. Data replication between primary and secondary storage subsystems: Metro Mirror

Asynchronous write mode (Global Copy and Global Mirroring)

When Global Copy is selected, host write requests are written to the primary logical drive, and the controller then sends an I/O completion indication back to the host system regardless of when the data was successfully copied to the secondary logical drive.

There are two types of mirroring that use asynchronous write mode: Global Copy and Global Mirroring. See "Write consistency groups" on page 135 for a description of each type.

Note: Remote mirroring using synchronous write mode is referred to as Metro Mirroring.

Asynchronous write mode offers faster host I/O performance than synchronous write mode, but does not guarantee that the copy has been successfully completed before processing the next write request. This is the preferred mode when the maximum distance between the storage subsystems in an Enhanced Remote Mirroring configuration is more than 10 km.

Figure 38 shows the data replication process for asynchronous write mode.

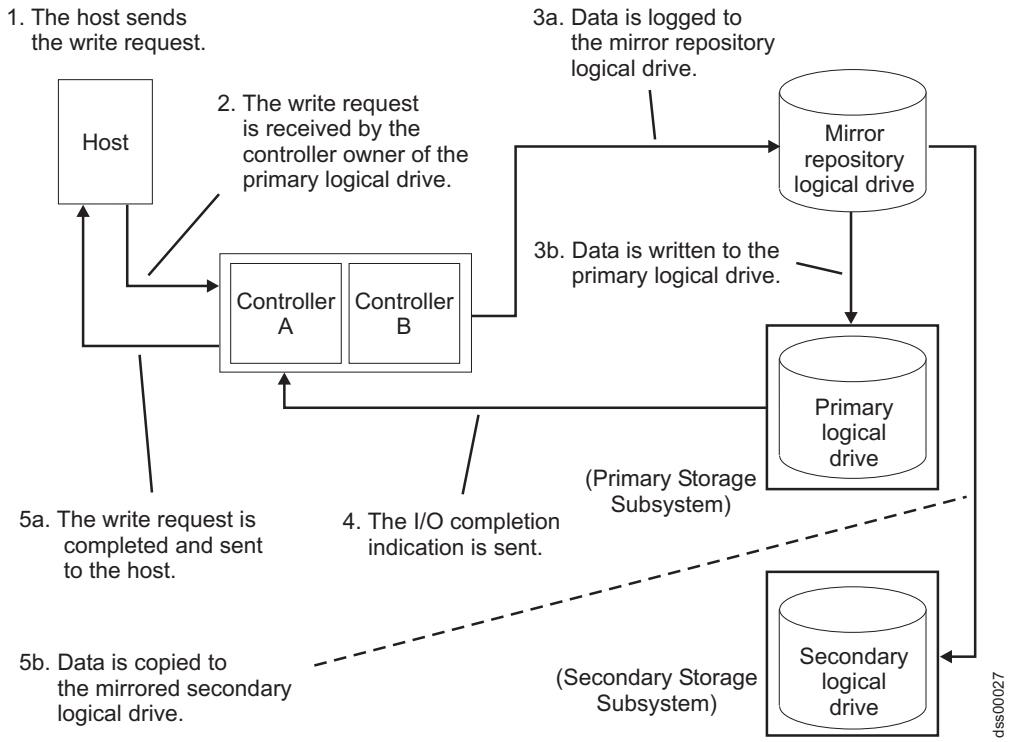


Figure 38. Data replication between primary and secondary storage subsystems: Asynchronous write mode (Global Copy/Global Mirroring)

Write consistency

Write consistency, a configuration option available for any primary or secondary logical drives in a remote mirror relationship using Global Copy, preserves write orders.

In Global Copy, write requests are not guaranteed to be completed in the same order on the secondary logical drive as they are on the primary logical drive. If the order of write requests is not retained, data on the secondary logical drive might become inconsistent with the data on the primary logical drive. This can jeopardize any attempt to recover data if a disaster occurs on the primary storage subsystem.

You can avoid this by selecting the write consistency option for multiple mirror relationships on the same storage subsystem. When you select write consistency, the order in which the data is synchronized is preserved. For example: In a remote mirror pair, the write for Mirror 1 is always performed before the write for Mirror 2.

Note: Selecting write consistency for a single mirror relationship does not change the process in which data is replicated. More than one mirror relationship must reside on the primary storage subsystem for the replication process to change.

Write consistency groups

When multiple mirror relationships on a single storage subsystem have been configured to use Global Copy and to preserve write consistency, they are considered to be an interdependent group known as a *write consistency group*. In a

write consistency group, all mirror relationships maintain the same order when sending writes from the primary logical drives to their corresponding secondary logical drives.

The data on the secondary, remote storage subsystem cannot be considered fully synchronized until all remote mirrors in the write consistency group are synchronized. If one mirror relationship in a write consistency group becomes unsynchronized, all of the mirror relationships in the write consistency group will become unsynchronized. In this case, write activity to the remote, secondary storage subsystem is prevented, in order to protect the consistency of the remote data set.

Note: Care must be taken in selecting the number of logical drives that are in a write consistency group to minimize the impact when multiple simultaneous remote writes becomes single-thread because of write consistency requirement.

Example of a write consistency group:
On a campus site, the Remote Mirror Option has been configured between two storage subsystems. At the primary site, the primary storage subsystem has three defined mirror relationships (RMO-A, RMO-B, and RMO-C), with each mirror relationship configured to copy data to the secondary storage subsystem.

All three mirror relationships have been configured to use Global Copy and to preserve write order. If the mirrored pair RMO-A becomes unsynchronized due to a link interruption, the controller will automatically transition RMO-B and RMO-C into an `Unsynchronized` state until communication can be resumed.

Global Copy and Global Mirroring:
There are two types of Enhanced Global Mirroring:

Global Copy
Refers to a remote logical drive mirror pair that is set up using Global Copy *without* the write consistency group option. This is also referred to as *Enhanced Global Mirroring without Consistency Group*.

Global Copy does not make sure that write requests to multiple primary logical drives are carried out in the same order on the secondary logical drives as they are on the primary logical drives. If it is critical that writes to the primary logical drives are carried out in the same order in the appropriate secondary logical drives, use Global Mirroring instead of Global Copy.

Global Mirroring
Refers to a remote logical drive mirror pair that is set up using Global Copy *with* the write consistency group option. This is also referred to as *Enhanced Global Mirroring with Consistency Group*.

Global Mirroring makes sure that write requests to multiple primary logical drives are carried out in the same order on the secondary logical drives as they are on the primary logical drives, preventing data on the secondary logical drives from becoming inconsistent with the data on the primary logical drives.

Note: In Global Mirroring mode, the controller handles write requests similar to the way logical drive mirror pairs are set up using Metro Mirror. Remote mirroring performance may be impacted when there are a large number of logical drives in the write consistency group and when the bandwidth between the remote mirroring sites is limited or slow.

Resynchronization methods

Data replication between the primary logical drive and secondary logical drive in a mirror relationship is managed by the controllers, and is transparent to host machines and applications. When the controller owner of the primary logical drive receives a write request from a host, the controller persistently logs information about the write to a mirror repository logical drive, then writes the data to the primary logical drive. The controller then initiates a write operation to copy the affected data to the secondary logical drive on the secondary storage subsystem.

If a link interruption or logical drive error prevents communication with the secondary storage subsystem, the controller owner of the primary logical drive transitions the mirrored pair into an `Unsynchronized` state and sends an I/O completion to the host that sent the write request. The host can continue to issue write requests to the primary logical drive, but remote writes to the secondary logical drive do not take place. These write requests are persistently logged in the primary-side remote mirror repository logical drive.

When connectivity is restored between the controller owner of the primary logical drive and the controller owner of the secondary logical drive, resynchronization takes place. To minimize the resynchronization effort, the Enhanced Remote Mirroring Option will copy only the blocks of data that were changed on the primary logical drive during the link interruption to the secondary logical drive.

If the remote mirror logical drive pair becomes unsynchronized due to the lost of mirror repository logical drives, full synchronization will be required when the mirror repository logical drives is restored.

Attention: Multiple communication disruptions and restore cycles that occur between the primary and secondary storage subsystems during resynchronization can result in a mix of new and old data on the secondary logical drive. If this happens, the data is unusable in a disaster recovery situation.

This section describes the two resynchronization methods that you can use:

- "Manual resynchronization"
- "Automatic resynchronization" on page 138

Important: Manual resynchronization is the preferred setting for all mirror relationships in a write consistency group. If automatic resynchronization is selected for a mirror relationship in a write consistency group, resynchronization will start as soon as communication is reestablished, which does not preserve consistency in the write consistency group.

Manual resynchronization

When you select manual resynchronization and a communication failure occurs between the primary and secondary storage subsystems, resynchronization of the data on the primary logical drive and secondary logical drive can be started manually after communication has been restored to the unsynchronized mirrored pair.

Important: Only the blocks of data that were changed on the primary logical drive during the link interruption are copied to the secondary logical drive.

Selecting the manual resynchronization option allows you to manage the resynchronization process in a way that provides the best opportunity for recovering data. When this option is selected and a communication failure occurs

between the primary and secondary logical drives, the mirror relationship transitions to an `Unsynchronized` state. Any write requests to the primary logical drive are logged and the storage subsystem is placed in a `Needs Attention` state.

After the controller owner of the primary logical drive detects that communication has been restored, the mirror relationship will remain in an `Unsynchronized` state until you select **Logical Drive → Remote Mirror Option → Resume** in the Subsystem Management window.

Automatic resynchronization

When the automatic resynchronization option is selected and a communication failure occurs between the primary and secondary storage subsystems, the controller owner of the primary logical drive will start resynchronizing the primary and secondary logical drives immediately after detecting that communication has been restored.

Important: Only the blocks of data that have changed on the primary logical drive during the link interruption are copied to the secondary logical drive.

Link interruptions or secondary logical drive errors

In the course of processing write requests, a primary controller might be able to write only to the primary logical drive while a link interruption prevents communication with the remote secondary controller.

After a link interruption, the remote write operation cannot complete to the secondary logical drive and the primary and secondary logical drives are no longer correctly mirrored. The primary controller transitions the mirrored pair into an `Unsynchronized` state and sends an I/O completion message to the primary host computer, as shown in Figure 39. The primary host computer can continue to write to the primary logical drive but remote write operations do not take place.

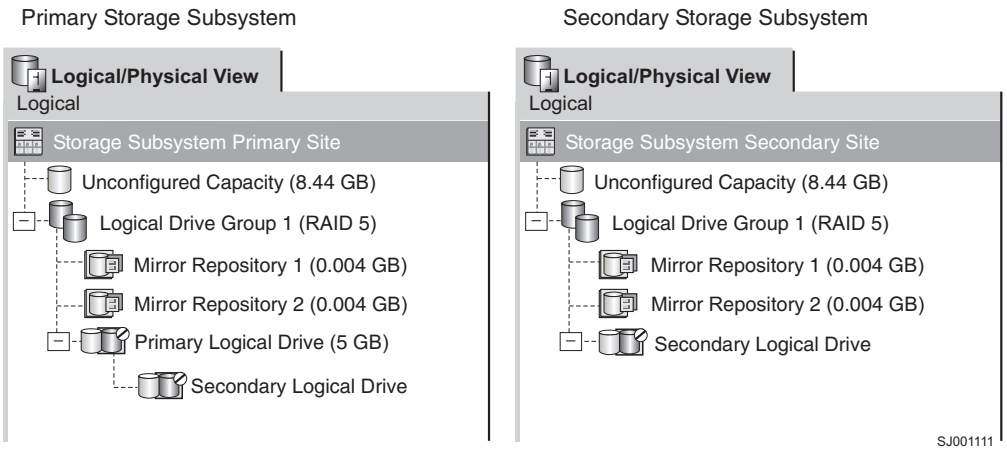


Figure 39. Mirrored logical drive pair showing Unsynchronized status

When connectivity is restored between the controller owner of the primary logical drive and the controller owner of the secondary logical drive, a resynchronization either happens automatically or must be started manually, depending on which method you chose when you set up the mirror relationship. During the resynchronization, only the blocks of data that were changed on the primary logical drive during the link interruption are copied to the secondary logical drive.

After the resynchronization begins, the mirrored pair transitions from an `Unsynchronized` state to a `Synchronization-in-Progress` state, as shown in Figure 40.

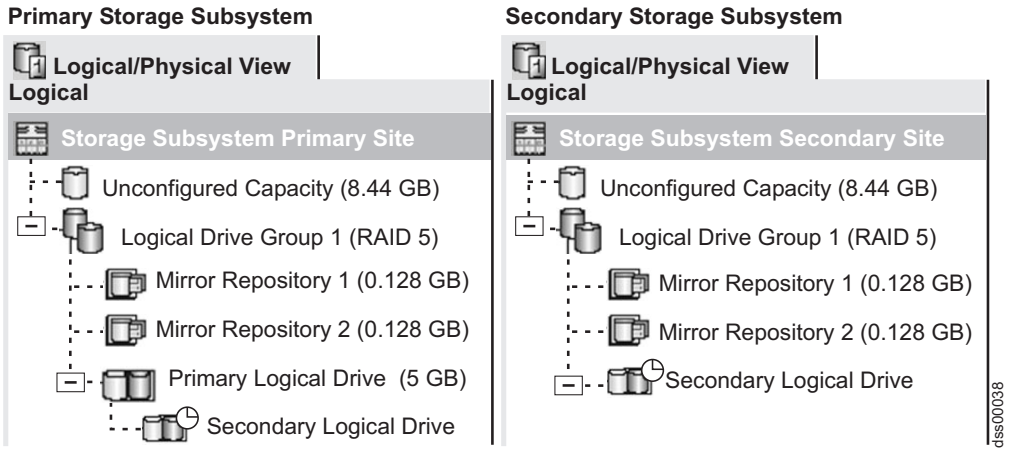


Figure 40. Mirrored logical drive pair showing Synchronization-in-Progress status

The primary controller places the mirrored pair in an `Unsynchronized` state when a logical drive error on the secondary storage subsystem prevents a remote write operation from completing. For example, an offline or failed secondary logical drive can cause the remote mirror to be placed in an `Unsynchronized` state. When the secondary logical drive is placed online or is recovered to an `Optimal` state, a manual or automatic resynchronization is required, and the mirrored pair transitions to a `Synchronization-in-Progress` state.

For more information about Remote Mirror Option status, see Chapter 11, "Using the Enhanced Remote Mirroring Option," on page 175.

Connectivity and I/O

The Remote Mirror Option requires a dedicated host port for mirroring data between storage subsystems. This section describes three configurations that you can use to connect storage subsystems for remote logical drive mirroring, controller ownership of logical drives within storage subsystems, the maximum storage subsystem distance permitted, and some general performance considerations. If these configurations do not meet your remote mirror configuration requirement, contact your IBM technical-support representative.

For the DS3500 with each controller configured with four Fibre Channel host ports and two SAS host ports, controller host ports A6 and B6 are dedicated for mirroring options when the Enhanced Remote Mirroring premium feature is enabled. See Figure 41 on page 140 for the location of the DS3500 controller host ports.

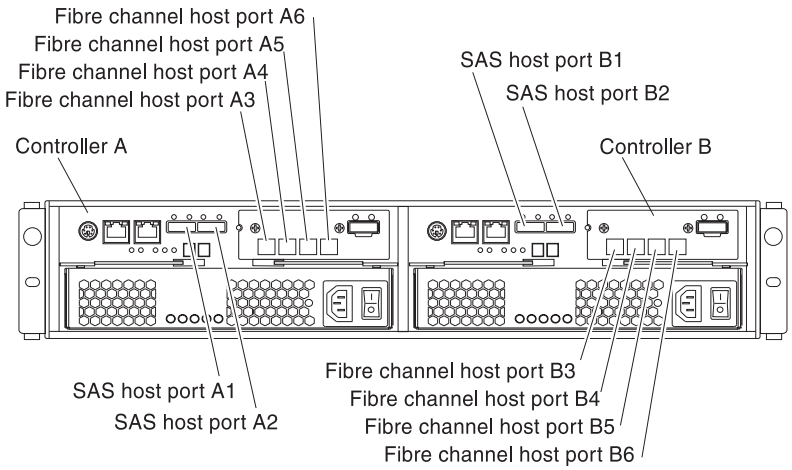


Figure 41. Controller A and Controller B host ports, DS3500 configured with two controllers and four Fibre Channel and two SAS host ports in each controller

For the DS3950 with each controller configured with two Fibre Channel host ports or two Fibre Channel host ports and two iSCSI host ports, controller host ports A2 and B2 are dedicated for mirroring options when the Enhanced Remote Mirroring premium feature is enabled. See Figure 42 for the location of the DS3950 controller host ports.

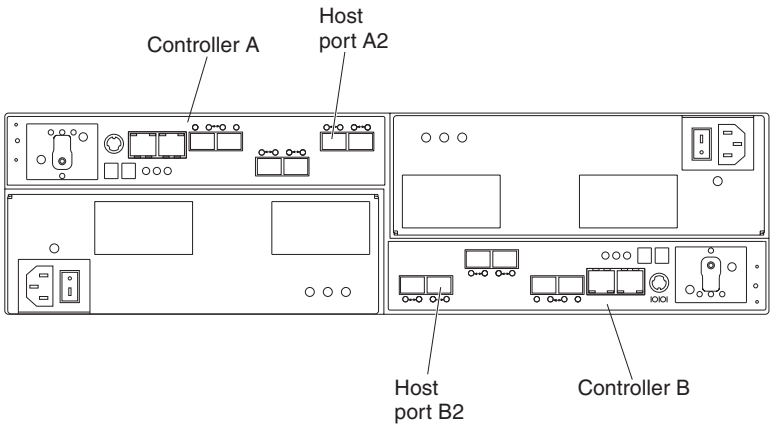


Figure 42. Controller A and Controller B host ports, DS3950 configured with two Fibre Channel or two Fibre Channel and two iSCSI host ports

The Remote Mirror Option is supported on DS4000 or DS5000 storage subsystems that have at least two Fibre Channel host ports per controller (DS4400, DS4300, and DS4500). When the Remote Mirror Option is activated, one Fibre Channel host-side I/O port on each controller is dedicated only to mirroring operations. For example, in the primary storage subsystem, controller host ports A2 and B2 are dedicated to mirroring operations. In the secondary storage subsystem, controller host ports A2 and B2 are also dedicated to mirroring operations. See Figure 43 on page 141 for the location of the controller host ports for DS4400, and see Figure 44 on page 141 for the location of controller host ports for DS4300.

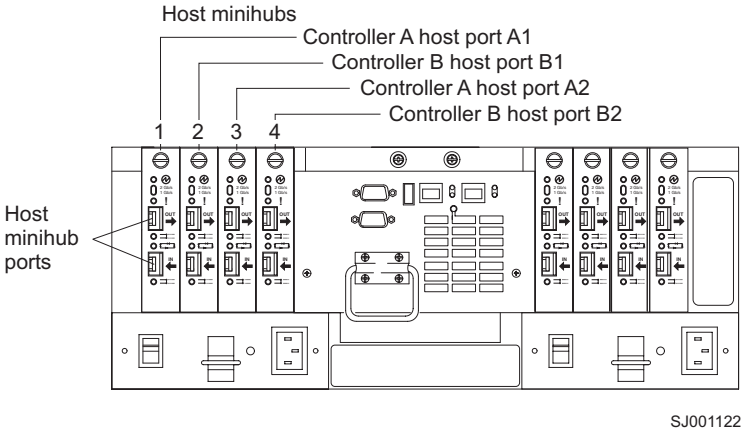


Figure 43. Controller A and Controller B host ports, DS4400

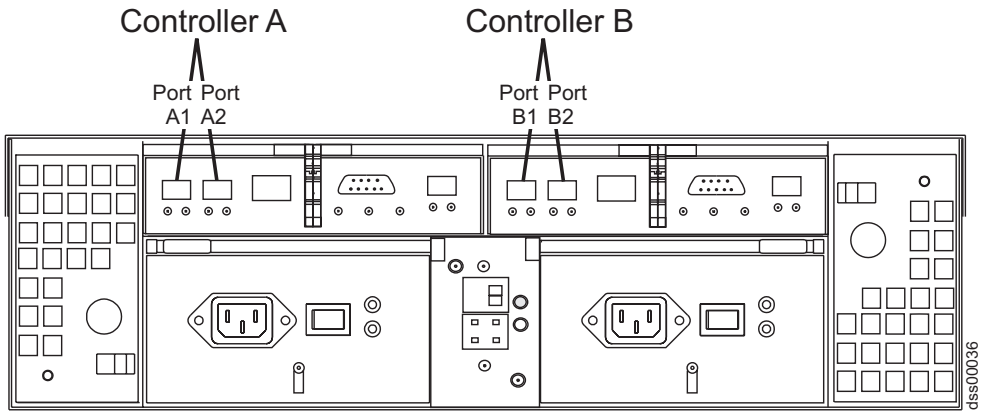


Figure 44. Controller A and Controller B host ports, DS4300

For the DS4800, controller host ports A4 and B4 are dedicated for mirroring options when the Enhanced Remote Mirroring premium feature is enabled. For DS4700/DS4200, controller host port 2 in DS4700 model 70A/H, and DS4200 and port 4 in model DS4700 72A/H are dedicated for mirroring options when the Enhanced Remote Mirroring premium feature is enabled. See Figure 45 on page 142 for the location of controller host ports for DS4800, and Figure 46 on page 142 and Figure 47 on page 142 for DS4700 and DS4200.

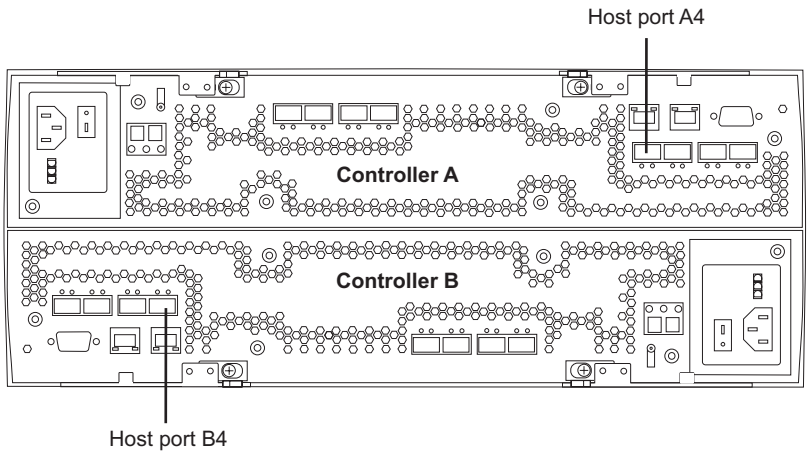


Figure 45. Controller A and Controller B host ports, DS4800

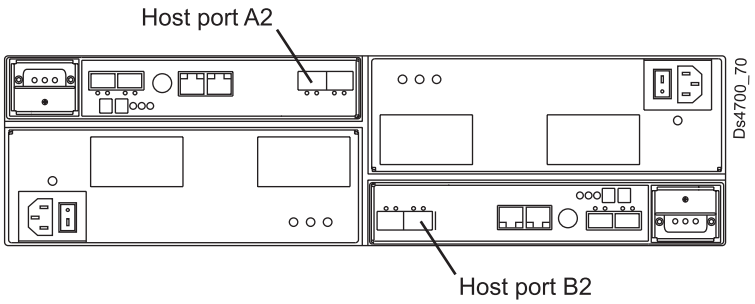


Figure 46. Controller A and Controller B host ports, DS4700 Model 70 and DS4200

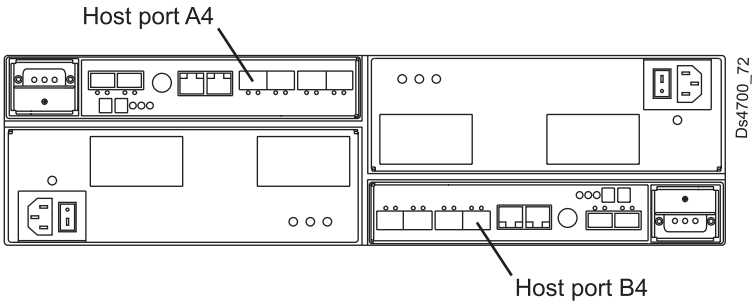


Figure 47. Controller A and Controller B host ports, DS4700 Model 72

For the DS5020 with each controller configured with two Fibre Channel host ports or two Fibre Channel host ports and two iSCSI host ports, controller host ports A2 and B2 are dedicated for mirroring options when the Enhanced Remote Mirroring premium feature is enabled. See Figure 48 on page 143 for the location of the DS5020 controller host ports.

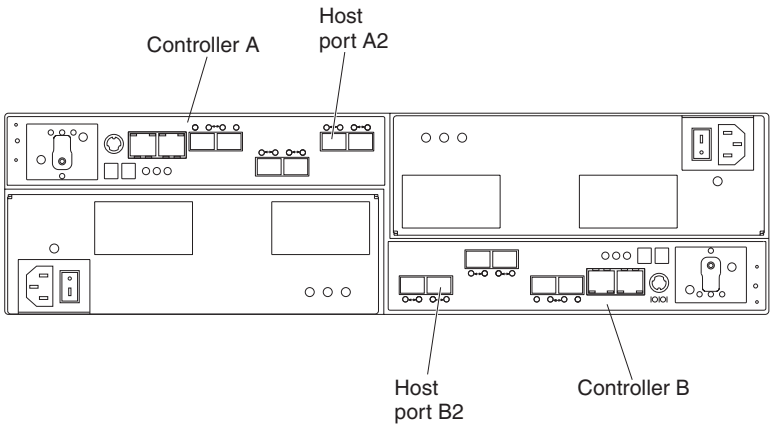


Figure 48. Controller A and Controller B host ports, DS5020 configured with two Fibre Channel or two Fibre Channel and two iSCSI host ports

For the DS5020 with each controller configured with four Fibre Channel host ports, controller host ports A4 and B4 are dedicated for mirroring options when the Enhanced Remote Mirroring premium feature is enabled. See Figure 49 for the location of the DS5020 controller host ports.

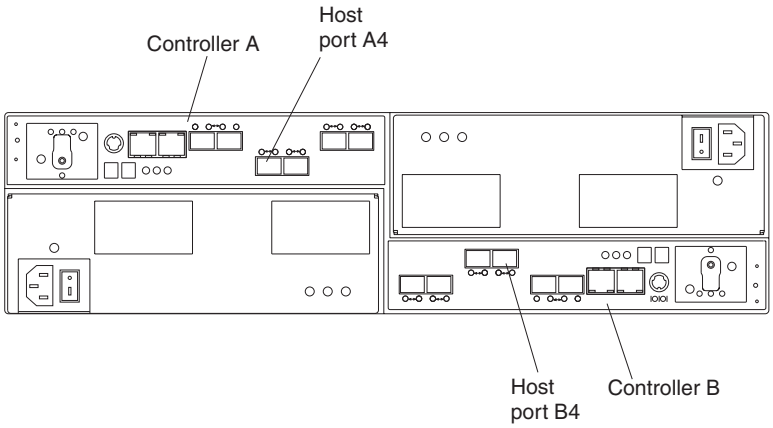


Figure 49. Controller A and Controller B host ports, DS5020 configured with four Fibre Channel host ports

For the DS5100 and DS5300 configured with a single Fibre Channel host interface card (HIC) or one Fibre Channel and one iSCSI HIC, controller host ports A4 and B4 of HIC 1 are dedicated for mirroring options when the Enhanced Remote Mirroring premium feature is enabled. See Figure 50 on page 144 for the location of controller host ports for DS5100 and DS5300 with a single HIC.

For the DS5300 configured with dual Fibre Channel host interface cards, controller host ports A4 and B4 of HIC 2 are dedicated for mirroring options when the Enhanced Remote Mirroring premium feature is enabled. See Figure 51 on page 144 for the location of controller host ports for the DS5300 with dual HICs.

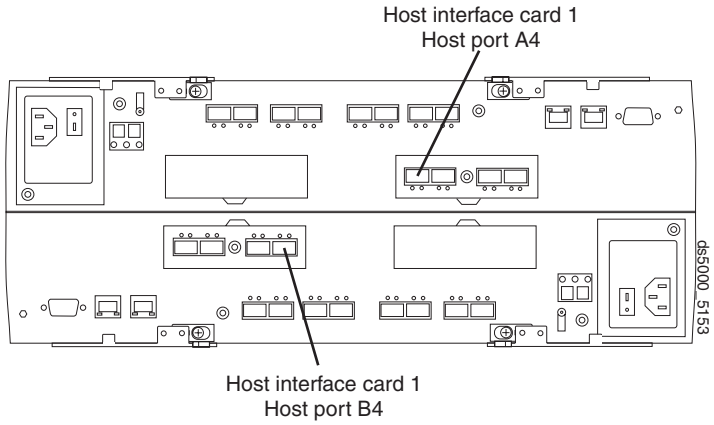


Figure 50. Controller A and Controller B host ports, Single HIC DS5100 and DS5300

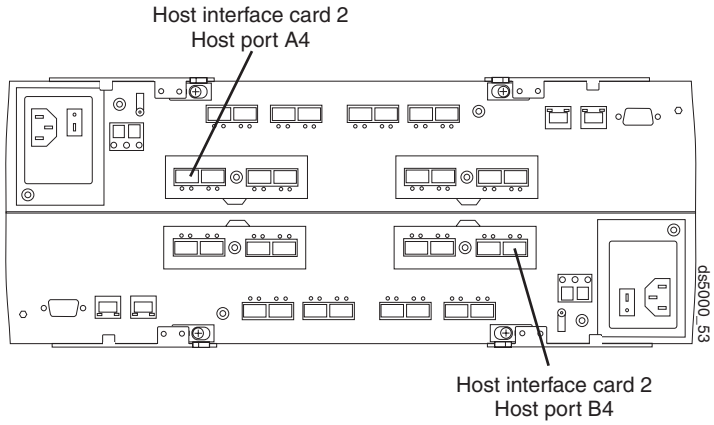


Figure 51. Controller A and Controller B host ports, Dual HIC DS5300

For DS4400, each of the controller host ports is connected to a mini-hub. Each mini-hub has two small form-factor pluggable (SFP) or gigabit interface converter (GBIC) port slots. If the first mini-hub SFP or GBIC port slot is connected to a Fibre Channel switch port as part of remote mirror setup, the second mini-hub port must not be occupied.

Host-initiated I/O operations are refused by the dedicated port. Requests that are received on this dedicated port are only accepted from a controller that is participating in the remote mirror relationship.

Controller ports that are dedicated to the remote logical drive mirror must be attached to a Fibre Channel fabric environment with support for the Directory Service and Name Service interfaces.

Logical drive ownership

The controller owner of the primary logical drive attempts to communicate with only its mirrored controller in the secondary storage subsystem. As shown in Figure 52 on page 145, controller A in the primary storage subsystem attempts to communicate with controller A in the secondary storage subsystem.

The controller (A or B) that owns the primary logical drive determines the controller owner of the secondary logical drive. Regardless of the secondary logical

drive controller ownership, if the primary logical drive is owned by controller A on the primary storage subsystem, the secondary logical drive is then owned by controller A on the secondary storage subsystem. If primary controller A cannot communicate with secondary controller A, no controller ownership changes take place and the remote mirror link is broken for that mirror logical drive pair. When primary controller A can communicate with secondary controller A, the next I/O request to the primary logical drive results in a secondary drive ownership change.

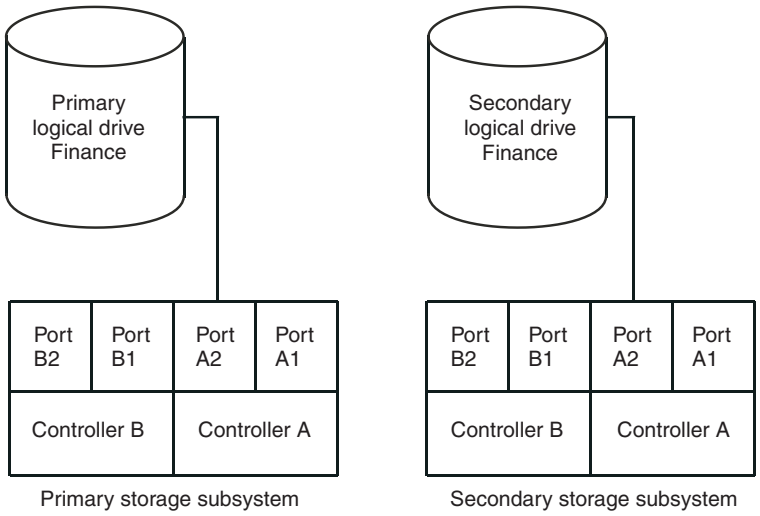


Figure 52. Controller A shown as the controller owner

When an I/O path error causes a logical drive ownership change on the primary storage subsystem, or if the storage administrator changes the controller owner of the primary logical drive, the next remote write request that is processed automatically starts an ownership change on the secondary storage subsystem.

As shown in Figure 53 on page 146, if a primary logical drive is owned by controller A and the controller owner is changed to controller B, the next remote write operation changes the controller owner of the secondary logical drive from controller A to controller B.

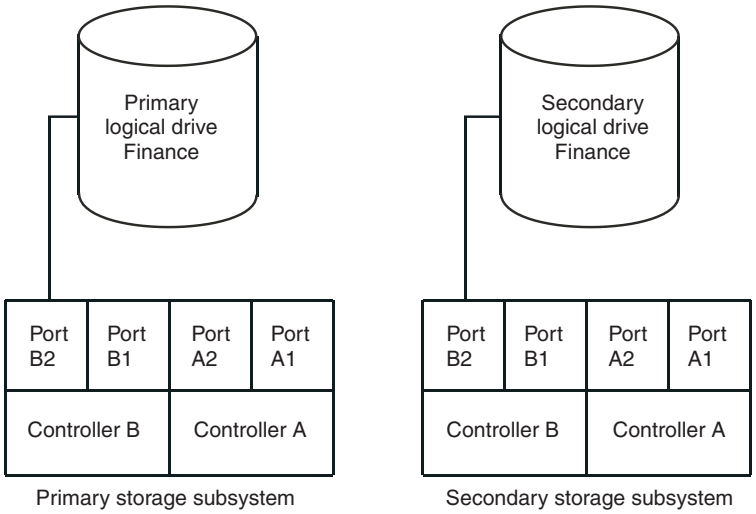


Figure 53. Controller B shown as controller owner

Because controller ownership changes on the secondary storage subsystem are controlled by the primary controller, they do not require any special intervention and you cannot manually change them.

Note: Create the primary and secondary mirrors on the same primary path.

Primary and secondary storage subsystem connection distance

The maximum connection distance that is permitted between storage subsystems that are participating in a mirror relationship is governed by the distance limits of the Fibre Channel interswitch links (ISL). With the previous Remote Mirror Option using standard single-mode fiber technology, the maximum link distance was 10 km (6.25 mi) between storage subsystems. In addition, the ISL link must be a standard Fibre Channel connection using single-mode Fibre Channel cables between two longwave GBICs or SFPs that are inserted into the Fibre Channel switch port slots. With the Enhanced Remote Mirroring Option, link distances between storage subsystems of more than 5150 km (3200 mi) can be achieved.

Role reversals

A role reversal is the act of promoting the secondary logical drive to be the primary logical drive of the mirrored logical drive pair, and demoting the primary logical drive to the secondary logical drive role.

In the event of a disaster at the storage subsystem that contains the primary logical drive, you can fail over to the secondary site by performing a role reversal to promote the secondary logical drive to the primary logical drive role. This allows business operations to continue and hosts to continue accessing data.

You can use one of the following methods to complete a role reversal:

- Click **Volume → Remote Mirroring → Change → Role to Primary** to change a secondary logical drive to a primary logical drive.

  This option promotes the selected secondary logical drive to become the primary logical drive of the mirrored pair, and can be used when a catastrophic failure has occurred. For step-by-step instructions, see the Subsystem Management window online help.
- Click **Volume → Remote Mirroring → Change → Role to Secondary** to change a primary logical drive to a secondary logical drive.

  This option demotes the selected primary logical drive to the secondary logical drive role, and can be used during normal operating conditions. For step-by-step instructions, see the Subsystem Management Window online help.

If the primary storage array is recovered but is unreachable due to a link failure, a forced promotion of the secondary logical drive results in both the primary and secondary logical drives viewing themselves in the primary logical drive role (dual-primary condition). If this occurs, the VolumeCopy in which the primary logical drive is participating will be unaffected by the role change.

General performance considerations

Note the following general performance considerations when you create remote mirrors:

- The controller owner of a primary logical drive performs a full synchronization in the background while processing local I/O write operations to the primary logical drive and associated remote write operations to the secondary logical drive. Because a full synchronization diverts controller processing resources from I/O activity, this can impact performance to the host computer program.

  To reduce the performance impact, you can set the synchronization priority to establish how the controller owner prioritizes a full synchronization relative to other I/O activity. The following are some basic guidelines for setting the synchronization rate:

  – A full synchronization at the lowest synchronization priority rate takes approximately eight times as long as a full synchronization at the highest priority synchronization rate.
  – A full synchronization at the low synchronization priority rate takes approximately six times as long as a full synchronization at the highest priority synchronization rate.
  – A full synchronization at the medium synchronization priority rate takes approximately three and a half times as long as a full synchronization at the highest priority synchronization rate.
  – A full synchronization at the high synchronization priority rate takes approximately twice as long as a full synchronization at the highest priority synchronization rate.

  For more information about setting the synchronization priority, see Chapter 11, "Using the Enhanced Remote Mirroring Option," on page 175.
- When the mirror logical drive pair is in the `Synchronization-in-Progress` state, all host computer write data is copied to the remote system in processing the I/O. Controller I/O bandwidth and I/O latency affect host computer write performance. Host read performance is not affected by the mirror relationship.
- The overall storage subsystem performance is impacted by the number of remote mirrors defined in the mirroring configurations and the number of write requests that need to be performed at a given time for all of the defined mirrors. The greatest impact occurs when the maximum number of Remote Mirroring pairs are defined and the I/Os to the primary LUNs are write only at the maximum I/O rate. Use the appropriate performance monitor to optimally define the maximum Remote Mirroring pairs for your applications.

Using other premium features with the Remote Mirror Option

This section describes how you can use the Remote Mirror Option with Storage Partitioning and FlashCopy .

For information about using the Remote Mirror Option with VolumeCopy, see "The Remote Mirror Option and VolumeCopy" on page 119.

Storage Partitioning and the Remote Mirror Option

Storage Partitioning is a premium feature which enables host computers to share access to logical drives in a storage subsystem. A storage partition is created when you define a collection of host computers (a host group) or a single host computer, and then define a logical drive to LUN map. This map enables you to define what host group or host computer has access to a particular logical drive in your storage subsystem.

Note: Storage partitioning is not a copy services premium feature. This guide does not describe how to enable and use the Storage Partitioning feature. For more

information about storage partitioning, see the *IBM System Storage DS Storage Manager Version 10 Installation and Support Guide* for your operating system.

Figure 54 shows the Mappings view of the Subsystem Management window, where primary logical drive `Accounting` is included in a partition that is accessible by host group `Campus East`, and secondary logical drive `Accounting 2` is included in a partition that is accessible by host group `Campus West`.

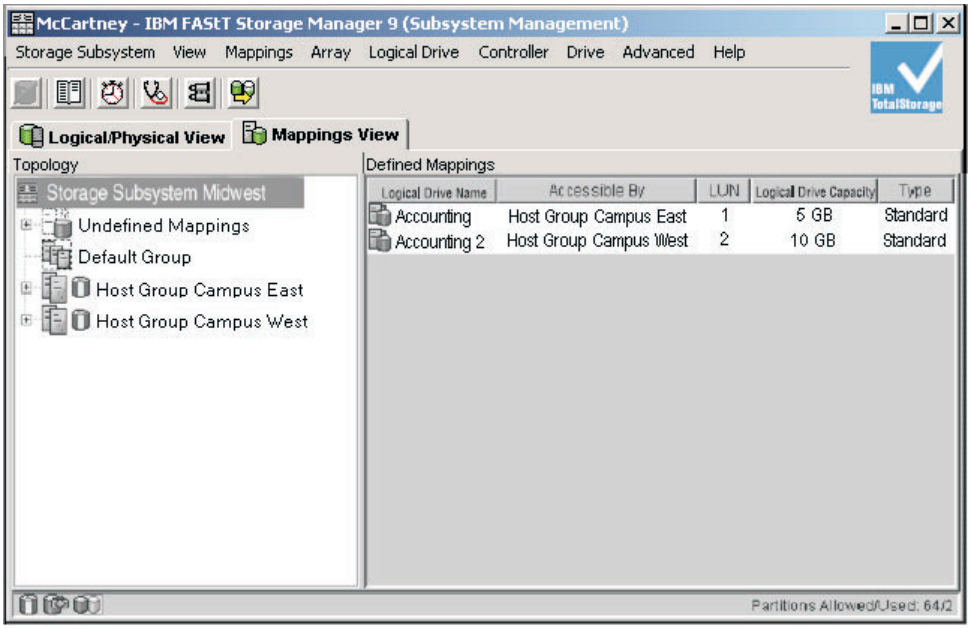


Figure 54. Mappings view of the Subsystem Management window showing storage partitioning

The storage partition definitions for the primary and secondary storage subsystems are independent of each other. If the storage partition definitions are put in place while the logical drive is in the secondary role, the storage partition reduces the administrative effort that is associated with storage subsystem recovery if it becomes necessary to promote the secondary logical drive to the primary role. However, depending on the host operating system and application, the secondary logical drive might not be assigned to the same host that the primary logical drive is mapped to. For more information about defining storage partitions, see the Subsystem Management window online help.

Storage partition definitions can be performed using the **Create** command in the Storage Manager Script window or the CLI. For more information, see the Enterprise Management window online help.

FlashCopy, Enhanced FlashCopy and the Remote Mirror Option

FlashCopy and Enhanced FlashCopy are premium features that are available with the DS Storage Manager software. You can enable this premium feature by purchasing the FlashCopy or Enhanced FlashCopy option depending on whichever is applicable. A FlashCopy or an Enhanced FlashCopy logical drive is a point-in-time (real-time) image of a base logical drive and is created so that a program, such as a backup program, can access the FlashCopy or Enhanced

FlashCopy logical drive and read the data while the base logical drive remains online and is accessible to host computers.

When Enhanced FlashCopy or FlashCopy is enabled, you can have the Enhanced FlashCopy group or images or FlashCopy logical drives that are based on the primary or secondary logical drive of a mirrored logical drive pair.

The logical drive for which the point-in-time image is created is known as the base logical drive and must be a standard logical drive in the storage subsystem. For remote logical drive mirroring, only the base logical drive of a FlashCopy or Enhanced FlashCopy logical drive is permitted to be a candidate for the primary logical drive in a mirror relationship. Figure 55 shows the primary logical drive (also the base logical drive for the FlashCopy logical drive), the secondary logical drive, and the FlashCopy repository logical drive in the Subsystem Management window for the primary storage subsystem.

Important: The base logical drive of a FlashCopy logical drive cannot be a candidate for the secondary logical drive role in a mirror relationship. Otherwise, the FlashCopy logical drive fails when the remote mirror relationship is created.

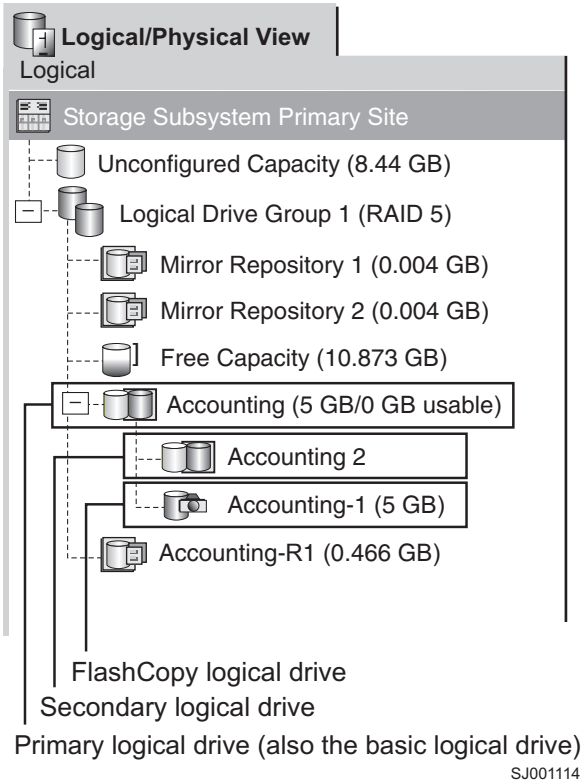


Figure 55. FlashCopy logical drive included in a mirror relationship

Dynamic Volume Expansion

Dynamic Volume Expansion (DVE) is a modification operation that you can use to increase the capacity of a standard logical drive or a FlashCopy repository logical drive. To increase the capacity, a DVE operation uses the free capacity that is available on the array of the logical drive.

The operation is considered to be "dynamic" because you can continuously access data on arrays, logical drives, and disk drives during the operation.

You can complete a DVE operation on both a primary and secondary logical drive in a remote mirror relationship.

You can expand either end. The key is that new capacity is not available until both ends have been expanded (assuming they start out the same size).

During mirror creation, you can select a secondary logical drive that has more capacity than the primary logical drive. When this happens, the effective mirror logical drive capacity is that of the primary logical drive. The usable capacity becomes the smaller of the two logical drives. The primary could then be expanded, and the secondary would already have capacity.

Note: After expansion of the remote logical drive occurs, the GUI will not reflect that expansion until a host write goes through. This can lead to some confusion because if there are no writes to the primary logical drive, the primary side AMW will not report that the secondary expansion has completed.

You cannot complete a DVE operation on a mirror repository logical drive. If the mirror repository logical drive exists from a previous release of Storage Manager and needs to be upgraded, see “Upgrading mirror repository logical drives” on page 175.

Important: DVE (Dynamic Volume expansion) is not possible on a logical drive that is in an active mirror relationship and whose write-mode is 'Asynchronous not write-consistent'. The DVE is possible if the write-mode is 'Synchronous' or 'Asynchronous write-consistent'. The DVE is not possible on either the primary or the secondary logical drive. DVE is also not possible on a FlashCopy Repository of the secondary logical drive. This is because the attribute of the write-mode on the primary logical drive (mirrored to the secondary) is given to the FlashCopy Repository Logical Drive of the secondary's FlashCopy Logical Drive.

A workaround is to set the write-mode of the mirrored primary logical drive, from 'Asynchronous not write-consistent' to 'Asynchronous write-consistent' or 'Synchronous' to run DVE. After DVE is over, reset the write-mode to 'Asynchronous not write-consistent'.

Chapter 10. Installing hardware and software for the Enhanced Remote Mirroring Option

This chapter contains the information that you need to install the hardware and software to run the Remote Mirror Option. The first section contains the steps that you must complete before you install the hardware and software. In the next section, hardware installation procedures are presented, followed by software installation procedures. Complete the procedures in this chapter sequentially, from beginning to end.

Preinstallation considerations

This section provides the following information that you must review and complete before you begin the hardware or software installation procedures:

- Site preparation
- Hardware requirements
- Software requirements
- Host operating systems
- Switch zoning overview

Site preparation

The Remote Mirror Option uses Fibre Channel switches to create a fabric environment for data replication. These Fibre Channel switches require only minimal additional site preparation beyond basic storage subsystem operation.

For basic site preparation considerations including the use of Fibre Channel cables and connections, see the *IBM System Storage DS Storage Manager Version 10 Installation and Support Guide* for your operating system.

For additional site preparation considerations concerning the Fibre Channel switches, including power requirements and physical dimensions and requirements, see the documentation provided with the fabric switch.

Hardware requirements

The following list contains the minimum hardware requirements for configuring your system to use the Enhanced Remote Mirror Option. The list includes the components that are supplementary to the standard requirements of a basic storage subsystem environment. For more information, see the *IBM System Storage DS Storage Manager Version 10 Installation and Support Guide* for your operating system.

- **IBM System Storage Storage Subsystems**

  Enhanced Remote Mirroring is currently supported on the DS3500, DS3950, DS4100, DS4200, DS4300, DS4400, DS4500, DS4700, DS4800, DS5020, DS5100, and DS5300 Storage Subsystems. For information about other storage subsystems that might be supported in the future, contact your IBM service representative.

  It is possible to have different storage subsystems in each of the two nodes of the Remote Mirror Option. For example, the local storage subsystem can be the IBM DS4400 Storage Subsystem and the remote storage subsystem can be the IBM DS4500 Storage Subsystem and vice-versa.

However, because the IBM DS4400 and IBM DS4500 Storage Subsystems are different sets of hardware with different performance characteristics, the storage subsystem and its associated drives and storage expansion enclosures in each of the nodes of the remote mirror setup must be the same for optimal and reliable performance.

- **Fibre Channel switches**

  Use these devices to connect multiple host computers with multiple storage subsystems in a storage area network (SAN) fabric environment.

  For Metro Mirroring (synchronous write mode), the Fibre Channel switches must be used to connect the storage subsystem controller ports that are dedicated for remote mirroring operations together (see "Connectivity and I/O" on page 139). For Global Copy and Global Mirroring (asynchronous write mode), use either the Fibre Channel switches or the Fibre Channel IP (FC-IP) routers for connecting the storage subsystem controller ports that are dedicated for remote mirroring operations together. If the FC-IP routers are used, make sure that minimum speed between the FC-IP router is 10 MB per second. (At this minimum speed, reduce the maximum number of active mirrors to eight.)

  For a list of certified Fibre Channel switches to use with the Remote Mirror Option, see the Storage Subsystem System Storage Interoperation Center at the following website:

  www.ibm.com/systems/support/storage/config/ssic/

- **Multimode Fibre Channel cables**

  Use these cables to connect the host computers and the storage subsystems to the Fibre Channel switches. Multimode Fibre Channel cables are used with shortwave SFP to complete Fibre Channel connections between any two nodes.

- **Single-mode Fibre Channel cables**

  Use these cables to connect between Fibre Channel switches to complete long-distance Fibre Channel connections between Fibre Channels switches. Singlemode Fibre Channel cables must also be used with longwave SFPs.

- **Fibre Channel host bus adapters (HBAs)**

  For a list of certified HBAs to use with the Remote Mirror Option, see the Storage Manager readme file for your host operating system. See "Finding Storage Manager software, controller firmware, and readme files" on page xxi to learn how to access the storage subsystem readme files on the web.

- **Ethernet switches and network**

  Use these devices to connect the storage subsystems to the storage subsystem management station. To create remote mirror logical drive pairs, the management station must have either in-band or out-of-band management connections to both storage subsystems where the logical drives reside.

  The management station with the Storage Manager client program that is used to manage an Enhanced Remote Mirror setup must have management connections to both the primary and the secondary storage subsystem setups. For example, both the primary and the secondary storage subsystems must have optimal entries in the Enterprise Management window of the Storage Manager client program. You must make sure that the management station, and the primary and secondary storage subsystems are in the same Ethernet subnet.

Software requirements

When configuring your host computer to use the new Enhanced Remote Mirroring Option, ensure that the following minimum software requirements are met:

- IBM DS Storage Manager version 9.x or later

- Controller firmware version 07.60.xx.xx or later for DS3950
- Controller firmware version 06.10.xx.xx or later for DS4300 Turbo Option, DS4400, and DS4500 (version 06.12.xx.xx or later is preferred)
- Controller firmware version 06.12.1x.xx or later for DS4100
- Controller firmware version 06.14.xx.xx or later for DS4800 (version 06.15.xx.xx or later is preferred)
- Controller firmware version 06.16.4x.xx or later for DS4700
- Controller firmware version 06.16.8x.xx or later for DS4200
- Controller firmware version 07.30.xx.xx or later for DS5100 and DS5300
- Controller firmware version 07.60.xx.xx or later for DS5020
- Controller firmware version 07.70.xx.xx or later for DS3500
- Controller firmware version 07.77.xx.xx or later for DCS3700
- Controller firmware version 07.83.xx.xx or later for DCS3700 storage subsystem with Performance Module Controllers
- IBM Enhanced Remote Mirror Premium Feature Key (one for each storage subsystem)

When configuring your host computer to use the previous, synchronous-mode-only version of Remote Mirror Option, ensure that the following minimum software requirements are met:

- IBM DS Storage Manager Version 9.x
- Controller firmware version 05.20.xx.xx or later for DS4400. Controller firmware version 05.30.xx.xx or later for DS4500.
- IBM Remote Mirror Premium Feature Key (one for each storage subsystem)

Host operating systems

Host computers that access mirrored logical drives must have one of the following operating systems installed to use the Remote Mirror Option. (For the most up-to-date information, see the most recent Storage Manager readme file for the appropriate host operating system. See “Finding Storage Manager software, controller firmware, and readme files” on page xxi to learn how to access the storage subsystem readme files on the web.)

- Microsoft Windows Server 2003
- Microsoft Windows Server 2008
- Solaris Version 2.8 (Solaris 8), Solaris 9, and Solaris 10
- HP-UX Version 11.23 and 11.31
- IBM i 6.1 with Licensed Internal Code (LIC) 6.1.1 or later
- AIX Version 5.1 or later
- Linux Red Hat Advance Server 4.0 and 5.0, and Novell SLES 9, 10, and 11
- Linux on POWER-based operating systems Red Hat Enterprise Linux 4 and 5, and Novell SLES 9, 10, and 11
- Novell NetWare Version 6.5

Switch zoning overview

This section describes how to create zones for Remote Mirroring. For host server zoning, see the *DS Storage Manager Installation and Support Guide* for your host operating system, in addition to the installation and user’s guide provided by the switch manufacturer.

To create switch zoning configurations for Remote Mirroring, use the management software that comes with the Fibre Channel switch.

The Enhanced Remote Mirroring Option requires two dedicated controller host port connections for each storage subsystem that will participate in Enhanced Remote Mirroring. When the Enhanced Remote Mirroring Option is activated on a storage subsystem, one of the host ports in each of the controllers is dedicated for Remote Mirroring. You cannot use this port for other types of I/O to the storage subsystem. In storage subsystems that have a maximum of two host ports on each controller, the second host port of each controller is the port that is dedicated for Remote Mirroring operations. See the *Storage Subsystem Installation, User's and Maintenance Guide* for your storage subsystem for information about Remote Mirroring dedicated ports.

You must create at least two zones – one zone that consists of the host ports in controller A of the Enhanced Remote Mirroring pair primary and secondary storage subsystems that are dedicated for mirroring operations, and similarly, one zone that consists of the host ports in controller B of the primary and secondary storage subsystems that are dedicated for mirroring operations. This configuration is required to make sure that one port on the controller is fully dedicated to remote mirroring operations. However, for best practices, also zone server HBA connections so that a single host bus adapter in a server can access only one controller per storage subsystem.

Important:

1. Establish one-to-one zones between the storage subsystems in the mirrored pair. The zoning and cabling procedures described in this section are for illustrative purposes only, and might not show one-to-one zoning. Adjust the procedures for your specific installation.
2. Do not zone the ISL port that connects (cascades) switches within a fabric environment.
3. Although the ports that are dedicated for remote mirroring operations are known as *host ports*, in a remote mirror setup you do not connect them to a host server. Instead, you connect them to the other storage subsystems in the mirrored pair.

When two or more Fibre Channel switches are cascaded together, each switch shares a common view of the SAN fabric. For example, if two 16-port Fibre Channel switches are physically connected (cascaded) with a Fibre Channel cable, the switch management software manages these two switches as if they are a single switch with 32 ports (0 - 31), rather than as two separate Fibre Channel switches with 16 ports each (0 - 15). Therefore, a zone that is created containing any of these ports exists on multiple cascaded Fibre Channel switches.

Note: This is usually, but not always the case, depending on the switch manufacturer. Some switch software might write over, rather than merge the switches.

In the top illustration in Figure 56 on page 155, the Fibre Channel switches are on the same network and cascaded. Therefore, there are two zones that span across two switches (Zone 1 and Zone 2). Zone 1 is the same zone on Switch 1A as Zone 1 on Switch 1B.

In the bottom illustration in Figure 56 on page 155, the Fibre Channel switches are on the same network, but are not cascaded. Therefore, in this configuration, there

are four different zones — two zones on Switch 1 and two zones on Switch 2. The zones on Switch 1 are independent of the zones on Switch 2.

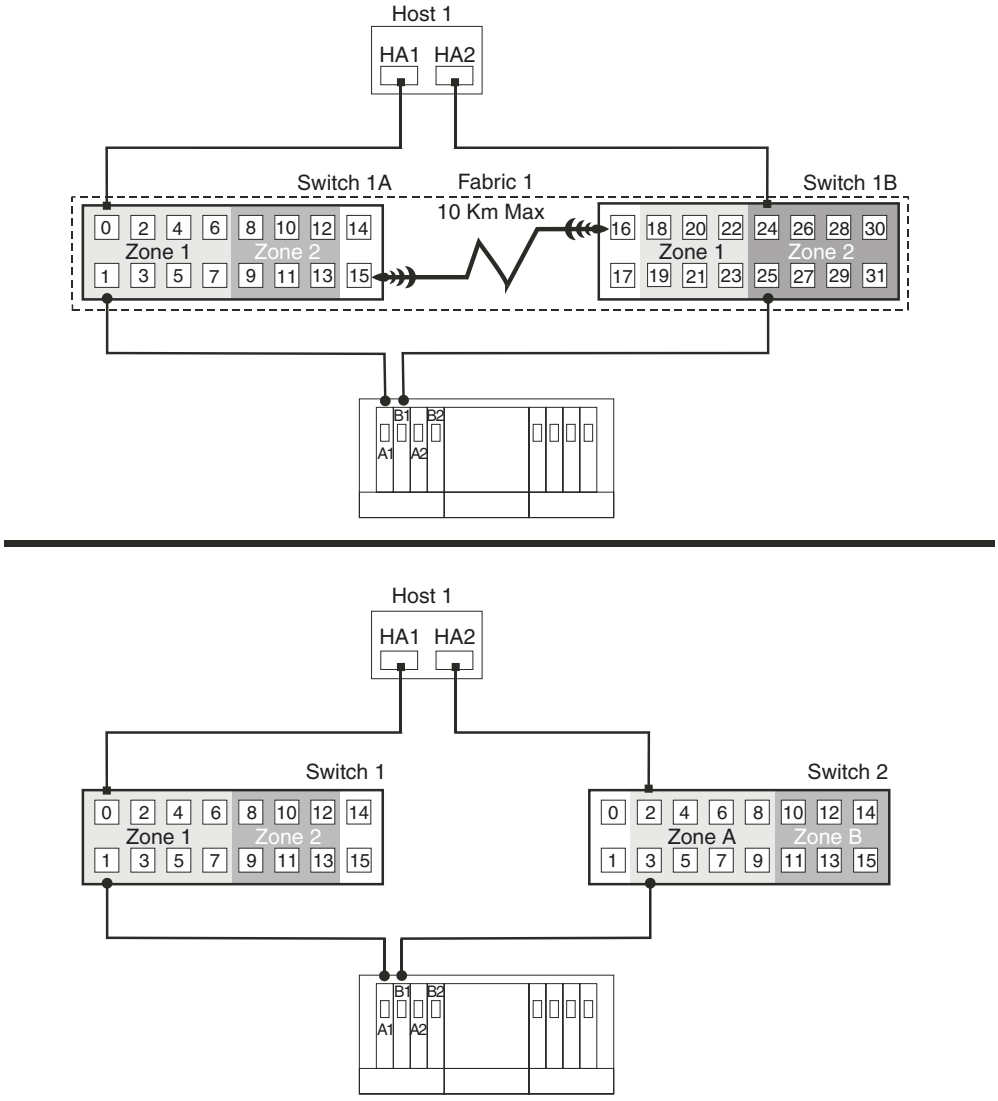


Figure 56. Switch zoning in cascaded (top) and noncascaded (bottom) Fibre Channel switches

For more information about Fibre Channel switch zoning or setting up a zone configuration, see the documentation that comes with the switch.

Installing the hardware

This section describes the procedures that are necessary to properly connect and configure one or more storage subsystems for use with the Remote Mirror Option.

For a checklist to make sure that all the required hardware components are configured properly, see "Hardware and software checklists" on page 171.

The following Remote Mirroring configurations are examples of configurations that IBM Corporation supports. Contact your IBM representative or reseller if you have questions about the implementation of your Remote Mirroring requirements.

Highest Availability Campus configuration

This configuration has two Fibre Channel switches at both the primary and secondary sites to provide complete failover and redundancy in the Fibre Channel switches and fabrics, in addition to all storage subsystem components and host computers. Two Fibre Channel switches at each site also provide redundancy to the local site in addition to a fully redundant remote configuration. There is no single point of failure in the hardware components. Therefore, data synchronization can continue for any single switch failure. This simplifies the disaster recovery process.

Use Metro Mirroring (synchronous write mode) for distance less than 10 km and Global Mirroring for distance of greater than 10 km. Additional hardware and/or Fibre Channel switch licensing might be required to support distances greater than 10 km.

Important:

1. Establish one-to-one zones between the storage subsystems in the mirrored pair. The zoning and cabling procedures described in this section are for illustrative purposes only, and might not show one-to-one zoning. Adjust the procedures for your specific Highest Availability Campus installation.
2. The Highest Availability Campus configuration is the preferred configuration for the Remote Mirror Option.

Figure 57 on page 157 shows the Highest Availability Campus configuration after installation is complete.

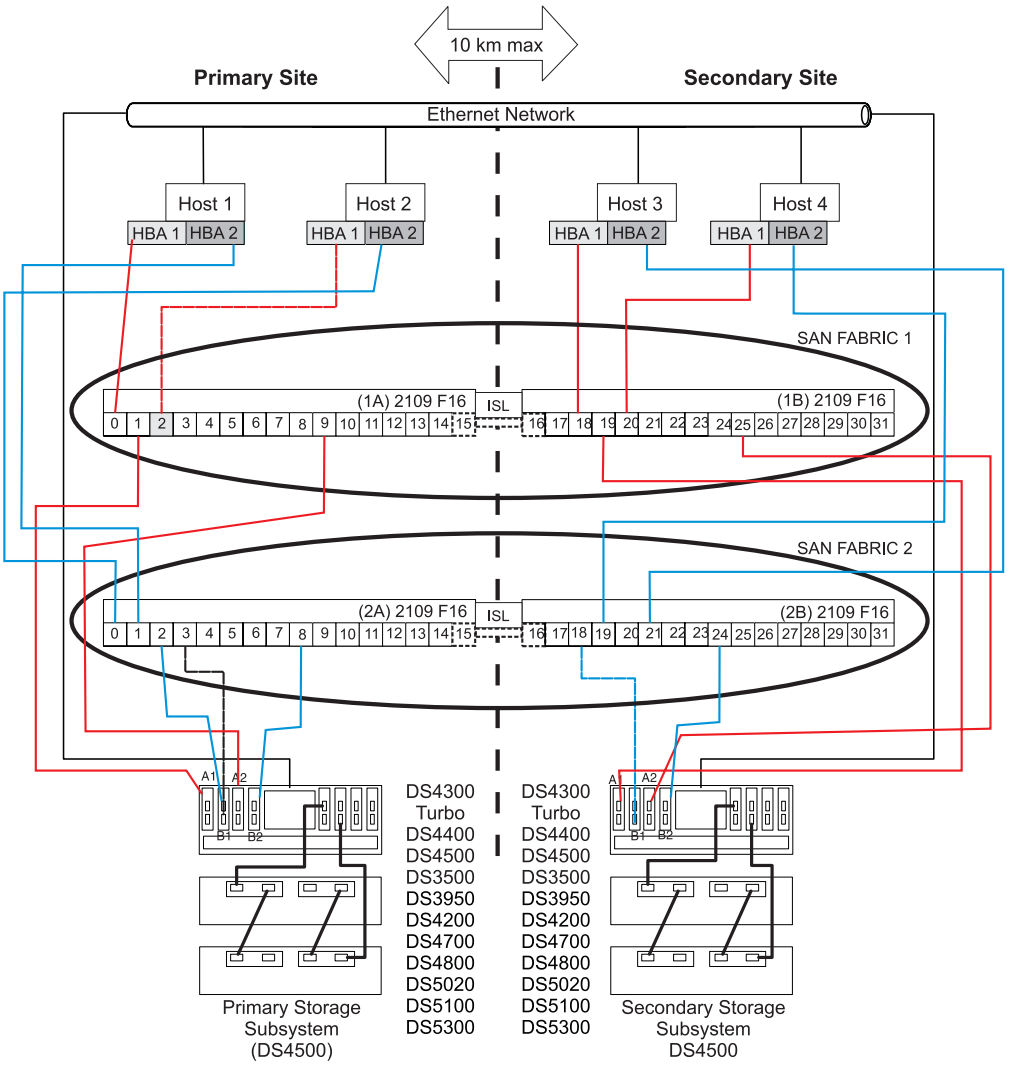


Figure 57. Highest Availability Campus configuration

Switch zoning for the Highest Availability Campus configuration

This configuration provides a separate zone for each reserved port for the Remote Mirroring Option.

You do not need to zone the Fibre Channel switches exactly as presented in this sample configuration. However, the following are requirements when zoning switches for the Highest Availability Campus configuration:

- The remote mirror host port connections cannot be zoned together. You must create two zones:
  - The first zone consists of the Remote Mirroring-dedicated host ports from Controllers A of the primary and secondary host subsystems.
  - The second zone consists of the Remote Mirroring-dedicated host ports from Controllers B of the primary and secondary host subsystems.
- The uplink port must not be zoned on any Fibre Channel switch.
- For best practices, zone server HBA connections so that a single host adapter can access only one controller per storage subsystem fabric.

Important: The Fibre Channel switches in Figure 57 on page 157 contain 16 ports each, which leaves many unused ports per switch. If you are performing switch zoning using the Fibre Channel host port number, instead of the WWNN of the SAN fabric logged-in ports, do not include Fibre Channel switch ports with no Fibre Channel connections in the zone definition. If you include these unused ports in your zones, unauthorized access to the SAN might result.

Figure 57 on page 157 shows how the four Fibre Channel switches are cabled for this Highest Availability Campus configuration. The zones are configured on the switch to allow one port per zone for a storage subsystem connection, and one HBA port per zone for each host. There are four zones in the following configuration example.

- Zone 1 and Zone 3 exist on Fabric 1 (switch 1A at the primary site, and switch 1B at the secondary site)
- Zone 2 and Zone 4 exist on Fabric 2 (switch 2A at the primary site, and switch 2B at the secondary site.

Before proceeding to the next section, make sure that all four Fibre Channel switches are properly zoned. For more information about zoning Fibre Channel switches, see "Switch zoning overview" on page 153.

Cabling examples for the Highest Availability Campus configuration

Table 10 and Table 11 on page 159 show examples of the Fibre Channel cabling connections in the Highest Availability Campus configuration. See the examples before you complete the procedure in "Setting up the Highest Availability Campus configuration" on page 159.

Important: Establish one-to-one zones between the storage subsystems in the mirrored pair. The examples shown in these tables are for illustrative purposes only, and do not show one-to-one zoning.

Table 10. Highest Availability Campus configuration connections (Primary site)

Primary site					
Switch 1A			**Switch 2A**		
Zone	**Port**	**Connection to and from:**	**Zone**	**Port**	**Connection to and from:**
1	0	Host 1, HBA 1 (HA1)	2	0	Host 2, HBA 2 (HB2)
	1	Controller port A1		1	Host 1, HBA 2 (HA2)
	2	Host 2, HBA 1 (HB1)		2	Controller port B1
	3	Additional host, HBA 1 (optional)		3	Additional host, HBA 2 (optional)
	4	Additional host, HBA 1 (optional)		4	Additional host, HBA 2 (optional)
	5	Additional host, HBA 1 (optional)		5	Additional host, HBA 2 (optional)
	6	Additional host, HBA 1 (optional)		6	Additional host, HBA 2 (optional)
	7	Additional host, HBA 1 (optional)		7	Additional host, HBA 2 (optional)

Table 10. Highest Availability Campus configuration connections (Primary site) (continued)

Primary site					
3	8	Unused	4	8	Controller port B2 (dedicated remote mirror port)
	9	Controller port A2 (dedicated remote mirror port)		9	Unused
	10	Unused		10	Unused
	11	Unused		11	Unused
	12	Unused		12	Unused
	13	Unused		13	Unused
N/A	14	Spare (can be added to either zone)	N/A	14	Spare (can be added to either zone)
N/A	15	Uplink with Switch 1B	N/A	15	Uplink with Switch 2B

Table 11. Highest Availability Campus configuration connections (Secondary site)

Secondary site					
Switch 1B			**Switch 2B**		
Zone	**Port**	**Connection from and to:**	**Zone**	**Port**	**Connection from and to:**
N/A	16	Uplink with Switch 2A	N/A	16	Uplink with Switch 1A
N/A	17	Spare (can be added to either zone)	N/A	17	Spare (can be added to either zone)
1	18	Host 3, HBA 1 (HC1)	2	18	Controller port B1
	19	Controller port A1		19	Host 4, HBA 2 (HD2)
	20	Host 4, HBA 1 (HD1)		20	Additional host, HBA 1 (optional)
	21	Additional host, HBA 1 (optional)		21	Host 3, HBA 2 (HD2)
	22	Additional host, HBA 1 (optional)		22	Additional host, HBA 1 (optional)
	23	Additional host, HBA 1 (optional)		23	Additional host, HBA 1 (optional)
3	24	Unused	4	24	Controller port B2 (dedicated remote mirror port)
	25	Controller port A2 (dedicated remote mirror port)		25	Unused
	26	Unused		26	Unused
	27	Unused		27	Unused
	28	Unused		28	Unused
	29	Unused		29	Unused
	30	Unused		30	Unused
	31	Unused		31	Unused

Setting up the Highest Availability Campus configuration

Complete the steps in this procedure to set up the Highest Availability Campus configuration for the Remote Mirror Option. Adjust the steps for your specific installation.

Before you begin, note the following information:

- It is good practice to establish one-to-one zones between the storage subsystems in the mirrored pair. The zoning and cabling procedures described in this section

are for illustrative purposes only, and might not show one-to-one zoning. Adjust the procedures for your specific Highest Availability Campus installation.

- See Figure 57 on page 157 as you complete the steps in this procedure.
- Begin the installation at the primary site. Repeat these steps for the secondary site when instructed to do so.
- All connections are completed using Fibre Channel cables of appropriate length.
- If you are adding the Remote Mirror Option hardware to an existing storage subsystem environment that stops I/O from all host computers, begin with step 1. If this is a new storage subsystem installation, begin with step 2.

1. Power down all storage subsystems, host computers, Fibre Channel switches, and all other hardware in the storage subsystem environment.
2. Make sure that the cabling between all storage subsystems and storage expansion enclosures is complete.

   Note: Depending on which site you are configuring, Switch 1 represents Switch 1A for the primary site and Switch 1B for the secondary site. Repeat the same configuration for Switch 2.
3. Connect the primary host bus adapter (Hx1) for each local host to an available port in Zone 1 of Switch 1.

   Note: You can connect the cables to any port in the proper zone of the switch.
4. Connect the secondary host bus adapter (Hx2) for each host at this site to an available port in Zone 2 of Switch 2.
5. Connect controller port A1 of the storage subsystem to an available port in Zone 1 of Switch 1.
6. Connect controller port B1 of the storage subsystem to an available port in Zone 2 of Switch 2.
7. Connect controller port A2 of the storage subsystem to an available port in Zone 3 of Switch 1.
8. Connect controller port B2 of the storage subsystem to an available port in Zone 4 of Switch 2.

   Note: Controller ports A2 and B2 are reserved for mirror relationship synchronization when the Remote Mirror Option is activated. For more information, see “Connectivity and I/O” on page 139.
9. If the primary site cabling and the secondary site cabling is complete, go to step 10. Otherwise, repeat step 1 through step 8 for the secondary site.
10. Complete the Fabric 1 environment for Switch 1 by connecting Switch 1A with Switch 1B. Connect each end of a long range Fibre Channel cable (that can support a distance up to 10 Km (6.25 mi)) to an unzoned port in each switch.
11. Repeat step 10 for Switch 2A and 2B to complete the Fabric 2 environment for Switch 2.
12. Cabling for this Highest Availability Campus configuration is complete. Repeat step 3 through step 9 for any additional storage subsystems that use the Remote Mirror Option.
13. Power on all storage subsystems, host computers, Fibre Channel switches, and any other hardware at both sites that were powered down in step 1.
14. Hardware installation is complete. The next step is to configure the storage management software to support mirror relationships. Go to “Installing the software” on page 168.

Campus configuration

The Campus configuration offers the same functionality as the Highest Availability Campus configuration, but contains only one switch at each site, rather than two. The configuration is still redundant for host bus adapters, controllers, and remote logical drive mirroring ports, but is a single point of failure for Fibre Channel switches. If a switch at either site fails, the Remote Mirror Option cannot function. For this reason, the Highest Availability Campus configuration is preferred for total environment redundancy. Figure 58 shows the Campus configuration after installation is complete.

Use Metro Mirroring (synchronous write mode) for distance less than 10 km and Global Mirroring for distance of greater than 10 km. Additional hardware and/or Fibre Channel switch licensing might be required to support distances greater than 10 km.

Important: Establish one-to-one zones between the storage subsystems in the mirrored pair. The zoning and cabling procedures described in this section are for illustrative purposes only, and might not show one-to-one zoning. Adjust the procedures for your specific Campus installation.

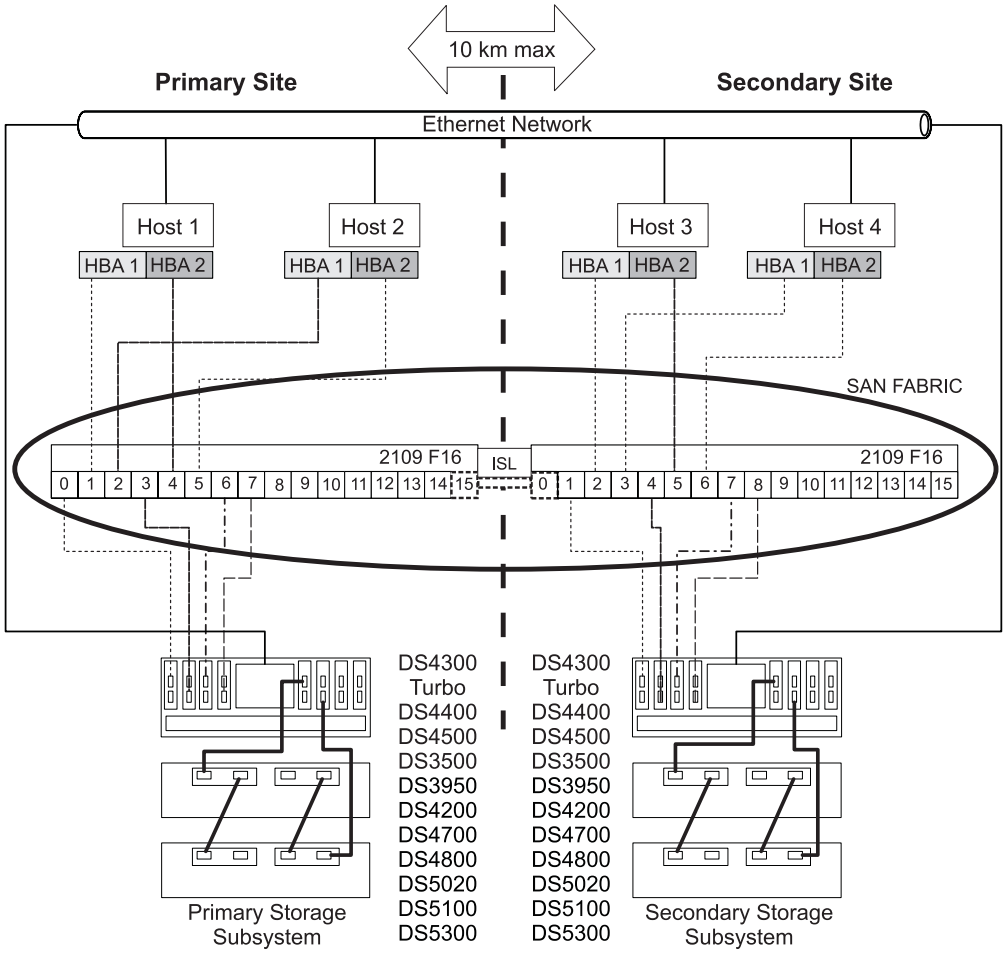


Figure 58. Campus configuration

Switch zoning for the Campus configuration

This configuration provides a separate zone for each reserved port for the Remote Mirroring Option.

For an example of how to zone the Fibre Channel switches, see "Switch zoning for the Highest Availability Campus configuration" on page 157. Remember that the Campus configuration uses two Fibre Channel switches and one 10Km (6.2 mi) ISL.

There are a total of four zones in this configuration.

- All zones exist on the Fabric 1 environment (Switch 1A at the primary site, and Switch 1B at the secondary site).
- Zone 3 and Zone 4 are reserved for the dedicated Remote Mirror Option connections.

Important: The Fibre Channel switches in Figure 58 on page 161 contain 16 ports each, which leaves many unused ports per switch. If you are performing switch zoning using the Fibre Channel host port number, instead of the WWNN of the SAN fabric logged-in ports, do not include Fibre Channel switch ports with no Fibre Channel connections in the zone definition. If you include these unused ports in your zones, unauthorized access to the SAN might result.

Before proceeding to the next section, make sure that both Fibre Channel switches are properly zoned. For more information about zoning Fibre Channel switches, see "Switch zoning overview" on page 153.

Cabling examples for the Campus configuration

Table 12 and Table 13 on page 163 show examples of the Fibre Channel cabling connections in the Campus configuration. See the examples before you complete the procedure in "Setting up the Campus configuration" on page 163.

Important: Establish one-to-one zones between the storage subsystems in the mirrored pair. The examples shown in these tables are for illustrative purposes only, and do not show one-to-one zoning.

Table 12. Campus configuration connections (Primary site)

Primary site		
Switch 1A		
Zone	**Port**	**Connection to and from:**
1	0	Host 1, HBA 1
	1	Controller port A1
	2	Host 2, HBA 1
	3	Additional host, HBA 1 (optional)
	4	Additional host, HBA 1 (optional)
	5	Additional host, HBA 1 (optional)

Table 12. Campus configuration connections (Primary site) (continued)

Primary site		
2	6	Host 1, HBA 2
	7	Controller port B1
	8	Host 2, HBA 2
	9	Additional host, HBA 2 (optional)
	10	Additional host, HBA 2 (optional)
	11	Additional host, HBA 2 (optional)
3	12	Controller port A2 (dedicated remote mirror port)
4	13	Controller port B2 (dedicated remote mirror port)
N/A	14	Spare
N/A	15	Uplink with Switch 2

Table 13. Campus configuration connections (Secondary site)

Secondary site		
Switch 1B		
Zone	**Port**	**Connection to and from:**
1	16	Uplink with Switch 1
	17	Spare
	18	Host port, HBA 1
	19	Controller port A1
	20	Host 4, HBA 1
	21	Additional host, HBA 1 (optional)
	22	Additional host, HBA 1 (optional)
	23	Additional host, HBA 1 (optional)
2	24	Host 3, HBA 2
	25	Controller port B1
	26	Host 4, HBA 2
	27	Additional host, HBA 2 (optional)
	28	Additional host, HBA 2 (optional)
	29	Additional host, HBA 2 (optional)
3	30	Controller port A2 (dedicated remote mirror port)
4	31	Controller port B2 (dedicated remote mirror port)

Setting up the Campus configuration

Complete the steps in this procedure to set up the Campus configuration for the Remote Mirror Option.

Before you begin, note the following information:

- Establish one-to-one zones between the storage subsystems in the mirrored pair. The zoning and cabling procedures described in this section are for illustrative purposes only, and might not show one-to-one zoning. Adjust the procedures for your specific Campus installation.
- See Figure 58 on page 161 as you complete the steps in this procedure.

- Begin the installation at the primary site. Repeat these steps for the secondary site when instructed to do so.
- All connections are completed using Fibre Channel cables of appropriate length.
- If you are adding Remote Mirror Option hardware to an existing storage subsystem environment that stops I/O from all host computers, begin with step 1. If this is a new storage subsystem installation, begin with step 2.

1. Power down all storage subsystems, host computers, Fibre Channel switches, and all other hardware in the storage subsystem environment.
2. Make sure that the basic cabling between all storage subsystems and storage expansion enclosures is complete.

   Note: Depending on which site is configured, Switch 1 represents Switch 1A for the primary site, and Switch 1B for the secondary site.
3. Connect the primary host bus adapter (Hx1) for each host at this site to an available port in Zone 1 of Switch 1.

   Note: You can connect the cables to any port in the proper zone of the switch.
4. Connect the secondary host bus adapter (Hx2) for each host at this site to an available port in Zone 2 of Switch 1.
5. Connect controller port A1 of the storage subsystem to an available port in Zone 1 of Switch 1.
6. Connect controller port B1 of the storage subsystem to an available port in Zone 2 of Switch 1.
7. Connect controller port A2 of the storage subsystem to an available port in Zone 3 of Switch 1.
8. Connect controller port B2 of the storage subsystem to an available port in Zone 4 of Switch 1.

   Note: Controller ports A2 and B2 are reserved for mirror relationship synchronization when the Remote Mirror Option is activated. For more information, see "Connectivity and I/O" on page 139.
9. The primary site cabling is now complete. If the secondary site cabling is complete, go to step 10. Otherwise, repeat step 1 through step 8 for the secondary site.
10. Complete the Fabric 1 environment by connecting Switch 1A with Switch 1B. Connect each end of a long range Fibre Channel cable (that can support a distance of up to 10 Km [6.25 mi]) to an unzoned port in each switch.
11. Cabling for this Campus configuration is complete. Repeat step 3 through step 9 for any additional storage subsystems that use the Remote Mirror Option.
12. Power on all storage subsystems, host computers, Fibre Channel switches, and any other hardware at both sites that were powered down in step 1.
13. Hardware installation is complete. The next step is to configure the storage management software to support mirror relationships. Go to "Installing the software" on page 168.

Intra-site configuration

This configuration is similar to the Campus configuration in that there are only two Fibre Channel switches. However, no multiple-switch fabrics exist in this configuration. This configuration is used in environments where a long distance fabric is not required due to the close proximity of the host computers and storage subsystems. The configuration is still redundant for host bus adapters, controllers,

remote logical drive mirroring ports, and Fibre Channel switches, but is a single point of failure for the site. For this reason, the Highest Availability Campus configuration is preferred for total environment redundancy.

Important:

- A switch failure in this configuration does not affect data access; however, an unsynchronized mirror state might occur as a result.
- Establish one-to-one zones between the storage subsystems in the mirrored pair. The zoning and cabling procedures described in this section are for illustrative purposes only, and might not show one-to-one zoning. Adjust the procedures for your specific Intra-site installation.

Figure 59 shows the Intra-site configuration after installation is complete.

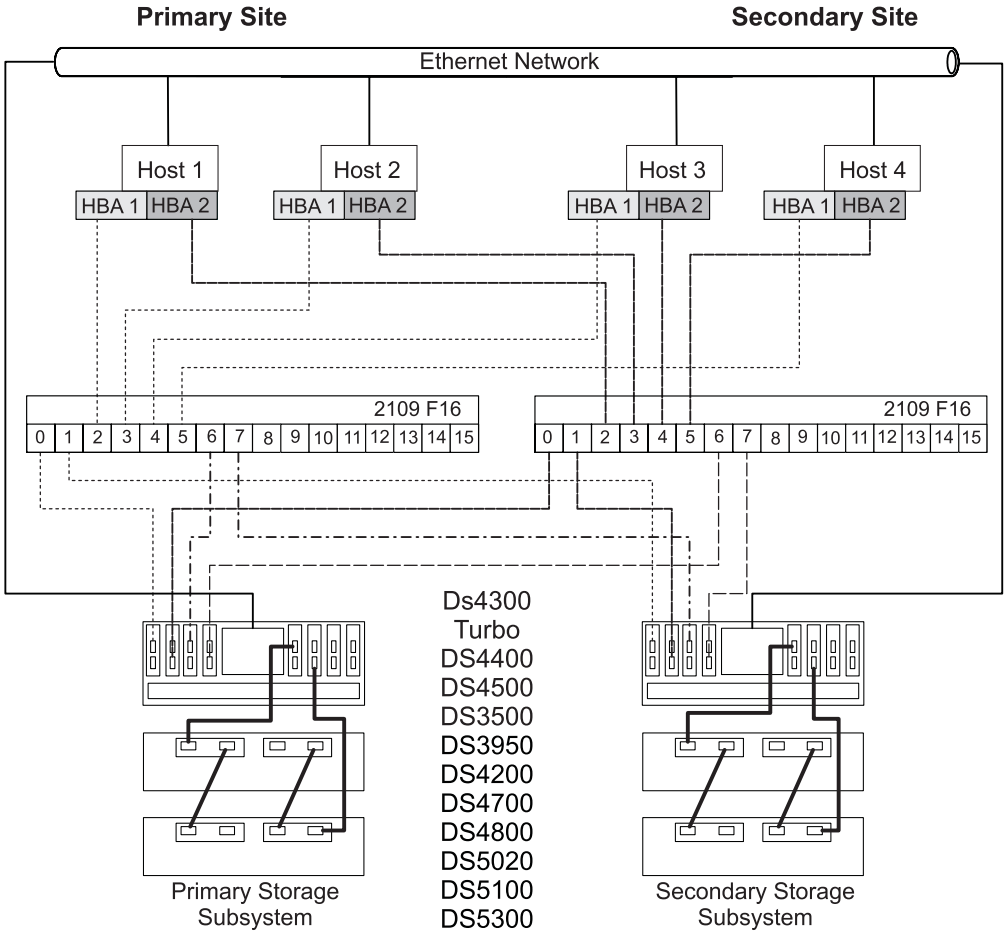


Figure 59. Intra-site configuration

Switch zoning for Intra-site configuration

Intra-site configuration is designed for switch redundancy. However, the Fibre Channel switches are not cascaded, and therefore are independent of each other. This configuration provides a separate zone for each reserved port for the Remote Mirror Option.

For an example of how to zone the Fibre Channel switches, see "Switch zoning for the Highest Availability Campus configuration" on page 157. Remember that the Intra-site configuration uses two Fibre Channel switches but does not use any 10Km (6.2 mi) ISLs.

Important: The Fibre Channel switches in Figure 59 on page 165 contain 16 ports each, which leaves many unused ports per switch. If you are performing switch zoning using the Fibre Channel host port number, instead of the WWNN of the SAN fabric logged-in ports, do not include Fibre Channel switch ports with no Fibre Channel connections in the zone definition. If you include these unused ports in your zones, unauthorized access to the SAN might result.

Note: Figure 59 on page 165 illustrates that there is no relationship between Zone A and Zone B in Switch 2 and Zone 1 and Zone 2 in Switch 1.

There are a total of four zones in this configuration.

- Zone 1 and Zone 2 exist on Switch 1
- Zone A and Zone B exist on Switch 2

Before proceeding to the next section, make sure that both Fibre Channel switches are properly zoned. For more information about zoning Fibre Channel switches, see "Switch zoning overview" on page 153.

Cabling examples for the intra-site configuration

Table 14 shows examples of the Fibre Channel cabling connections in the intra-site configuration. See the examples before you complete the procedure in "Setting up the Intra-site configuration" on page 167.

Important: Establish one-to-one zones between the storage subsystems in the mirrored pair. The examples shown in these tables are for illustrative purposes only, and do not show one-to-one zoning.

Table 14. Intra-site configuration connection

Switch 1			**Switch 2**		
Zone	**Port**	**Connection to and from:**	**Zone**	**Port**	**Connection to and from:**
1	0	Host 1, HBA 1 (HA1)	A	0	Host 1, HBA 2 (HA2)
	1	Controller port A1 (primary storage subsystem)		1	Controller port B1 (primary storage subsystem)
	2	Host 2, HBA 1 (HB1)		2	Host 2, HBA 2 (HB2)
	3	Controller port A1 (secondary storage subsystem)		3	Controller port B1 (secondary storage subsystem)
	4	Host 3, HBA 1 (HC1)		4	Host 3, HBA 2 (HC2)
	5	Additional host, HBA 1 (optional)		5	Additional host, HBA 2 (optional)
	6	Host 4, HBA 1 (HD1)		6	Host 4, HBA 2 (HD2)
	7	Additional host, HBA 1 (optional)		7	Additional host, HBA 2 (optional)

Table 14. Intra-site configuration connection (continued)

Switch 1			Switch 2		
2	8	Unused	B	8	Unused
	9	Controller port A2 (primary storage subsystem - dedicated remote mirror port)		9	Controller port B2 (primary storage subsystem - dedicated remote mirror port)
	10	Unused		10	Unused
	11	Controller port A2 (secondary storage subsystem - dedicated remote mirror port)		11	Controller port B2 (secondary storage subsystem - dedicated remote mirror port)
	12	Unused		12	Unused
	13	Unused		13	Unused
	14	Unused		14	Unused
	15	Unused		15	Unused

Setting up the Intra-site configuration

Complete the steps in this procedure to set up the Intra-site configuration for the Remote Mirror Option.

Before you begin, note the following information:

- Establish one-to-one zones between the storage subsystems in the mirrored pair. The zoning and cabling procedures described in this section are for illustrative purposes only, and might not show one-to-one zoning. Adjust the procedures for your specific Intra-site installation.
- See Figure 59 on page 165 as you complete the steps in this procedure.
- Begin the installation at the primary site. Repeat these steps for the secondary site when instructed to do so.
- All connections are completed using Fibre Channel cables of appropriate length.
- If you are adding Remote Mirror Option hardware to an existing storage subsystem environment that stops I/O from all host computers, begin with step 1. If this is a new storage subsystem installation, begin with step 2.

1. Power down all storage subsystems, host computers, Fibre Channel switches, and all other hardware in the storage subsystem environment.
2. Make sure that the basic cabling between all storage subsystems and storage expansion enclosures is complete on both storage subsystems.
3. Connect the primary host bus adapter for each host (Hx1) to an available port in Zone 1 of Switch 1.

   Note: You can connect the cables to any port in the proper zone of the switch.
4. Connect the secondary host bus adapter (Hx2) for each host to an available port in Zone A of Switch 2.
5. Connect controller port A1 of the primary storage subsystem to an available port in Zone 1 of Switch 1.
6. Connect controller port B1 of the primary storage subsystem to an available port in Zone A of Switch 2.
7. Connect controller port A2 of the primary storage subsystem to an available port in Zone 2 of Switch 1.

8. Connect controller port B2 of the primary storage subsystem to an available port in Zone B of Switch 2.

   Note: Controller Ports A2 and B2 are reserved for mirror relationship synchronization when the Remote Mirror Option is activated. For more information, see "Connectivity and I/O" on page 139.
9. Connect controller port A1 of the secondary storage subsystem to an available port in Zone 1 of Switch 1.
10. Connect controller port B1 of the secondary storage subsystem to an available port in Zone A of Switch 2.
11. Connect controller port A2 of the secondary storage subsystem to an available port in Zone 2 of Switch 1.
12. Connect controller port B2 of the secondary storage subsystem to an available port in Zone B of Switch 2.
13. Cabling for this Intra-site configuration is complete. Repeat step 3 on page 167 through step 12 for any additional storage subsystems that use the Remote Mirror Option.
14. Power on all storage subsystems, host computers, Fibre Channel switches and any other hardware that was powered down in step 1 on page 167.
15. Hardware installation is complete. The next step is to configure the storage management software to support mirror relationships. Go to "Installing the software."

Installing the software

The Remote Mirror Option is a premium feature that is included as part of the Storage Manager installation. You must purchase an Storage Manager Remote Mirror Option for each storage subsystem in your remote mirror configuration. This option contains a GenKey file that will enable the Remote Mirror Option. If you want to purchase the Remote Mirror Premium Feature option, contact your IBM technical-support representative.

Important: All storage subsystems participating in mirror relationships must have firmware level 05.2x.xx.xx or later installed. For more information about upgrading firmware and installing the storage-management software, see the appropriate *IBM System Storage DS® Storage Manager Version 10 Installation and Support Guide* for your operating system.

For a checklist to make sure that all the required software components are configured properly, see "Hardware and software checklists" on page 171.

For more information about enabling or activating the Remote Mirror Option, see "Enabling and activating the Remote Mirror Option."

Enabling and activating the Remote Mirror Option

The Remote Mirror Option premium feature key must be purchased before you can enable the option. The option must be activated with a GenKey program before you can create any mirror relationships. First, determine the status of the Remote Mirror Option. Then enable and activate it.

Determining Remote Mirror Option status

There are four possible statuses of the Remote Mirror Option:

- `Disabled/Deactivated`

- Disabled/Activated
- Enabled/Deactivated
- Enabled/Activated

Important: The Remote Mirror Option must be in the Enabled/Activated state on the secondary storage subsystem as well as the primary storage subsystem to create and maintain mirror logical drive pairs.

You can determine the current status by hovering the mouse pointer over the **Remote Mirror** option icon in the status area of the Subsystem Management window, as shown in Figure 60.

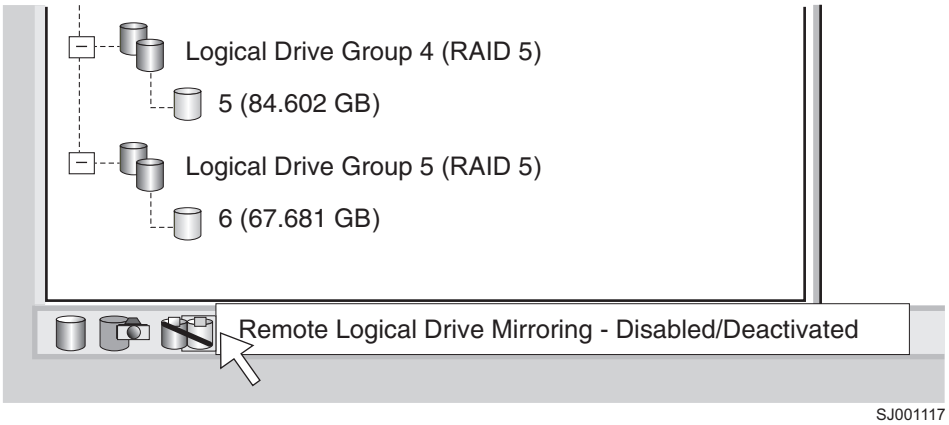


Figure 60. Remote Mirror Option status

Important: The Remote Mirror Option status for the primary storage subsystem is managed independently from the secondary storage subsystem. To determine the status for both storage subsystems, select each storage subsystem independently, then determine the status.

The Remote Mirror Option statuses are as follows:

Disabled and deactivated

No function of the Remote Mirror Option can be performed. Full Remote Mirror Option functionality is not available until the option is enabled and activated. The icon for this state displays in the Premium Feature status area as a cylinder with a mirrored reflection. The icon has a red slash through it to show it is disabled and deactivated. An example of this state is shown in Figure 60.

Disabled and activated

The Remote Mirror Option is disabled, preventing new mirror relationships from being created. However, any pre-existing mirror relationships are maintained with all functions of the Remote Mirror Option. The icon that displays for this state is similar to the disabled and deactivated state, because the red slash remains to show the option is disabled. However, the cylinder and its reflection are green to show that the option is active.

Enabled and deactivated

The Remote Mirror Option is enabled, but not activated. The icon that displays for this state is similar to the disabled and deactivated state,

because the cylinder and its reflection remain gray indicating that it is not available. However, there is no red slash, indicating that the option is enabled.

Enabled and activated
The Remote Mirror Option is enabled and active. You can create and maintain mirror relationships. The icon for this state displays in the Premium Feature status area as a green cylinder with a mirrored reflection.

Enabling the Remote Mirror Option

If the current status of the Remote Mirror Option is `Disabled/Deactivated` or `Disabled/Activated`, complete the following steps to enable the Remote Mirror Option.

To enable the Remote Mirror Option, you must complete the following two procedures in the following order:

1. Obtain the feature enable identifier. This procedure is described in detail in "Obtaining the feature enable identifier using firmware version 6.xx.xx or earlier" on page 7.
2. Generate the feature key file and enable the Remote Mirror Option. This procedure is described in detail in "Generating the feature key file" on page 8.

Before you begin, gather the following information:

- Your Feature Activation Code, which is printed on the IBM Remote Mirror premium feature web activation instructions.
- Your controller unit IBM serial number, machine type, and model number, which are printed on a black label on the front-left mounting flange of the controller.

  Note: To see the mounting flange, you must remove the front bezel.
- The 32 alphanumeric-character feature enable identifier (see "Obtaining the feature enable identifier using firmware version 6.xx.xx or earlier" on page 7).

To obtain the storage subsystem feature enable identifier, make sure that your controller unit and storage expansion enclosures are connected, powered on, and managed using the SMclient.

If the Remote Mirror Option has not been activated, go to "Activating the Remote Mirror Option." If the Remote Mirror Option is activated, go to "Creating mirror relationships" on page 177.

For more detailed steps on how to enable the Remote Mirror Option, see "Enabling the VolumeCopy feature" on page 94. For information on how to view a list of those premium features that are enabled on your storage subsystem, see "Verifying that the premium feature is enabled using firmware version 6.xx.xx or earlier" on page 8.

Activating the Remote Mirror Option

Activating the Remote Mirror Option prepares the storage subsystem to create and configure mirror relationships. When the option is activated, ports A2 and B2 of the storage controller are reserved and dedicated to Remote Mirror Option usage. In addition, a mirror repository logical drive is created for each controller in the storage subsystem.

If the current status of the Remote Mirror Option is `Enabled/Deactivated`, complete the following steps to activate the option:

1. In the Subsystem Management window, click **Storage subsystem → Remote Mirroring → Activate**.

   The Activate Remote Logical Drive Mirroring - Introduction window opens.

   Note: Click **Back** at any time to change the information in the previous window.
2. Decide where the mirror repository logical drives will reside. Select one of the following
   - **Use free capacity on existing arrays** - If this option is selected, then a corresponding logical drive must also be selected.
     a. Select a logical drive.
     b. Select **Finish** or **Next**.
     c. Go to step 6.
   - **Create a new array using unconfigured capacity** - If this option is selected, more information must be collected about the new logical drive. Go to step 3.
3. In the Create New Array window, select the RAID level for the new logical drive.
4. Under the drive selection choices, select one of the following:
   - **Automatic** - The drives are chosen automatically according to available capacity.
   - **Manual** - This option gives you the option to specify which drives contain the mirror repository logical drive.

   a. Press and hold the Ctrl key and click to select the drives that you want to include in your array.
   b. Click **Apply**.

   Important: If the RAID level for the new array is RAID 1, then the number of drives must be an even number. If an odd number of drives are selected, an error message displays when you click **Apply**.
5. Click **Next**.
6. Review the information in the Preview window and click **Finish** if all information is satisfactory.
7. If the storage subsystem password is protected, type the password and click **OK**.

   If the storage subsystem password is not protected, go to step 8
8. Review the information in the Completed window and click **OK** to finish the Remote Mirror Option activation.

   The Remote Mirror Option must be enabled and activated on all storage subsystems that are part of a remote mirror setup. When the Remote Mirror Option is activated, the icon in the Premium Feature status area changes from gray to green. If this is not the case, repeat the steps in "Enabling and activating the Remote Mirror Option" on page 168 and step 1 through step 8 of this procedure for each storage subsystem that has the remote mirror option disabled and deactivated.
9. Continue with "Creating mirror relationships" on page 177.

Hardware and software checklists

Complete the hardware checklist in Table 15 on page 172 and the software checklist in Table 16 on page 172 to make sure that all the required hardware and software components are configured properly.

Hardware checklist

Complete the tasks in Table 15 before you configure the Remote Mirror Option using the storage management software.

Table 15. Hardware checklist

Task description	Validation activity
Make sure that the minimum hardware requirements are met. For a complete list of the hardware requirements, see "Hardware requirements" on page 151.	☐ Completed
Configure your primary and secondary storage subsystems. See the appropriate storage subsystem *Installation and User's Guide* for configuration information and see "Installing the hardware" on page 155.	☐ Completed
Configure your Fibre Channel switches and cables. For more information about configuring the Fibre Channel switches to use with the Remote Mirror Option, see "Installing the hardware" on page 155.	☐ Completed

Software checklist

Complete the tasks in Table 16 before you define mirror relationships in your storage subsystems.

Table 16. Software checklist

Task description	Validation activity
Back up all data on the primary and secondary storage subsystems that are participating in remote logical drive mirroring.	☐ Completed
Install the correct version of firmware and storage-management software. For more information about upgrading firmware or installing the storage management software, see the appropriate Storage Manager Installation and Support Guide or the Subsystem Management window online help.	☐ Completed
Enable the Remote Mirror Option on both the primary and secondary storage subsystems. For information about enabling the feature, see "Enabling and activating the Remote Mirror Option" on page 168.	☐ Completed
Activate the Remote Mirror Option and create a mirror repository logical drive for each controller on the primary storage subsystem. For more information about activating the Remote Mirror Option, see "Enabling and activating the Remote Mirror Option" on page 168.	☐ Completed
Create the required primary and secondary logical drives on the primary and secondary storage subsystems. For more information about establishing a mirror relationship, see Chapter 11, "Using the Enhanced Remote Mirroring Option," on page 175.	☐ Completed

Verifying installation and configuration

All hardware and software is now set up to support mirror relationships through the Remote Mirror Option. However, before creating mirror relationships, make sure that all required components are working properly.

Complete the following procedure for each storage subsystem that is participating in any aspect of a mirror relationship to verify correct configuration:

1. Start the storage management software. For more information about starting the storage management software, see the *IBM System Storage DS Storage Manager Version 10 Installation and Support Guide* for operating system specific procedures.

   If this is the first time that you have started the storage management software, go to step 2. If this is not the first time that you have started the storage management software, go to step 3.
2. If this is the first time that you have started the storage management software, complete the following steps::
   a. Click **OK** when prompted for Automatic Discovery of devices.
   b. Make sure that all the storage subsystems that are designated to participate in mirror relationships are displayed in the Device Tree view of the Enterprise Management window.

      Note: If the storage subsystems do not display, see Chapter 16, "Troubleshooting the Enhanced Remote Mirroring Option," on page 217.
3. If this is not the first time that you have started the storage management software, complete the following steps:
   a. In the Enterprise Management Window, click **Tools → Automatic Discovery**.
   b. Click **OK**.
   c. Verify that all the storage subsystems that are designated to participate in mirror relationships are displayed in the Device Tree view of the Enterprise Management window.

      Note: If the storage subsystems do not display, see Chapter 16, "Troubleshooting the Enhanced Remote Mirroring Option," on page 217.
4. In the Enterprise Management window, select a storage subsystem that will participate in mirror relationships.
5. Click **Tools → Manage Device** to open the Subsystem Management window for that storage subsystem.
6. In the Subsystem Management window, click **Help → About**.
7. Verify that the version of the storage management software is 08.3x.xx.xx or later. If this requirement is not met, see the procedures to upgrade the storage management software in the *IBM System Storage DS Storage Manager Version 10 Installation and Support Guide* for your operating system.
8. Click **OK**.
9. In the Subsystem Management window, click **Storage Subsystem → View Profile**.
10. Click the **All** tab, and verify that the current firmware version is 05.2x.xx.xx or later. If this requirement is not met, see the procedures to upgrade the firmware in the *IBM System Storage DS Storage Manager Version 10 Installation and Support Guide* for your operating system.

    When your installation is completed, see the following online help systems:
    - Enterprise Management window help - Use this online help system to learn more about working with the entire management domain.
    - Subsystem Management window help - Use this online help system to learn more about managing individual storage subsystems and Remote Mirror Option.

You can access these help systems from within the SMClient. In either a Enterprise Management or Subsystem Management window, click **Help** or press F1.

11. Click **Close**.
12. Observe the **Remote Mirror Option** icon in the status area. The icon represents the Disabled and Deactivated status of the Remote Mirror Option.
13. To begin working with mirror relationships, go to Chapter 11, "Using the Enhanced Remote Mirroring Option," on page 175.

Chapter 11. Using the Enhanced Remote Mirroring Option

This chapter contains the procedures for completing the major tasks that are associated with the Remote Mirroring Option:

Upgrading mirror repository logical drives

In previous versions of Storage Manager, the maximum number of logical drives that could participate in mirror relationships was 32. Storage Manager, in conjunction with storage subsystem controller firmware version 06.10.xx.xx or later, allows 64 logical drives to participate in mirror relationships. Therefore, to support creating more than 32 logical drives in mirror relationships, you need to upgrade any existing mirror repository logical drives on the storage subsystem to have a minimum capacity of 128 MB (increased from 4 MB). Because two mirror repository logical drives are required per storage subsystem, a maximum of 256M of disk space will be needed.

Note: You do not need to complete the steps in this section if Storage Manager 9.1x is the first time you have activated the Remote Mirror Option. Upgrading the mirror repository logical drives is only required if a previous version of Storage Manager existed on your system, with the Remote Mirror Option feature installed, before you installed Storage Manager 9.1x.

Use the Upgrade Mirror Repository Logical Drives Wizard to create new, larger mirror repository logical drives on your storage subsystem, then to move any data from the existing mirror repository logical drives to the new ones, and then to delete the old mirror repository logical drives.

Important:

1. If there is not enough free capacity or unconfigured capacity available on your storage subsystem, you will not be able to upgrade your mirror repository logical drives. The Free Capacity or Unconfigured Capacity options you select for the mirror repository logical drives must have a total of 256 MB capacity available. Two mirror repository logical drives are created on this capacity: one for each controller.
2. For each mirrored pair that you upgrade, leave a minimum of 0.25 GB free capacity in the same array as the mirror repository logical drives. If you someday deactivate the mirrored pair, this will make sure that you have enough capacity to reestablish the mirrored pair from the deactivated state. Otherwise, if there is no free capacity available on the storage subsystem, you might not be able to reestablish the mirrored pair.

Complete the following steps to upgrade the mirror repository logical drives:

1. Select **Storage Subsystems → Remote Mirroring → Upgrade Mirror Repository Logical Drives**.

   The Upgrade Mirror Repository Logical Drives: Introduction dialog window opens.

2. In the Upgrade Mirror Repository Logical Drives: Introduction dialog window, select one of the following options, based on where the upgraded mirror repository logical drives will reside:
   - **Free capacity on same array (create individual logical drive)** – You must also select a corresponding array.
     a. Select an array.
     b. Select **Next**.
     c. Go to step 5.
   - **Free capacity on different array (create individual logical drive)** – You must also select a corresponding array.
     a. Select an array.
     b. Select **Next**.
     c. Go to step 5.
   - **Unconfigured capacity (create new array)** – If you select this option, the Create New Array dialog window opens. Go to step 3 to create a new array.
3. In the Create New Array dialog, select the RAID level for the new array.

   Note: If you need more detailed information about the options in this dialog window, select the Help button to launch the online help that is specific to this dialog window.
4. Under the drive selection choices, select one of the following options:
   - **Automatic** – The drives are chosen automatically according to available capacity. Click **Next**; the Preview dialog window opens.
   - **Manual** – The user specifies which drives contain the mirror repository logical drive, as follows:
     – Select the desired drives. You can select multiple drives by pressing and holding Ctrl while you select.
     – Click **Add** to move the drives to the Selected Drives panel.
     – Click **Next**. The Preview dialog window opens.

     Important: If the RAID level for the new array is RAID 1, then you must select an even number of drives. If you select an odd number of drives, an error message will display when you click **Apply**. RAID 0 is not an option; therefore, the number of drives that you select must always be greater than one for all RAID levels. RAID 3 and RAID 5 require a minimum of three drives.
5. Review the information that displays in the Preview dialog window, then click **Finish** if all information is satisfactory.

   Note:
   a. If prompted for a password, enter the password and select **OK**.
   b. The upgrade process might take a minute or longer to complete, depending on the current workload of the storage subsystem. Any I/O activity to the storage subsystem might be delayed during the upgrade process.

   The Completed dialog window opens.
6. Review the information that displays in the Completed dialog window, then click **OK**. The mirror repository logical drives are now upgraded, and the storage subsystem can support up to 64 mirror relationships.

7. Repeat step 1 on page 175 through step 6 on page 176 for the secondary storage subsystem, and for any additional storage subsystems that contain mirror repository logical drives that have not yet been upgraded.

Creating mirror relationships

Before you create mirror relationships, be sure that the Remote Mirroring Option is enabled and activated.

Note: The secondary host ports on the storage subsystems are reserved for data synchronization between a primary and secondary logical drive of a mirror relationship.

Creating logical drives for mirror relationships

Before you create mirror relationships, be sure that logical drives exist at both the primary and secondary storage subsystems. The logical drive of the remote mirror pair that is presented to the host is the primary logical drive. The storage subsystem that the primary drive resides in is called the *primary* storage subsystem. Similarly, the storage subsystem that the secondary logical drive resides in is called the *secondary* storage subsystem.

If a primary or secondary logical drive does not exist, you must create one on the corresponding storage subsystem.

Consider the following when creating a logical drive:

- Create the primary and secondary mirrors on the same primary path.
- The secondary logical drive must be of equal or greater size than the primary logical drive.
- The RAID level of the secondary logical drive does not have to be the same as that of the primary logical drive.

For more information about creating logical drives, see the Subsystem Management window online help.

When logical drives exist at both sites, you can create mirror relationships with the Create Remote Mirror wizard.

Creating a mirror relationship using the Create Remote Mirror wizard

Using the Create Remote Mirror wizard, you can create a mirror relationship between a primary logical drive and a secondary logical drive. Before beginning the wizard, make sure that the following requirements are met:

- The Remote Mirroring Option is enabled on both storage subsystems in which the primary and secondary logical drives will reside.
- The Remote Mirroring Option is activated on both subsystems.
- The storage subsystems are connected through a proper Fibre Channel fabric configuration.
- The size of the secondary logical drive is equal to or greater than the primary logical drive.
- There are management connections to both the primary and secondary storage subsystems. The Enterprise Management window must display both primary and secondary storage subsystems in the management domain.

- The remote Fibre Channel switch connections are made between the primary and secondary storage subsystems. The Fibre Channel switches are zoned so that the controller host ports are by themselves.

When these requirements are met, complete the following steps to create a mirror relationship:

1. In the Logical/Physical view of the Subsystem Management window, select the logical drive that will become the primary logical drive in the mirror relationship.
2. Click **Logical Drive → Remote Mirroring → Create**.
3. Click **Next**.
4. Follow the instructions in the Select Remote Storage subsystem window.

   The Create Remote Mirror window opens and displays starting requirements that are similar to those listed at the beginning of this section.

   a. Select the proper storage subsystem. The wizard displays all available storage subsystems within the management domain that have the Remote Mirroring Option enabled and activated.
   b. Click **Next**. The Select Secondary Logical Drive window displays.
5. Select the logical drive that will become the secondary logical drive in the mirror relationship. If there are no logical drives listed, the secondary storage subsystem that you selected does not have logical drives with enough capacity available to mirror the selected logical drive.
6. Click **Next**. The Set Write Mode window displays.
7. Select one of the following write modes:
   - Synchronous
   - Asynchronous

   If you select Asynchronous mode, the "Add to write consistency group" check box becomes available. Select the "Add to write consistency group" check box if you want to define a Global Mirroring mirror pair (makes sure that write operations to the secondary storage subsystem are completed in the same order as on the primary storage subsystem) instead of a Global Copy mirror pair. For more detailed descriptions of each type of write mode, see “Write options” on page 133.

   Note:

   a. Synchronous remote mirroring is referred to as Metro Mirroring.
   b. Asynchronous remote mirroring with the consistency group option is referred to as Global Mirroring; without the consistency group option, it is referred to as Global Copy.
   c. Adding the mirrored pair to a write consistency group (Global Mirroring) might impact host I/O performance.
   d. For more information about write consistency groups, see “Write consistency groups” on page 135 or “Changing the write mode” on page 184.
8. Click **Next**. The Select Synchronization Settings window displays.
9. Select the synchronization priority level.

   Note: For more information about the synchronization priority level, see “Changing the synchronization settings” on page 181.
10. Select the resynchronization method.

Note: For more information about resynchronization methods, see "Resynchronization methods" on page 137.

11. Click **Finish**.
12. If the remote storage subsystem is password protected, type the password and click **OK**.

    If the remote storage subsystem is not password protected, go to step 13.
13. If you do not exceed the maximum number of mirrored logical drive pairs that can be created for the storage subsystem, you are prompted to create another mirror logical drive pair by the Create Remote Mirror wizard. If you do not want to create another mirror logical drive pair, click **No** and go to step 14. Otherwise, complete the following steps:
    a. Select the logical drive that will become the next primary logical drive.
    b. Click **Next**.
    c. Repeat step 4 on page 178 through step 13 for each additional mirror relationship.
14. Review the information in the Completed window, then click **OK** to complete the Create Remote Mirror wizard.

The primary and secondary logical drives are now displayed with the mirror relationship icons, which will change slightly when the data synchronization is completed. The amount of time that is required for the data to be synchronized between the two logical drives varies proportionally to the size of the logical drive being mirrored and storage subsystem I/O loads. After the synchronization is complete, the icons change to the optimal state mirror relationship icons. Figure 61 shows how the icons display during and after data synchronization.

Note: To view all the icons that are associated with the Remote Mirror Option and a description of their purpose, see the Subsystem Management window online help.

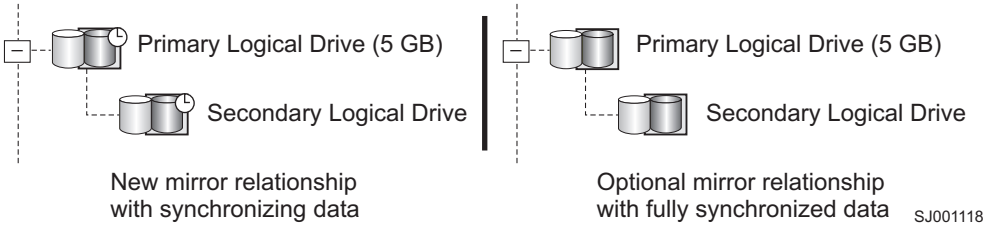


Figure 61. Synchronizing and optimal mirror relationship icons

The mirror relationship is now created and optimal.

Maintaining mirror relationships

When a mirror relationship is active, you can modify certain attributes of the relationship at any time. This section describes how to view information about the mirror relationship, how to change the synchronization priority level, how to remove a mirror relationship, and how to delete logical drives that are participating in a mirror relationship.

Viewing mirror relationships

The mirror relationship that exists between the primary logical drive and the secondary logical drive can be examined by various methods, such as using the storage subsystem profile, the Mirroring Properties window, and the View Associated Components window.

Displaying the storage subsystem profile

The storage subsystem profile is the most efficient way to view information about any or all components of the storage subsystem. Details for all logical drives, such as the primary, secondary, and mirror repository logical drives can all be easily viewed through the storage subsystem profile. The storage subsystem profile also contains specific information about components that are associated with mirror relationships.

To display the storage subsystem profile, complete the following steps:

1. In the Subsystem Management window click **Storage Subsystem → View Profile**.
2. Click the **Logical Drives** tab.
   - To view information about the mirror relationships that exist on this storage subsystem, click the **Mirrors** tab.
   - To view information about the mirror repository logical drive, click the **Repositories** tab.

Note: Click **Save As** to save all of the information that is shown in the storage subsystem profile as a text (.txt) file. The Save Profile window that opens provides the option of saving the current window, multiple windows, or the entire storage subsystem profile.

The Mirroring Properties window

The Mirroring Properties window displays all the physical characteristics of a single logical drive in the mirror relationship.

The window displays the same information as the storage subsystem profile for the selected logical drive, but is specific only to that logical drive. The synchronization progress displays if the selected logical drive is synchronizing data with another logical drive in a newly defined mirror relationship or in an existing mirror relationship after the broken mirror link is restored.

Complete the following steps for each logical drive that needs to be examined in the mirror relationship:

1. Select the primary or secondary logical drive.
2. Click **Logical Drive → Properties**.
3. Click the **Mirroring** tab.

You can also use this procedure to view the synchronization progress of a recently-created mirror relationship.

The View Associated Components window

The View Associated Components window provides a graphical representation of the logical drives that are participating in the mirror relationship. Details are provided for all components, rather than just the logical drive that was initially selected.

Complete the following steps to view all the associated components in a mirror relationship, including primary, secondary, and mirror repository logical drives:

1. Select the primary or secondary logical drive in a mirror relationship.
2. Right-click and select **View Associated Components**.

   The View Associated Components window opens.
3. Click **Close** to exit the window.

Changing the synchronization settings

The synchronization priority level of a mirror relationship defines the amount of system resources that are used to synchronize the data between the primary and secondary logical drives of a mirror relationship. If you select the highest priority level for a mirror relationship, the data synchronization uses a high amount of system resources to increase mirror performance, but might decrease performance for all other functions, including other mirror relationships. If you select the lowest synchronization level, there is less impact on complete system performance, but the mirror relationship synchronization might be slower.

The setting for the resynchronization method defines whether the communication between the primary and secondary logical drives is restored manually or automatically after a communication interrupted.

To change the synchronization settings for a mirror relationship, complete the following steps:

1. In the Logical/Physical view of the Subsystem Management window, select a primary logical drive of a mirror relationship.
2. Click **Logical Drive → Remote Mirroring → Change → Synchronization Settings**.

   The Change Synchronization Settings window opens. The primary logical drive that you chose in step 1 is selected by default in the **Select Logical Drives** field.
3. Select one or more logical drives.
4. Select the synchronization priority level. The five levels are Lowest, Low, Medium, High, and Highest. All selected logical drives will change to the same synchronization priority level.

   For more information about the performance impact of the five priority settings, see “General performance considerations” on page 146.
5. Select the resynchronization method. You can select Manual or Automatic.

   For more information about the resynchronization methods, see “Resynchronization methods” on page 137.
6. Click **OK**.
7. Click **Yes** when the Confirmation window opens.
8. Click **OK** when the Completed window opens.

Suspending a mirror relationship

Use the Suspend option to stop data transfer between a primary logical drive and a secondary logical drive participating in a mirror relationship, without removing the mirror relationship.

Suspending a mirror relationship enables you to control when the data on the primary and secondary logical drives is synchronized. This helps reduce any performance impact to the host application that might occur while any changed data on the primary logical drive is copied to the secondary logical drive.

When a mirror relationship is in a Suspended state, no attempt is made to contact the secondary logical drive. Any writes to the primary logical drive are persistently logged in the mirror repository logical drives. After the mirror relationship is resumed, only the modified regions of the primary logical drive are written to the secondary logical drive. The Suspend option can be used to backup a secondary logical drive.

Attention: If the mirrored pair that you select to suspend is part of a write consistency group, the system automatically suspends all mirrored pairs in the write consistency group. Use the command line interface to resume single write-consistent mirrored pairs. For more information about using the command line interface, see the Enterprise Management Window online help. For more information about write consistency groups, see "Write consistency groups" on page 135.

Note:

1. Suspending a mirror relationship removes any Needs Attention status resulting from communication failure between the primary and secondary logical drives.
2. Any data that is written to the primary logical drive will be logged while the mirror relationship is suspended and will automatically be written to the secondary logical drive when the mirror relationship is resumed. A full synchronization will not be required.
3. The state of the remote logical drive mirror remains suspended until you use the Resume option to resume synchronization activity.

Figure 62 shows a mirror relationship in Suspended state.

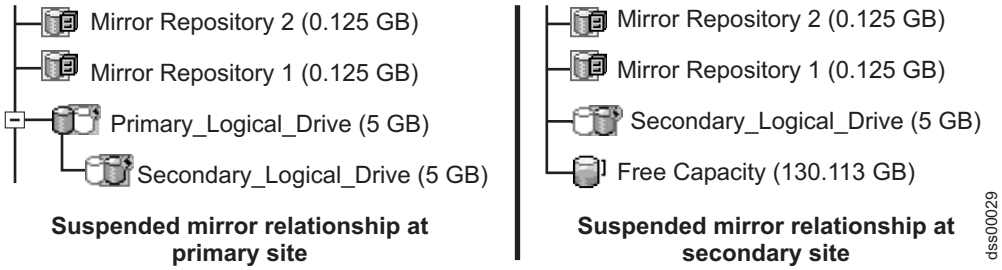


Figure 62. Suspended mirror relationships at primary site and secondary site

To suspend a mirror relationship, complete the following procedure:

1. In the Logical/Physical view of the Array Management Window, select a primary logical drive of a mirror relationship.
2. Select **Logical Drive → Remote Mirroring → Suspend**. The Suspend Mirrored Pair window opens.
3. Select one or more mirror relationships to suspend.
4. Click **Suspend**.
5. Carefully review the information that is presented in the Confirmation window.
6. If the information in the Confirmation window is correct, type `Yes` and click **OK**.

   Important: If the mirrored pair that you select to suspend is part of a write consistency group, the system automatically suspends all mirrored pairs in the write consistency group. Use the command line interface to resume single write-consistent mirrored pairs. For more information about using the command line interface, see the Enterprise Management Window online help.

For more information about write consistency groups, see “Write consistency groups” on page 135. The Suspend Mirrored Pair - Progress window displays while the selected mirrored logical drives are suspended. After all of the selected mirrored pairs are suspended, the **OK** button becomes available.

7. Click **OK**. The Subsystem Management window opens, showing the primary and secondary logical drives in an Optimal/Suspended state.

   For information about icons used for mirror relationships, see the Subsystem Management window online help.

Resuming a mirror relationship

Use the Resume option to restart data transfer between a primary logical drive and secondary logical drive participating in a mirror relationship, after the mirror has been suspended or unsynchronized.

This option enables you to control when the data on the primary logical drive and secondary logical drive is resynchronized. This helps reduce any performance impact to the host application that might occur while any changed data on the primary logical drive is copied to the secondary logical drive.

After the mirrored pair is resumed, only the regions of the primary logical drive that changed since the mirrored pair was suspended are written to the secondary drive.

Attention: If the mirrored pair that you select to resume is part of a write consistency group, the system automatically resumes all mirrored pairs in the write consistency group. Use the command line interface to resume single write-consistent mirrored pairs. For more information about using the command line interface, see the Enterprise Management Window online help. For more information about write consistency groups, see “Write consistency groups” on page 135.

Complete the following procedure to resume a suspended mirror relationship:

1. In the Logical/Physical view of the Subsystem Management Window, select a primary logical drive of a mirror relationship.
2. Select **Logical Drive → Remote Mirroring → Resume**. The Resume Mirrored Pair window opens.
3. Select one or more mirror relationships to resume.
4. Click **Resume**.
5. Carefully review the information that is presented in the Confirmation window.
6. If the information in the Confirmation window is correct, click **Yes** to resume data transfer to the mirrored pairs that you selected. The Resume Mirrored Pair - Progress window displays while data transfer is resumed to the selected mirrored pairs. After data transfer is resumed to the mirrored pairs, the **OK** button becomes available.
7. Click **OK**. The Subsystem Management Window opens, showing the primary and secondary logical drive in an Optimal or Synchronizing state.

Removing mirror relationships

Removing a mirror relationship between a primary and secondary logical drive does not affect any of the existing data on either logical drive. The link between the logical drives is removed, but the primary logical drive still continues normal I/O operation.

This method is not for backup routines. Instead, suspend the mirror relationship, because suspend operation maintains the mirror relationship. See “Suspending a mirror relationship” on page 181 for more information about the suspend procedure.

A mirror relationship between the two logical drives can be re-created unless one of the logical drives is deleted.

Complete the following steps to remove a mirror relationship between two logical drives:

1. In the Subsystem Management window, select a local primary or local secondary logical drive of a mirror relationship.
2. Click **Logical Drive → Remote Mirror → Remove Mirror Relationship**.

   The Remove Mirror Relationship window displays all mirror relationships that are associated with this storage subsystem.
3. Select one or more mirror relationships to be removed, and click **Remove**.
4. Carefully review the information that is presented in the Confirmation window.
5. If all the information in the Confirmation window is correct, click **Yes**.

Changing the write mode

You can select one of the following two write modes:

Synchronous

Synchronous write mode offers the best chance of full data recovery from the secondary storage subsystem in the event of a disaster. Metro Mirror provides slower host I/O performance than Global Copy.

Remote mirroring using Metro Mirror is referred to as Metro Mirroring.

Asynchronous

Global Copy offers faster host I/O performance than Metro Mirror, but it does not guarantee that data is successfully written to the secondary logical drive before indicating a successful write to the host system.

Remote mirroring using Global Copy with the consistency group option is referred to as Global Mirroring. Remote mirroring using Global Copy without the consistency group option is referred to as Global Copy.

Complete the following steps to change the write mode of a mirror relationship:

1. From the Subsystem Management window, select a local primary logical drive of a mirror relationship.
2. Select **Logical Drive → Remote Mirror → Change → Write Mode**. The Change Write Mode window opens.
3. Select one or more mirrored pairs.
4. Select one of the following write modes:
   - Synchronous
   - Asynchronous

   If you select Asynchronous mode, the "Add to write consistency group" check box becomes available. Do not select the "Add to write consistency group" check box if you want to define a Global Copy mirror pair (in which write operations to the secondary storage subsystem are not required to be completed in the same order as on the primary storage subsystem) instead of a Global Mirroring mirror pair. For more detailed descriptions of each type of write mode, see “Write options” on page 133.

Note:

a. Synchronous remote mirroring is referred to as Metro Mirroring.
b. Asynchronous remote mirroring with the consistency group option is referred to as Global Mirroring; without the consistency group option, it is referred to as Global Copy.
c. Adding the mirrored pair to a write consistency group (Global Mirroring) might impact host I/O performance.
d. For more information about write consistency groups, see "Write consistency groups" on page 135.

Deleting primary and secondary logical drives

Deleting a logical drive that is participating in a mirror relationship removes the mirror relationship and completely deletes the logical drive from the storage subsystem. The mirror relationship cannot be redefined until you create a new logical drive or an alternate logical drive replaces the deleted logical drive.

You cannot delete a secondary logical drive that is actively participating in a mirror relationship. When you delete a primary logical drive, the mirror relationship is removed, and the secondary logical drive becomes a standard logical drive, which you can then delete.

Complete the following steps to delete a primary or secondary logical drive from a mirror relationship:

Attention:

- If you have data or logical drives that you want to keep, do not click **Recovery → Reset → Configuration**. This resets the controller unit and deletes all previously-configured logical drives.
- You must use Disk Administrator and delete operating system logical drives before you delete logical drives or reset the configuration in Storage Manager. This avoids damage to your registry information.
- The following steps will permanently remove data from the selected logical drive.

1. In the Subsystem Management window for the primary site, select a primary logical drive.
2. Select **Logical Drive → Delete**.
3. The Delete Logical Drives window opens.
4. Select one or more logical drives to delete.
5. Click **OK**. The confirmation window opens.
6. Carefully review the information in the confirmation window. If all the information is correct, type `Yes` in the text area and click **OK**.
7. In the Subsystem Management window for the secondary site, repeat these steps to remove the secondary logical drive, if required.

Deactivating and disabling the Remote Mirror Option

If no mirror relationships exist and the Remote Mirror Option is no longer required, you can deactivate the option to reestablish normal use of dedicated ports on both storage subsystems and delete both mirror repository logical drives.

The Remote Mirror Option can also be disabled. When the option is in the `Disabled/Active` state, you can still maintain and manage previously existing

mirrors; however, you cannot create any new mirror relationships. When in the Disabled/Deactivated state, no Remote Mirror Option activity occurs.

Note: When all capacity on a storage subsystem is used (no free capacity is available), attempts to re-enable or reactivate a disabled/deactivated remote mirror might fail with an error message indicating that there is not enough space available for creating the remote mirror repository logical drives. Therefore, it is best practice to leave a minimum of 0.25 GB free capacity for each mirrored pair. The free capacity must be within the same array as the mirrored logical drives. Alternatively, you can add additional capacity to the storage array, or delete a logical drive from the array to create more space.

Deactivating the Remote Mirror Option

Complete the following steps to change the Remote Mirror Option status from Enabled/Activated to Enabled/Deactivated or from Disabled/Activated to Disabled/Deactivated:

1. Verify that all mirror relationships are removed. For more information, see "Removing mirror relationships" on page 183.
2. Click **Storage subsystem → Remote Mirror →Deactivate**.
3. Carefully review the information that is presented in the Confirmation window.
4. If the information in the Confirmation window is correct, click **Yes**.

Disabling the Remote Mirror Option

Complete the following steps to change the Remote Mirror Option status from Enabled/Deactivated to Disabled/Deactivated or from Enabled/Activated to Disabled/Activated:

Attention: After you disable the Remote Mirror Option, you will need the Enhanced Remote Mirroring premium key file to re-enable the feature. Make sure that you have this key file to re-enable the Remote Mirror Option after you disable it. Do not disable the Remote Mirror feature if you do not have this key file.

1. In the Subsystem Management window, click **Storage subsystem → Features → Disable**.
2. Click **Remote Mirror**.
3. Click **OK**.
4. Carefully review the information that is presented in the Confirmation window.
5. If the information in the Confirmation window is correct, click **Yes**.

Chapter 12. Overview of Enhanced Global Mirroring

This chapter provides a functional overview of the Enhanced Global Mirroring premium feature.

Enhanced Global Mirroring is shipped with the controller firmware release 7.84 and later. You can enable this feature using a premium feature key. Fibre Channel and low-cost fabric connectivity (iSCSI) is enabled on this feature. It creates a temporary image on the primary logical drive to periodically synchronize with the secondary logical drive. This minimizes the impact on non-high-speed networking during peak hours. DS3500, DCS3700, and DCS3700 storage subsystems with Performance Module Controllers, with controller firmware 7.84 and later, supports Enhanced Global Mirroring. The DS3500 and DCS3700 storage subsystems can have up to 32 mirror pairs, while the DCS3700 storage subsystems with Performance Module Controllers can have up to 128 mirror pairs.

Overview of Enhanced Global Mirroring

The Enhanced Global Mirroring feature provides a controller-level, firmware-based mechanism for data replication between a local site and a remote site. Enhanced Global Mirroring is managed separately for each individual logical drive, which enables you to associate a distinct remote mirrored logical drive with primary logical drives on a given storage subsystem.

When write operations are performed on the primary logical drive of an Enhanced Global Mirrored Pair, the modified data region of the primary logical drive is tracked. Periodically, the firmware creates a new point-in-time image of the primary logical drive and sends the changed data regions to the secondary logical drive. When data synchronization completes, the system uses the point-in-time images on the secondary logical drive to ensure that the data is maintained in a consistent state.

To maintain data on a remote site, as a point-in-time, consistent copy of data on a local site, an active Enhanced Global Mirroring session automatically completes the following steps:

1. Enhanced Global Mirror Groups consisting of logical drives are created at the local site.
2. Increments of consistent data are sent to the remote site.
3. Point-in-time copy operations are performed at the remote site.

The steps are repeated according to the defined synchronization intervals.

Note: Enhanced Global Mirroring supports both iSCSI and Fibre Channel (FC) connections between storage subsystems.

Enabling Enhanced Global Mirroring premium feature activation

To enable the Enhanced Global Mirroring premium feature, apply the key, which you purchased from the Technical Support representative, through the premium features dialog.

You must enable the premium feature on both the primary storage subsystem and the remote storage subsystem. You also must activate the premium feature after you enable it. If you are using a Fibre Channel connection, one Fibre Channel (FC) host side I/O port on each controller is solely dedicated to Enhanced Global Mirroring operations.

Host-initiated I/O operations are not accepted by the dedicated port. Only remote controllers that run mirror operations can send I/O requests to this port.

An Enhanced Global Mirror group

An Enhanced Global Mirror Group contains several mirrored pairs, which are composed of two logical drives, a primary logical drive and a secondary logical drive. The Enhanced Global Mirror Group is associated with a local storage subsystem and a remote storage subsystem that are used for mirroring.

- The local storage subsystem will be the primary side of the mirror group, while the remote storage subsystem will be the secondary side of the mirror group.
- All logical drives added to the mirror group on the local storage subsystem would hold the primary role in the mirror relationship.
- All logical drives added to the mirror group on the remote storage subsystem would hold the secondary role in the mirror relationship.

Because applications might need to use more than one logical drive, Enhanced Global Mirror Groups must be mirrored as a pair. All members of the Enhanced Global Mirror Group are synchronized as a coordinated data set to provide a consistent backup at the remote site.

You create an Enhanced Global Mirror Group to define the synchronization settings for all mirrored pairs within the mirror group. Each mirrored pair in an Enhanced Global Mirror Group share synchronization settings, primary and secondary roles, and write mode.

Connectivity and logical drive ownership

The controller that owns the primary logical drive determines the current owner of the secondary logical drive. The primary and secondary logical drives in a mirrored pair use the following ownership rules:

- If the primary logical drive is owned by controller A on the primary side, the secondary logical drive is owned by controller A on the secondary side.
- If the primary logical drive is owned by controller B on the primary side, the secondary logical drive is owned by controller B on the secondary side.
- If primary controller A cannot communicate with secondary controller A, controller ownership does not change. A primary controller attempts to communicate only with its matching controller in the secondary Enhanced Global Mirror Group.

The next remote write processed command automatically triggers a matching ownership change on the secondary side if one of these conditions exists:

- When an I/O path error causes a logical drive ownership change on the primary side.
- If the storage administrator changes the current owner of the primary logical drive.

For example, a primary logical drive is owned by controller A, and then you change the controller owner to controller B. In this case, the next remote write

process automatically changes the controller owner of the secondary logical drive from controller A to controller B. Because controller ownership changes on the secondary side are controlled by the primary side, they do not require any special intervention by the storage administrator.

Controller resets and storage subsystem power cycles

Sometimes a remote write is interrupted by a controller reset or a storage subsystem power cycle before it can be written to the secondary logical drive. The storage subsystem controller does not need to perform a full synchronization of the mirrored pair in this case.

A controller reset causes a controller ownership change on the primary side from the preferred controller owner to the alternate controller in the storage subsystem.

When a remote write has been interrupted during a controller reset, the new controller owner on the primary side reads information stored in a log file in the mirror repository logical drive of the preferred controller owner. The new controller owner then copies the affected data blocks from the primary logical drive to the secondary logical drive, eliminating the need for a full synchronization of the mirrored logical drives.

An Enhanced Global Mirrored Pair and a mirror repository

An **Enhanced Global Mirrored Pair** is composed of two logical drives, a primary logical drive and a secondary logical drive, that contain identical copies of the same data. The mirrored pair is a part of an Enhanced Global Mirror Group, which enables the mirrored pair to synchronize at the same time as any other mirrored pairs within the mirror group. Write operations are performed first to the primary logical drive and then to the secondary logical drive.

The two logical drives comprising the mirrored pair function as a single entity. As a result, you can run operations on the entire mirrored pair instead of doing so on the two individual logical drives.

Special **mirror repository** logical drives are used to manage mirror data synchronization. Mirror repository logical drives are required for both the primary and secondary logical drives in a mirrored pair.

For the Enhanced Global Mirroring premium feature, a mirror repository logical drive is required for both the primary and secondary logical drives in a mirrored pair. However, the Enhanced Remote Mirroring premium feature requires only a single mirror repository, which is created during activation. It is used for all Enhanced Remote Mirroring relationships. The controller stores mirroring information about the mirror repository logical drive, which includes information about remote writes that are not yet complete. You can use this information to recover information from controller resets and the accidental shutting down of storage subsystems.

Requirements for using Enhanced Global Mirroring

Note: You must have a dual-controller hardware configuration to use Enhanced Global Mirroring.

Requirements for using Enhanced Global Mirroring are as follows:

- You must have two storage subsystems.

- You must have write access to both storage subsystems.
- You must have enough space on the remote site for the remote copy of production data.
- Mirror repository logical drives are required for both the primary and secondary logical drives in a mirrored pair.
- Inter-controller communication for the Enhanced Global Mirroring feature uses the host-connected ports to initiate connections to the remote storage subsystem and is only supported on controllers with Fibre Channel or iSCSI host-connect ports.
- SAS and InfiniBand are not supported as inter-subsystem communication channels.
- Fibre Channel connection requirements:
  - You must attach dedicated Enhanced Global Mirroring ports to a Fibre Channel fabric environment. In addition, these ports must support the Name Service.
  - You can use a fabric configuration that is dedicated solely to the Enhanced Global Mirroring ports on each controller. In this case, host systems can connect to the storage subsystems using fabric.
  - Fibre Channel Arbitrated Loop (FC-AL), or point-to-point configurations are not allowed for inter-subsystem connections. FC-AL/P2P is for host connections only. These configurations are independent of the dedicated Enhanced Global Mirroring fabric.
  - You can use a single Fibre Channel fabric configuration for both the Enhanced Global Mirroring connectivity and for the host I/O paths to the controllers.
  - The maximum distance between the local site and the remote site is 10 km (6.2 miles), using single-mode fibre gigabit interface converters (GBICs) and optical long-wave GBICs.
- iSCSI connection considerations:
  - iSCSI does not require dedicated Enhanced Global Mirroring ports when using Enhanced Global Mirroring.
  - The iSCSI inter-controller communication must use a host-connect port and not the management Ethernet port.
  - The controller maintains a list of the remote storage subsystems to which the iSCSI initiator attempts to establish a session. The first port that successfully establishes an iSCSI connection is used for all subsequent communication with that remote storage subsystem. If communication fails, a new session is attempted using available ports.
- FC connection and iSCSI connection considerations:
  - If both storage subsystems are connected with FC and iSCSI channels, only one channel is used for mirroring.
  - There is no failover from one channel to the other.
  - If both storage subsystems are connected with FC and iSCSI connections, one Enhanced Global Mirror Group can be mirrored over FC and the other Enhanced Global Mirror Group can be mirrored over iSCSI.

Restrictions for using Enhanced Global Mirroring

The following restrictions apply to mirrored logical drive candidates and storage subsystem mirrors:

- RAID level, caching parameters, and segment size can be different on the two mirrored logical drives.

- The secondary logical drive must be at least as large as the primary logical drive.
- Only a standard logical drive can be used in a mirror relationship. FlashCopy logical drives, Enhanced FlashCopy logical drives, and thin logical drives cannot be used.
- A primary logical drive can be a source logical drive or a target logical drive in a VolumeCopy. A secondary logical drive cannot be a source logical drive or a target logical drive unless a role reversal was initiated after the copy has completed. If a role reversal is initiated while a copy is in process, the copy fails and cannot be restarted.
- A given logical drive might be used in only one mirror relationship.
- A logical drive used in a copy request cannot be used in a mirrored secondary logical drive.

Chapter 13. Comparing the mirroring premium features

Overview of the premium features

Enhanced Global Mirroring is suitable for running 24x7 operations. It is network-efficient for scheduled processes, such as backup and archiving.

Enhanced Remote Mirroring is suitable for continuous replication between few systems for business continuity. However, unlike Enhanced Global Mirroring, it is not suitable for scheduled processes such as backup and archiving.

Table 17. Comparison between mirroring features.

Enhanced Global Mirroring	Enhanced Remote Mirroring
Replication Method	
Point-in-time - Mirroring is done on demand or automatically according to a user-defined schedule. Schedules can be defined in minutes.	**Continuous** - Mirroring is automatically executed continuously, copying data from every host write.
Repository	
Multiple - A repository is required for each mirrored pair.	**Single** - A single repository exists for all mirrored logical drives.
Synchronization	
Writes only changed data - Differences between the current point-in-time image and the previous one are copied to the remote storage subsystem.	**Writes all data** - All writes captured on the primary logical drive are copied to the secondary logical drive.
Communication	
iSCSI and Fibre channel - Supports iSCSI and Fibre Channel interfaces between storage subsystems.	**Fibre channel** - Supports only Fibre Channel interfaces between storage subsystems.
Distance	
Unlimited - Provides support for unlimited distances between the local storage subsystem and the remote storage subsystem. The distance is typically limited only by the capabilities of the network and the channel extension technology.	**Restricted** - Typically must be within about 10 km (6.2 miles) of the local storage subsystem to meet latency and application-performance requirements.

Creating logical drives in a mirroring relationship

Before you can use either Enhanced Global Mirroring or Enhanced Remote Mirroring, you must enable and activate the feature on both the local storage subsystem and the remote storage subsystem. If a logical drive does not exist on either the local storage subsystem or the remote storage subsystem, you must create the logical drives. Both the local storage subsystem and the remote storage subsystem must have a primary logical drive and a secondary logical drive.

When the primary and secondary logical drives are available, you can create a mirrored pair. When the remote mirrored logical drive is first created, a full synchronization automatically occurs. Data from the primary logical drive is copied to the secondary logical drive.

Prerequisites for creating a mirror relationship

Ensure the following are met before you create a mirror relationship between two storage subsystems.

Enhanced Global Mirroring

- The Enhanced Global Mirroring premium feature must be enabled and activated on the local and remote storage subsystem that is used for mirroring.
- The local storage subsystem and the remote storage subsystem must be connected through a proper Fibre Channel fabric or iSCSI interface.
- The remote storage subsystem must contain a logical drive and a mirrored logical drive of the same capacity, so that the mirrored logical drive can be used as the primary logical drive on the local storage subsystem.
- Ensure that you know the password for the local and the remote storage subsystem.

Enhanced Remote Mirroring

- The Enhanced Remote Mirroring premium feature must be activated.
- The local storage subsystem must contain two mirror repository logical drives.
- The local storage subsystem must contain the primary logical drive, and the remote storage subsystem must contain the secondary logical drive. If either of the logical drives do not exist, you must create it before you can create the remote logical drive mirror.
- The secondary logical drive must meet the following requirements:

1. The RAID level of the secondary logical drive need not be the same as the RAID level of the primary logical drive.
2. The capacity of the secondary logical drive must be equal to or greater than the capacity of the primary logical drive.

About mirror repository logical drives

For the Enhanced Global Mirroring premium feature, a mirror repository logical drive is required for both the primary and secondary logical drives in a mirrored pair. However, the Enhanced Remote Mirroring premium feature requires only a single mirror repository, which is created during activation and is used for all Enhanced Remote Mirroring relationships. The controller stores mirroring information about the mirror repository logical drive, which includes information about remote writes that are not yet complete. You can use this information to recover information from controller resets and the accidental shutting down of storage subsystems.

Capacity of the mirror repository logical drive

- You can create the mirror repository logical drive from the unused capacity of a logical drive group or a disk pool.
- You can create a new logical drive group or a new disk pool and its member mirror repository logical drive from the unused capacity of the storage subsystem.

- The Enhanced Remote Mirroring activation process creates mirror repository logical drives of equal capacity. In a dual controller storage subsystem, the default capacity of both mirror repository logical drives is either 128 MB or 256 MB. You can neither increase nor decrease the capacity.
- When you activate the Enhanced Remote Mirroring premium feature and create the logical drive group and mirror repository logical drives from the unused capacity of the storage subsystem, you select the RAID level. However, when you create the mirror repository logical drives from an existing storage subsystem, you need not select the RAID level.
- The Enhanced Global Mirroring process uses mirror repository logical drives to manage data synchronization.
- For Enhanced Global Mirroring, the minimum mirror repository size is 0.02 percent of the base logical drive capacity or 32 MB; the maximum mirror repository size is 101 percent of the base logical drive capacity.
- For Enhanced Global Mirroring, primary and secondary mirror repository logical drives are not required to be the same size. Mirror repository logical drives can be created on separate logical drive groups with different RAID levels. However, mirror repository logical drives must have compatible security, T10PI, and quality of service of the associated mirrored logical drive.

Attention: Since the data stored on the mirror repository logical drives is critical, do not create mirror repository logical drives in an existing logical drive group that has RAID level 0. If you create a new logical drive group for the mirror repository logical drives, do not select RAID level 0.

Resynchronizing logical drives in a mirror relationship

The controllers manage data replication between the primary and secondary logical drives in a mirrored pair and are transparent to host machines and applications. When the controller owner of the primary logical drive receives a write request from a host, the controller first logs information about the write to a mirror repository logical drive and then writes the data to the primary logical drive. The controller then initiates a write operation to copy the data to the secondary logical drive on the remote storage subsystem.

If a link interruption or a logical drive error prevents communication with the remote storage subsystem, the current owner of the primary logical drive changes the status of the mirrored pair to Unsynchronized. The controller then sends an I/O completion to the host that sent the write request. The host can continue to issue write requests to the primary logical drive, but remote writes to the secondary logical drive do not take place.

Resynchronization is done once connectivity between the controller owner of the primary logical drive, and the controller owner of the secondary logical drive is restored. Only the blocks of data that have changed on the primary logical drive when the link was interrupted are copied to the secondary logical drive.

The following table describes two resynchronization methods:

Table 18. Resynchronizing logical drives in a mirror relationship.

Method	Description
Manual	• This is the recommended method because it enables you to manage the resynchronization process in a way that provides the best opportunity for recovering data. • For Enhanced Global Mirroring, manual resynchronization causes immediate resynchronization of data on all of the mirrored pairs within the Enhanced Global Mirror Group. For Enhanced Remote Mirroring, manual resynchronization causes immediate resynchronization of data on the remote mirror. • If you choose **Manual** as the synchronization method, you must use the **Manual Resynchronization** option to send updates of modified data from the local storage subsystem to the remote storage subsystem.
Automatic	• The time specified in minutes from the beginning of the previous update to the beginning of the next update. For example, if the synchronization interval is set at 30 minutes, and the synchronization process starts at 4:00 pm, the next one starts at 4:30 pm. To change the automatic synchronization interval from the default of every 10 minutes, you can edit the interval value, which is defined in minutes. • If a communication between the local storage subsystem and the remote storage subsystem fails, and a synchronization interval was missed during that time period, the controller owner of the primary logical drive starts the resynchronization process immediately after communication has been restored. **Note:** If you choose **Automatic** as the synchronization method, you also can also manually synchronize at any time using the **Manual Resynchronization** option.

You might need to periodically test the communication between the primary and secondary logical drives in a mirrored pair, especially after resynchronizing the logical drives.

Reversing the roles in a mirror relationship

Enhanced Global Mirroring

Use the **Change Role** option to perform a role reversal between Enhanced Global Mirror Groups. You can either promote the selected Enhanced Global Mirror Group to a primary role or change the selected Enhanced Global Mirror Group to a secondary role.

- A suspended Enhanced Global Mirror Group resumes during the change role operation.
- The role reversal change affects all mirrored pairs within the selected Enhanced Global Mirror Group. For example, when a primary Enhanced Global Mirror Group is changed to a secondary role, all the primary logical drives of the mirrored pairs in that mirror group are also changed to secondary logical drives.
- If you are changing a primary Enhanced Global Mirror Group to a secondary role and the current secondary Enhanced Global Mirror Group can be contacted, the secondary Enhanced Global Mirror Group is automatically promoted to a primary role in the mirror relationship. Likewise, if you are promoting a secondary Enhanced Global Mirror Group to a primary role and the current primary Enhanced Global Mirror Group can be contacted, the primary Enhanced Global Mirror Group is automatically changed to a secondary role in the mirror relationship.
- You also can use the **Change Role** option while using Recovery Guru to set a dual primary Enhanced Global Mirroring option. To avoid dual primary Enhanced Global Mirroring, wait until the connection between the storage subsystems is operational to perform the role reversal.

Enhanced Remote Mirroring

If the primary logical drive in a remote logical drive mirror fails, you can reverse the roles of the primary and secondary logical drives to transfer the data to the restored logical drive. Reversing the roles promotes the secondary logical drive to the role of primary logical drive and changes the primary logical drive to the role of secondary logical drive in a remote logical drive mirror.

Attention: If you try to reverse roles between the secondary logical drive and the primary logical drive while a logical drive copy is in progress, the role reversal succeeds, but the logical drive copy fails and cannot be restarted.

Remember the following guidelines when performing a role reversal between mirror groups:

- You cannot perform a VolumeCopy on a secondary logical drive in a remote logical drive mirror. To create a logical drive copy of a secondary logical drive, you must reverse the roles of the secondary logical drive and the primary logical drive, and then perform the VolumeCopy on the new primary logical drive.
- While a remote logical drive mirror is synchronizing, you cannot perform a VolumeCopy on either the primary or secondary logical drive.
- You can reverse roles from a primary to a secondary logical drive if the secondary drive is smaller than the primary drive. However, the usable capacity of the new secondary logical drive would equal the total capacity of the new primary logical drive (which is the original secondary logical drive).

Removing the mirror relationship

Enhanced Global Mirroring

Use the **Remove Mirrored Pair** option to remove the mirror relationship between the two logical drives in an Enhanced Global Mirroring relationship.

Removing an Enhanced Global Mirrored Pair from an Enhanced Global Mirror Group breaks the mirror relationship between the primary logical drive on the local storage subsystem and the secondary logical drive on the remote storage subsystem. Data on the logical drives is not affected. As a result of this operation, the primary and secondary logical drives become standard, host-accessible, non-mirrored logical drives.

Remember these guidelines when removing an Enhanced Global Mirrored Pair:

- This option is not available unless the Enhanced Global Mirror Group contains mirrored pairs.
- This option is available either by selecting the individual mirrored pair itself, or by selecting the associated Enhanced Global Mirror Group.
- The mirror relationship is first removed on the local storage subsystem and then on the remote storage subsystem. Sometimes, the mirror relationship is successfully removed on the local storage subsystem but cannot be removed on the remote storage subsystem because of a communication problem. In this case, an error message displays, which contains the names of the remote storage subsystem with the orphaned mirrored pair and logical drive. To resolve the problem, open the subsystem Management Window for the remote storage subsystem, select the orphaned mirrored pair, and remove the mirror relationship.
- Sometimes, the mirror relationship is successfully removed from the remote storage subsystem, but not from the local storage subsystem. In this case, the next synchronization operation from the primary logical drive to the secondary logical drive causes the synchronization process to pause. The Logical pane of the primary subsystem Management Window also shows an unresponsive remote secondary logical drive. Remove the mirror relationship on the local storage subsystem to correct the problem.

Enhanced Remote Mirroring

Use the **Remove Mirror Relationship** option to remove the mirror relationship between the two logical drives in a Enhanced Remote Mirroring relationship.

Remember these guidelines when removing the mirror relationship between the two logical drives.

- This option is not available unless defined mirror relationships exist on the storage subsystem.
- This option does not delete the primary logical drive, secondary logical drive, or the mirror repository logical drives that support Enhanced Remote Mirroring for the storage subsystems. Data on the logical drives is not affected. As a result of this operation, the primary and secondary logical drives become standard, host-accessible, non-mirrored logical drives.
- This option is available only for the local logical drive (primary or secondary) that is present in the storage subsystem that you are currently managing. This option is not available if you select a remote secondary logical drive in the Logical pane.
- The mirror relationship is first removed on the local storage subsystem and on the remote storage subsystem. Sometimes, the mirror relationship is successfully removed on the local storage subsystem but cannot be removed on the remote storage subsystem because of a communication problem. In this case, an error message displays the following information:

  The name of the remote storage subsystem with the orphaned mirrored logical drive

The name of the logical drive

- To resolve the problem, open the subsystem Management Window for the remote storage subsystem, select the specified logical drive, and remove the mirror relationship.

  Sometimes, the mirror relationship is successfully removed from the secondary drive, but not the primary drive. In this case, the first I/O write to the primary logical drive causes the mirror state to change to Unsynchronized. The Logical pane of the primary subsystem Management Window also shows an unresponsive remote secondary drive. Remove the mirror relationship on the primary storage subsystem to correct the problem.

  Sometimes, the mirror relationship is successfully removed on the primary drive, but not on the secondary drive. In this case, there is no change to the representation of the secondary logical drive in the secondary Logical pane in the subsystem Management Window. Remove the mirror relationship on the auxiliary storage subsystem to correct the problem, and make the logical drive accessible by hosts.

Attention: Do not remove a mirror relationship to back up a mirrored logical drive. To perform backups of either the primary or secondary logical drive, suspend the remote logical drive mirror so that the mirror relationship is not broken.

Suspending a mirrored pair

Enhanced Global Mirroring

Use the **Suspend** option to suspend data transfer between all mirrored pairs in an Enhanced Global Mirror Group without removing the mirror relationship.

The **Suspend** option lets you suspend the synchronization of data on all mirrored pairs at the Enhanced Global Mirror Group level. This option is more efficient than suspending mirrored pairs individually. It helps to reduce any performance impact on the host application that might occur while any changed data on the local storage subsystem is copied to the remote storage subsystem.

When an Enhanced Global Mirror Group is suspended, no attempt is made to copy data from the primary logical drives to the secondary logical drives of the mirrored pairs. Any writes to the primary side of the Enhanced Global Mirror Group are persistently logged in its associated mirror repository logical drives. After the Enhanced Global Mirror Group is resumed, only the modified regions of the primary logical drives are written to the secondary logical drives.

Note: The Suspend Enhanced Global Mirror Group option is available on the local storage subsystem only. This option is not available on the remote storage subsystem.
Remember these guidelines when you suspend an Enhanced Global Mirror Group:

- Any data that is written to the primary side of the Enhanced Global Mirror Group is logged while the mirror group is suspended and is written automatically to the secondary side of the Enhanced Global Mirror Group when the mirror group is resumed. A full synchronization is not required.
- The state of the Enhanced Global Mirror Group and mirrored pairs stays suspended until you use the Resume option to resume synchronization activity.

Enhanced Remote Mirroring

Use the **Suspend** option to suspend data transfer between a primary logical drive and a secondary logical drive without removing the mirror relationship.

The **Suspend** option lets you control data synchronization between the primary and secondary logical drives. This option helps to reduce any performance impact to the host application that might occur while any changed data on the primary logical drive is copied to the secondary logical drive.

When a remote mirror is in a Suspended status, no attempt is made to contact the secondary logical drive. Any writes to the primary logical drive are persistently logged in the mirror repository logical drives. After the mirrored pair is resumed, only the modified regions of the primary logical drive are written to the secondary logical drive.

Attention: If the selected mirrored pair is part of a write consistency mode group, all mirrored pairs are automatically suspended in the write consistency mode group. Use the command line interface to resume single write-consistent mirrored pairs.

Remember these guidelines when you suspend a mirrored pair:

- Any data that is written to the primary logical drive will be logged while the mirrored pair is suspended, and will be written automatically to the secondary logical drive when Enhanced Remote Mirroring is resumed. A full synchronization is not required.
- The state of the remote mirror stays suspended until you use the Resume Mirrored Pair option to resume synchronization activity.

Resuming a mirrored pair

Enhanced Global Mirroring

Use the **Resume Enhanced Global Mirror Group** option to resume data transfer between all mirrored pairs in an Enhanced Global Mirror Group. Data written to the primary logical drives while the Enhanced Global Mirror Group was suspended is written to the secondary logical drives immediately. Periodic synchronization resumes if an automatic synchronization interval has been set. The **Resume Enhanced Global Mirror Group** option enables the user to resume synchronization of data for all mirrored pairs at the Enhanced Global Mirror Group level. After an Enhanced Global Mirror Group is resumed, only the modified regions of the primary logical drives are written to the secondary logical drives.

The **Resume Enhanced Global Mirror Group** option is available on the local storage subsystem only. This option is not available on the remote storage subsystem.

Enhanced Remote Mirroring

Use the **Resume Enhanced Remote Mirroring** dialog to resume data transfer between a primary logical drive and a secondary logical drive participating in Enhanced Remote Mirroring, after the mirror has been suspended or unsynchronized. When a remote logical drive mirror is suspended, data continues to read to the primary logical drive, but the data is not written to the secondary logical drive. Writes to the primary logical drive are persistently logged into the mirror repository logical drives

After communications are restored in a remote logical drive mirror, data transfer between the primary and secondary logical drives must be resynchronized. After the remote logical drive mirror resumes, data is automatically written to the secondary logical drive. Only the regions of the primary logical drive that changed since the mirrored pair was suspended are written to the secondary logical drive.

Attention: When you resume a remote logical drive mirror, and either the primary or secondary logical drive is a member of a write consistency group, all other suspended remote logical drive mirrors for mirrored pairs in the write consistency group also resumed.

Note: When the write mode is synchronous, you do not need to resynchronize the primary and secondary logical drives after you resume the remote logical drive mirror

Using other premium features with mirroring

You can use the mirroring premium features with the following premium features that are enabled and active on the primary storage subsystem.

- SANshare Storage Partitioning
- FlashCopy logical drive
- VolumeCopy
- Dynamic Volume Expansion (DVE)

Using the SANshare storage partitioning premium feature with Enhanced Remote Mirroring

The SANshare Storage Partitioning premium feature lets hosts share access to logical drives in a storage subsystem. A storage partition is created when you define a collection of hosts (a host group) or a single host, and then define a logical drive-to-logical unit number (LUN) mapping. This mapping lets you define which host group or host will have access to a particular logical drive in the storage subsystem.

The storage partition definitions for the local storage subsystem and the remote storage subsystem are independent of each other. If these definitions are put in place while the secondary logical drive is in a secondary role, it reduces the administrative effort that is associated with site recovery if it becomes necessary to promote the logical drive to a primary role.

Using the FlashCopy logical drive premium feature with mirroring

A FlashCopy logical drive is a point-in-time image of a logical drive. Do not mount a FlashCopy logical drive on the same server on which the primary logical drive is mounted in a remote logical drive mirror.

Using the VolumeCopy premium feature with mirroring

Attention: If a role reversal is started while a VolumeCopy is in progress, the VolumeCopy will fail and cannot be restarted.

The VolumeCopy premium feature copies data from a source logical drive to a target logical drive within the same storage subsystem.

- A primary logical drive in a remote logical drive mirror can be either a source logical drive or a target logical drive in a logical drive copy.
- You can create a VolumeCopy on the primary logical drive in a mirrored pair, but you cannot create a VolumeCopy on a secondary logical drive in a mirrored pair. You can make a copy of a secondary logical drive in two ways:

  Promote the secondary logical drive to the role of primary logical drive.

  Create a FlashCopy logical drive of the secondary logical drive, and then perform a VolumeCopy on the FlashCopy logical drive.

Using the Dynamic Volume Expansion premium feature with mirroring

Dynamic Volume Expansion (DVE) increases the capacity of a logical drive. The increased capacity is achieved by using the free capacity that is available on the logical drive group of the standard logical drive or the FlashCopy repository logical drive.

Performing a DVE operation does not interrupt access to data on logical drive groups, logical drives, or drives.

You can perform a DVE operation on a primary logical drive or a secondary logical drive of a mirrored pair. However, you cannot perform a DVE operation on a mirror repository logical drive.

Note: To perform a DVE operation, the remote logical drive mirror must be in Optimal status. The **Properties** pane in the **Logical** view shows the status of a logical drive.

Chapter 14. Using the Enhanced Global Mirroring option

Note: Before creating mirror relationships, ensure that the **Enhanced Global Mirroring** option is enabled.

Check mirroring connectivity result

1. In the Subsystem Management window, click **Copy Services** > **Mirroring** > **View Mirroring Port Connections**.
2. Select the subsystem would be used in the remote storage subsystem.

   Note: The remote storage subsystem name would be displayed if it is detected from the fabric and followed by fabric name for Fibre or iSCSI.
3. Click **Start** to validate the connections.

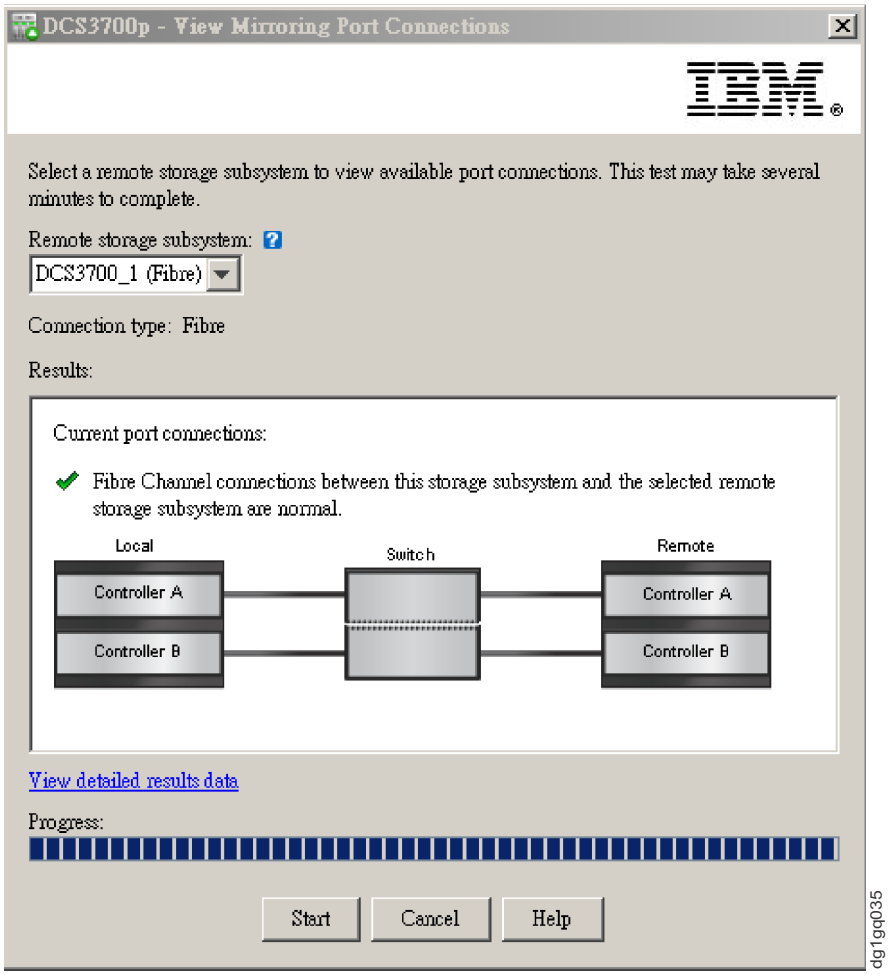


Figure 63. Viewing mirroring port connections

4. A *green* check and the storage subsystem connectivity topology will be displayed in the results screen, if the setup environment is qualified for Enhanced Global Mirroring.
5. Close the window to complete the check.

Activate Enhanced Global Mirroring

1. In Subsystem Management Window, click **Copy Services** > **Mirroring** > **Activate**.
2. Select **Enhanced Global Mirroring** then click **Finish** to complete the activation.

Figure 64. Enhanced Global Mirroring activated pop-up window

3. Repeat the procedure on the secondary storage subsystem.

Create Enhanced Global Mirroring group

1. In the **Storage & Copy Services** view, right-click **Enhanced Global Mirror Groups** then click the **Create** option.

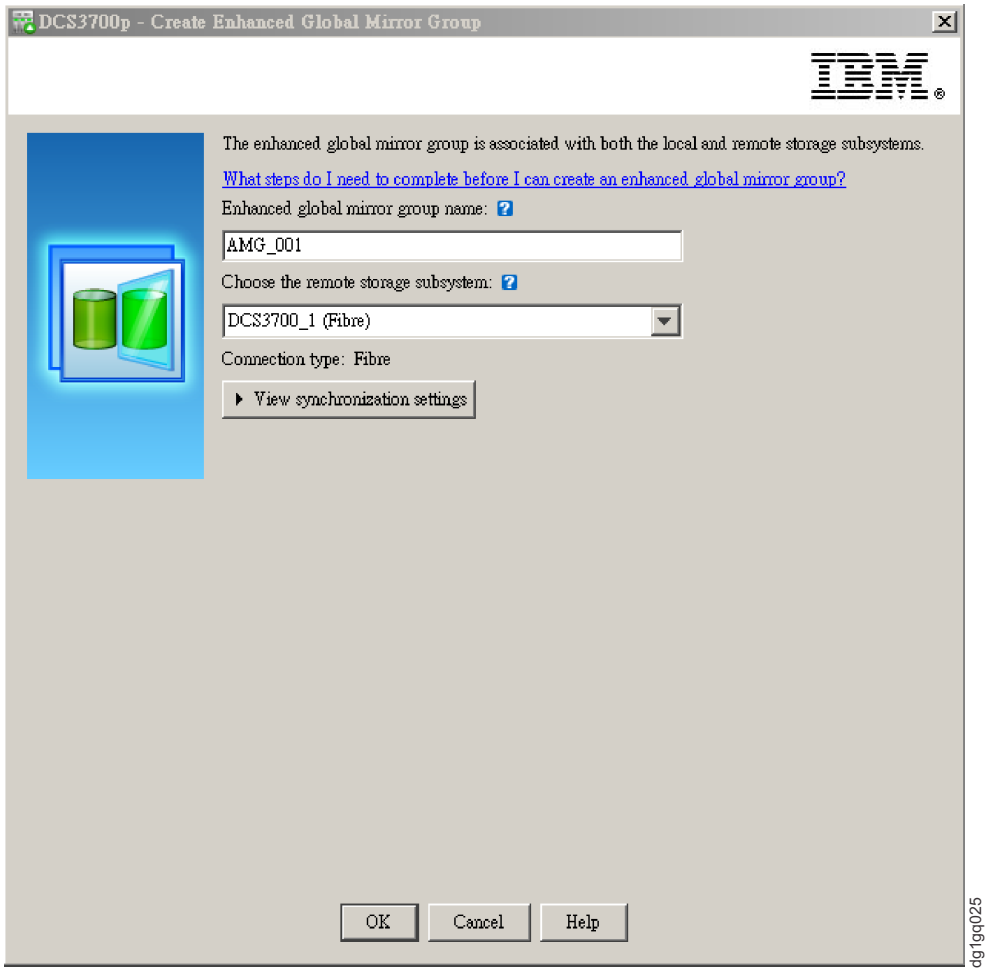


Figure 65. Creating an Enhanced Mirror Group

2. Type the name for the mirror group or leave it as `default` and select the remote storage subsystem in the **`Choose the remote storage subsystem`** option.
3. Click **View synchronization settings** to set **Automatic** or **Manual** for **Interval method**.

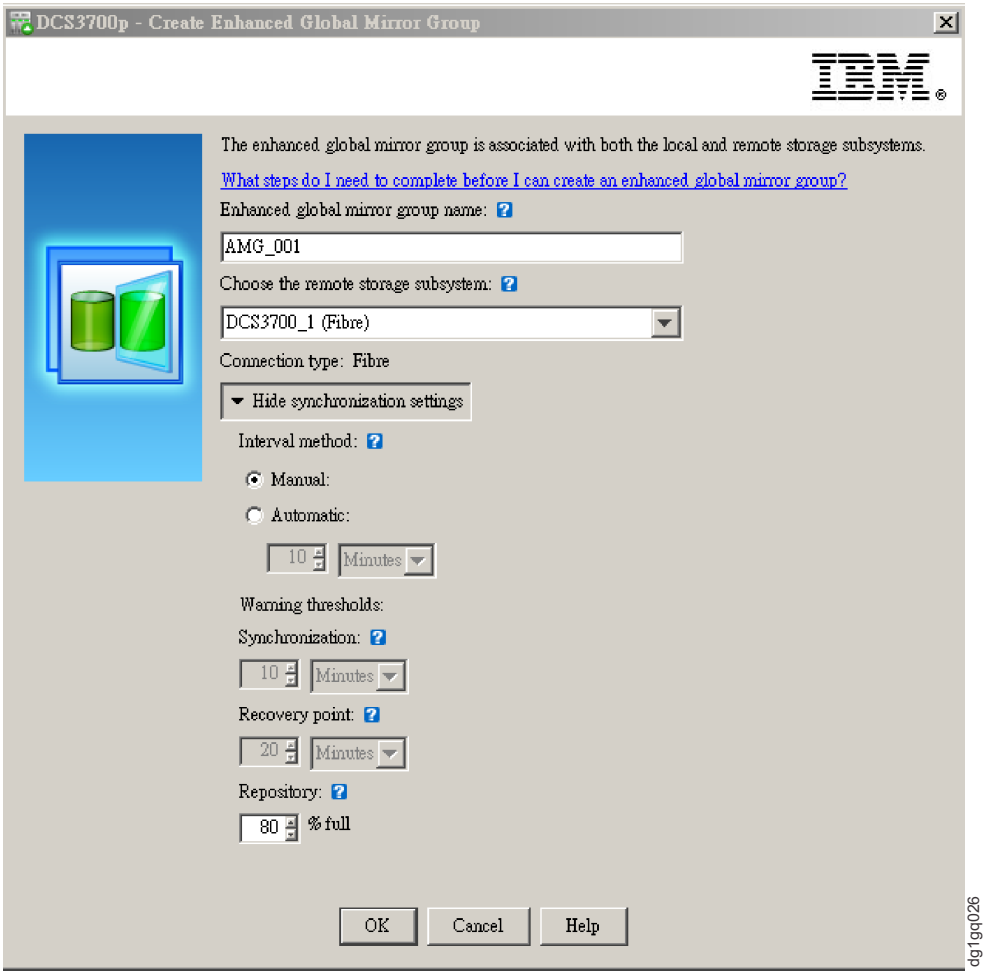


Figure 66. Enhanced Mirror Group - configuring automatic and manual settings

4. Click **OK** to complete the Enhanced Global Mirroring group creation.

Create Enhanced Global Mirroring pairs

1. In **Storage & Copy Services** view, right-click a logical drive that would be used to create the pair.

   Note: This selected logical drive will be assigned to a primary logical drive in the pair.
2. Select **Create** > **Enhanced Global Mirrored Pairs**.
3. Select a group name that is listed in Mirror groups or select a new enhanced global mirror name to create a new group, then click **Next**.

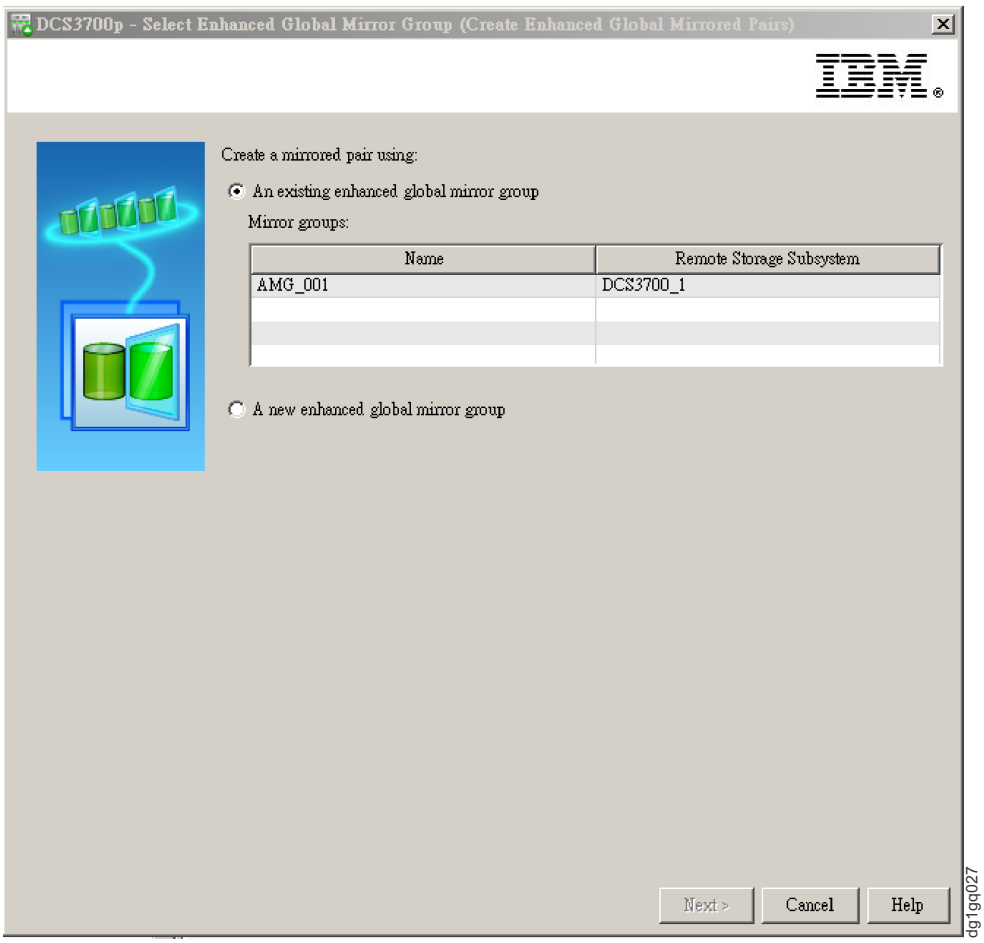


Figure 67. Selecting an Enhanced Global Mirror group

- If a new enhanced global mirror name is selected, see "Create Enhanced Global Mirroring group" on page 204 to create a new Enhanced Global Mirroring group.

4. Select **Automatic** or **Manual** for repository settings.
   a. Select **Automatic** then click **Finish** to create the Enhanced Global Mirroring pair.
   b. Select **Manual** then click **Next** to start the advanced options setup.
5. Specify the repository candidate capacity preference for primary logical drives, then click **Finish** to complete the creation.

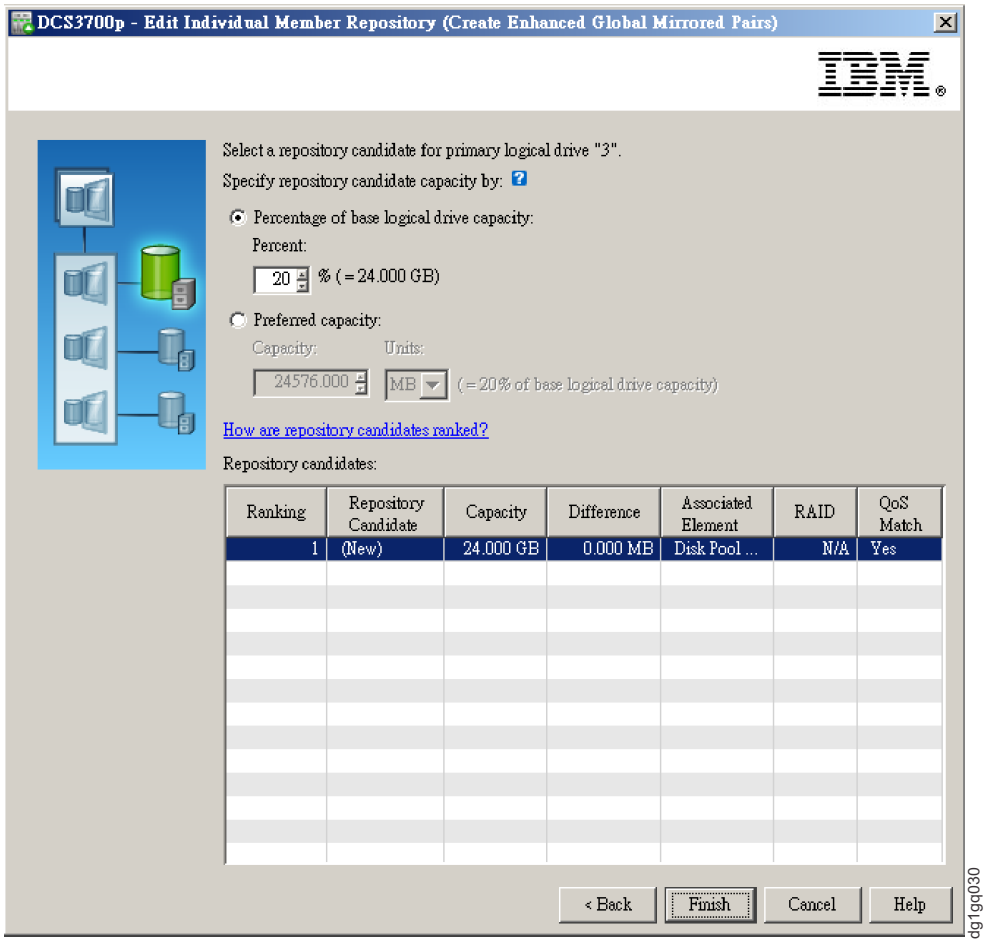


Figure 68. Editing an individual member repository

6. Go to the secondary Subsystem Management window then click the mirror group on Enhanced Global Groups. The paired logical drives would be listed in **Associated mirrored pairs** and status displayed is **Incomplete**.

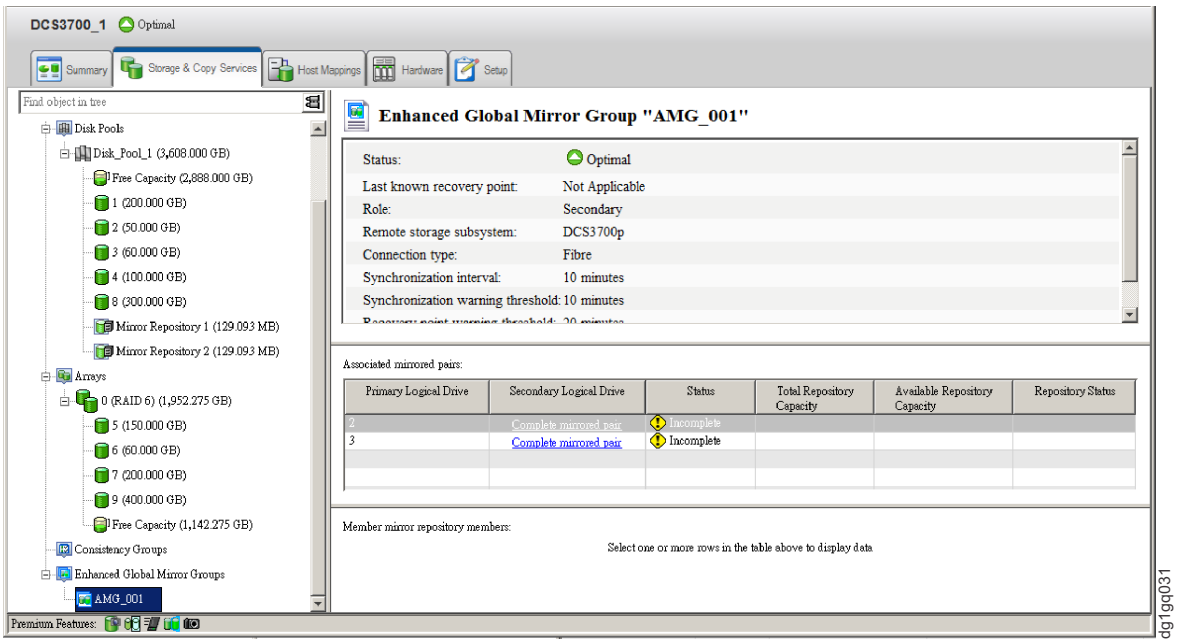


Figure 69. Enhanced Global Mirror Group summary screen

7. Click **Complete mirrored pair** to initiate the mirror activity.
   a. Type the name in the **Logical Drive name** field of **Automatically create a secondary logical drive and repository** and select the desired Disk Pool or Array, then click **Finish** to start the synchronization.
   b. Select **Manually choose an existing logical drive** and define repository parameters, then click **Next**.
8. Select the desired existing logical drive in the list.
   a. Select **Automatic** in **Choose a repository selection method** then click **Finish** to start the synchronization.
   b. Select **Manual** for the advanced options setup, then click **Next**.
9. Specify the repository candidate capacity preference for secondary logical drives, then click **Finish** to start the synchronization.

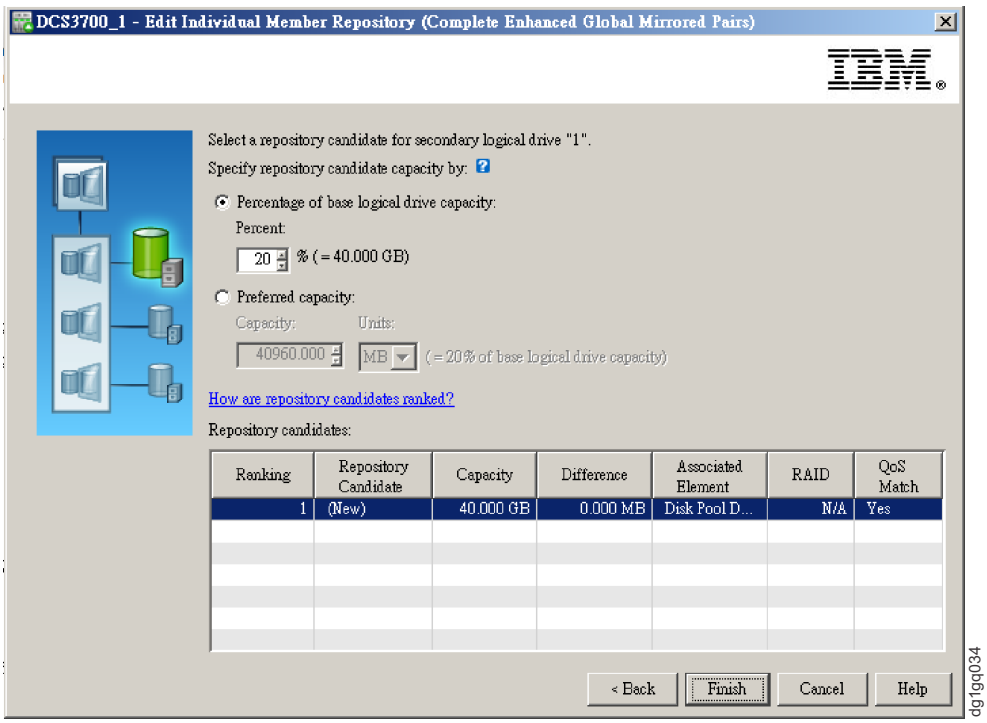


Figure 70. Manual creation of a secondary logical drive and repository

Chapter 15. Disaster recovery

This chapter describes the actions to take to prepare for a disaster, the actions to take if a hardware component failure occurs, and the actions to take if a complete site failure occurs.

As businesses increasingly require around-the-clock data access, you are required to make sure that critical data is safeguarded against potential disasters. In preparing for a potential disaster, you must develop a disaster recovery plan that details the procedures to prepare for and prevent disasters, and the actions that you need to take to respond to and recover from disasters if they occur.

Recovering from switch failures

The Campus configuration and the Intra-Site configuration are the two configurations where each switch is a single point of failure. In the Highest Availability Campus configuration, if a switch fails, at least one other switch is configured to be an alternate path for all I/O. The single switch at each site is not only responsible for the communication between the two sites for the Remote Mirror Option, but for all host-to-storage subsystem I/O as well.

If a switch fails in the Campus configuration or the Intra-Site configuration, you must decide whether or not to do a complete site failover. This decision must be based on the immediate availability of a backup switch or the time it will take to receive a replacement.

If a replacement switch is not readily available, you will need to use one of the following temporary scenarios until the switch is replaced.

- **Direct connection between host computers and storage subsystems** - This bypasses the switch and allows normal I/O to continue. All mirror relationships are suspended until a normal configuration is resumed. Since the storage subsystems have a finite number of host connections, all host computers might not be able to access the storage subsystem. For information about how to directly connect host computers and storage subsystems, see the *IBM System Storage DS Storage Manager Version 10 Installation and Support Guide* for your operating system.
- **Entire site failover** - The switch at the secondary site is still functional, which enables all host computers to access the switch and storage subsystems. Mirror relationships are suspended until the primary storage subsystem is recovered. If a complete site failover is needed to continue normal operations, see "Performing an entire site failover."

Recovering from storage subsystem failures

This section provides procedures for recovering storage systems when one of the following situations has occurred:

- The primary storage subsystem is damaged or destroyed
- The entire primary site is damaged or destroyed

Both situations require a complete site failover from the primary site to the secondary site so that normal operations can continue. For a secondary site failure, no site failover is necessary. If the primary logical drive is not damaged, then a full synchronization occurs when the site is recovered. If the primary storage subsystem is damaged, follow the procedure in "Rebuilding a damaged site" on page 213.

Attention: You must complete the procedures in this section in the order that they are presented to make sure that the affected site or storage subsystem is recovered successfully.

Performing an entire site failover

Entire site failover is necessary when an event occurs that inhibits normal operation to the primary site for an extended period of time.

Complete the following steps to complete an entire site failover:

1. Manually reverse the role of the primary logical drive of the mirror relationship to the secondary role. For more information, see "Reversing the roles of primary and secondary logical drives" on page 214.
2. If storage partitioning is preconfigured so that hosts can access the logical drives, go to step 4. Otherwise, continue with step 3.
3. Configure the storage partitioning so that host to logical drive access is identical to the primary site configuration. When configured, continue to step 4. For more information about storage partitioning, see "Using other premium features with the Remote Mirror Option" on page 147 and the Subsystem Management window online help.
4. If the host computers at the secondary site are properly configured for host failover, go to step 6 on page 213. Otherwise, continue with step 5 on page 213.

5. Reinstall the host software and reconfigure the settings as needed. For more information about installing and configuring host software, see the documentation that comes with the software.
6. Run the Hot_add utility on hosts that have only mapped logical drives from the secondary storage subsystem. Restart all hosts that have logical drive mappings from the primary and secondary storage subsystems. Then resume normal operation with the secondary site acting as a new, fully-functioning primary site.
7. The entire site failover is complete. The primary site must now be reconfigured and the remote mirror environment must be re-created. The next step depends on the resulting status of the storage subsystem.
8. If the storage subsystem and all of the contained data is recovered and fully operational, go to "Recreating a mirror relationship." Otherwise, go to "Rebuilding a damaged site."

Rebuilding a damaged site

If a disaster occurs to the primary or secondary site that renders the storage subsystem or all data on the storage subsystem irreparable, then the site needs to be rebuilt with new hardware.

Complete the following steps to rebuild a damaged site:

1. Obtain new storage subsystems and any host computers and hardware that are needed to properly use the Remote Mirror Option. Be sure that the new hardware has the same level of specifications as the damaged hardware.
2. Depending on the configuration, complete the switch zoning and hardware installation procedures for this site only. See "Installing the hardware" on page 155.
3. Define a logical drive to replace the mirrored logical drive that was damaged on the original storage subsystem. Be sure that the new logical drive is identical to the specifications of the damaged logical drive.
4. Make sure that storage partitioning is properly defined so that it can take over normal operation from the secondary site. For more information about storage partitioning, see "Using other premium features with the Remote Mirror Option" on page 147 and the Subsystem Management window online help.
5. Make sure that the host software is properly configured so that the host computers can take over I/O from the secondary site host computers. For more information about installing and configuring host software, see the documentation that comes with the software.
6. The site is recovered and is now ready to resume any mirror relationships that were active before the failure. Go to "Recreating a mirror relationship."

Recreating a mirror relationship

After the damaged site is back online and properly configured, mirror relationships can be resumed.

Complete the following steps to re-create a mirror relationship:

1. From the active secondary site, define a mirror relationship using the logical drive on the recovered primary site as the secondary logical drive. For more information, see "Creating mirror relationships" on page 177.
2. Make sure that storage partitioning is properly defined on the recovered primary site so that it can take over normal operation from the secondary site.

For more information about storage partitioning, see “Using other premium features with the Remote Mirror Option” on page 147 and the Subsystem Management window online help.

3. Make sure that the host software is properly configured so that the host computers at the recovered primary site can take over I/O from the secondary site host computers. For more information about installing and configuring host software, see the documentation provided with the software.
4. Complete a manual role reversal so that the recovered primary site now possesses the active primary logical drive, and the secondary logical drive now exists on the secondary site. For more information, see “Reversing the roles of primary and secondary logical drives.”
5. The remote mirror configuration is now optimal.

Reversing the roles of primary and secondary logical drives

A role reversal is the process of promoting the secondary logical drive to be the primary logical drive within the mirrored logical drive pair, and demoting the primary logical drive to be the secondary logical drive.

A role reversal is performed using one of the following methods:

Changing a secondary mirrored logical drive to a primary logical drive
This method promotes a selected secondary logical drive to become the primary logical drive of the mirrored pair, and is used when an unrecoverable error has occurred. For step-by-step instructions, see “Changing a secondary logical drive to a primary drive.”

Changing a primary mirrored logical drive to a secondary logical drive
This method demotes a selected primary logical drive to become the secondary logical drive of the mirrored pair, and is used during normal operating conditions. For step-by-step instructions, see “Changing a primary logical drive to a secondary drive” on page 215.

Role reversals can also be performed using the **Set** command in the Storage Manager Script window or the CLI. For more information, see the Enterprise Management window online help.

Changing a secondary logical drive to a primary drive

A secondary logical drive is usually promoted to a primary logical drive role when an unrecoverable error has occurred on the storage subsystem that contains the primary logical drive. The secondary logical drive needs to be promoted so that host computers can access data and normal operations can continue.

This method is not available unless the Remote Mirror Option is activated.

Note: When the secondary logical drive becomes a primary logical drive, any host computers that are accessing the logical drive through a logical drive-to-LUN mapping are now able to read or write to the logical drive. This condition applies if the host did not have the same logical-drive-to-LUN mapping as the LUN in the primary logical drive that was demoted to secondary logical drive. If it did, you must restart the host for the newly-promoted-to-primary (secondary) logical drive to replace the demoted (primary) logical drive.

If a communication problem between the secondary site and the primary site prevents the demotion of the primary logical drive, an error message displays. However, you are given the opportunity to proceed with the promotion of the

secondary logical drive, even though this leads to a `Dual Primary Remote Mirror` status condition. The recovery for this condition occurs when the remote mirror pairs are re-created. If you attempt to change the role of one of the primary drives, an error occurs.

Complete the following steps to promote a secondary logical drive to the primary logical drive role:

1. Select the secondary logical drive in the Logical view of the secondary Subsystem Management window. Then, either click **Logical Drive → Remote Mirroring → Change → Role to Primary**, or right-click the drive and click **Change → Role to Primary**. The Change to Primary window opens.
2. Click **Yes**. The secondary logical drive is promoted to the primary logical drive role in the remote logical drive mirror.

   When the controller owner of the primary logical drive is contacted, the primary logical drive is automatically demoted to the secondary logical drive role in the remote logical drive mirror.

Changing a primary logical drive to a secondary drive

Changing a primary logical drive to the secondary logical drive is used for role reversals during normal operating conditions. You can also use this option during a recovery procedure when a `Dual Primary Remote Mirror` status condition occurs.

Role reversal does not occur unless the Remote Mirror Option is activated.

Important: After the role reversal, any host computers that are accessing the primary logical drive through a logical drive-to-LUN mapping are no longer able to read or write to the logical drive. When the primary logical drive becomes a secondary logical drive, only remote write requests initiated by the primary controller are written to the logical drive.

If a communication problem between the primary and secondary sites prevents the demotion of the primary logical drive, an error message displays. However, you are given the opportunity to proceed with the demotion of the primary logical drive even though this leads to a `Dual Secondary Remote` logical drive mirror status condition. The recovery this status condition occurs when the remote mirror pairs are re-created. If you attempt to change the role of one of the primary drives, an error occurs.

Attention: If the selected primary logical drive has associated FlashCopy logical drives, demoting this logical drive to a secondary role causes the associated FlashCopy logical drives to fail.

Complete the following steps to demote a primary logical drive to the secondary logical drive role:

1. Select the primary logical drive in the Logical view of the primary Subsystem Management window. Then, either click **Logical Drive → Remote Mirror → Change → Role to Secondary**, or right-click the drive and click **Change → Role to Secondary**. The Change to Secondary window opens.
2. Click **Yes**. The primary logical drive is demoted to be the secondary logical drive in the remote logical drive mirror.

   When the controller owner of the primary logical drive is contacted, the secondary logical drive is automatically promoted to the primary logical drive role in the remote logical drive mirror.

Chapter 16. Troubleshooting the Enhanced Remote Mirroring Option

This chapter provides information about some problems that are commonly encountered when using the Remote Mirror Option and how to resolve them.

The following troubleshooting topics are included in this chapter:

- Testing communication between primary and secondary logical drives
- General remote logical drive mirroring problems
- Inappropriate Fibre Channel fabric configurations
- Problems with storage subsystem components that are involved in remote logical drive mirroring
- Basic switch troubleshooting

Also provided is a list of the critical events that might be generated, and instructions for upgrading future versions of controller firmware.

Locate the section that directly relates to your problem or consult the section describing general troubleshooting techniques. If your problem is not discussed in any of the sections in this chapter, contact your IBM technical-support representative.

Testing communication between primary and secondary logical drives

Use the Test Communication dialog to diagnose possible communication problems between a primary logical drive and secondary logical drive participating in a mirror relationship. After the communication test has been completed, the dialog will display either a Passed, Warning, or Failed status together with values for the following:

- Test data round trip time
- Maximum allowed round trip time
- Average round trip time

Important: If the communication test returns a Failed status, the test will continue to run after you close the Test Communication dialog until communication between the mirrored pair is restored. If you have enabled automatic resynchronization, the mirrored pair will automatically synchronize. Otherwise, select **Logical Drive → Remote Mirroring Option → Resume** to manually start resynchronization.

To run the Test Communication function, follow the steps below:

1. Select a primary logical drive or secondary logical drive in the Logical View.
2. Select **Logical Drive → Remote Mirroring Option → Test Communication**.
3. The Communication Test dialog displays.If the communication test returns a Passed with Caution status, the primary logical drive and secondary logical drive are communicating correctly; however, the test data round trip time is approaching the maximum allowed. This indicates that you will need to take some kind of action to fix this problem. If the communication test returns a Failed status, the reason for the failure is indicated, and you are directed to reference the Recovery Guru to correct the problem.

4. Review the information displayed in the dialog, and click **OK** to return to the Storage Subsystem Management window.

General troubleshooting

Table 19 describes some of the usual problems that you might encounter when using the Remote Mirror Option. The information is presented in order from the time the option is enabled and activated, to problems that might be encountered as you use the Remote Mirror Option.

Information about the probable cause and how you can resolve each problem is provided. If your problem is not addressed in this section, see the remaining sections in this chapter before you contact your IBM technical-support representative.

Table 19. General Remote Mirror Option problems

Problem	Cause	Resolution
The Remote Mirror menu options in the Subsystem Management window are not available.	The Remote Mirror Option is not enabled or activated.	1. Enable the Remote Mirror Option. A premium feature key is required to enable premium features. 2. Activate the Remote Mirror Option. The Remote Mirror Option is a premium feature option. Contact your IBM technical-support representative for purchase information. For step-by-step instructions to enable and activate the Remote Mirror Option, see "Enabling and activating the Remote Mirror Option" on page 168 or the Subsystem Management window online help.
The Remote Mirror icon in the premium feature status area is marked with a red line and is not available.	The Remote Mirror Option is not enabled or activated.	1. Enable the Remote Mirror Option. A premium feature key file is required to enable the feature. 2. Activate the Remote Mirror Option. The Remote Mirror Option is a premium feature option. Contact your IBM technical-support representative for purchase information. For step-by-step instructions to enable and activate the Remote Mirror Option, see "Enabling and activating the Remote Mirror Option" on page 168 or the Subsystem Management window online help.

Table 19. General Remote Mirror Option problems (continued)

Problem	Cause	Resolution
When creating a remote logical drive mirror, the following error message is received: `Error 158 - The operation cannot complete because the selected logical drive is not a a valid candidate for Remote Mirroring`	The secondary logical drive candidate was participating in a mirror relationship with a different logical drive on this storage subsystem. The mirror relationship was successfully removed from the other storage subsystem. However, a communication error prevented the successful removal of the mirror relationship on this storage subsystem.	A logical drive on this storage subsystem still has a mirror relationship defined with the secondary logical drive. 1. Click **View → Storage subsystem profile**. Click the **Logical Drives** tab, and then click the **Mirrors** tab. 2. Locate the logical drive that is still participating in the mirror relationship with the secondary logical drive candidate and remove the mirror relationship. For step-by-step instructions, see "Removing mirror relationships" on page 183 or the Subsystem Management window online help. 3. Re-create the intended remote logical drive mirror using the original candidate logical drives. For step-by-step instructions, see "Creating mirror relationships" on page 177 or the Subsystem Management window online help.
The primary logical drive is showing a `Synchronization-in-Progress` status.	A full synchronization, between the primary and secondary logical drives participating in a mirror relationship, is in progress. Data available on the primary logical drive is copied in its entirety to its associated secondary logical drive.	Wait for the full synchronization to complete. When full synchronization has finished copying data from the primary logical drive to the secondary logical drive, the mirrored logical drive pair transitions to a `Synchronized` status. For more information about monitoring the status of a remote logical drive mirror, see the Subsystem Management window online help.

Table 19. General Remote Mirror Option problems (continued)

Problem	Cause	Resolution
Both the primary and secondary logical drive are displayed as being the primary logical drive.	A disaster or unrecoverable error has occurred on the storage subsystem that contains the primary logical drive, and the secondary logical drive is promoted to the primary logical drive role. The primary storage subsystem is now operational, but unreachable because of a link failure. A forced promotion of the secondary logical drive has resulted in both the primary and secondary logical drives being displayed in the primary logical drive role.	If the mirror logical drive pair status is `Synchronized`, complete step 1 and step 2. Otherwise, complete step 3 and step 4. 1. Determine which of the logical drives in the mirrored logical drive pair must be the primary logical drive. 2. Choose the logical drive that must be in the secondary logical drive role, then click **Storage subsystem → Change → Role to Secondary**. A resynchronization automatically occurs. 3. Delete the mirror relationship from either storage subsystem. Select either primary logical drive in its respective Subsystem Management window and click **Logical Drive → Remote Mirroring → Remove Mirror Relationship**. **Note:** The mirror relationship for the remote logical drive is not removed if there is a connection problem between the two storage subsystems. If the mirror relationship remains on the remote logical drive after the previous action, select that logical drive from its respective Subsystem Management window and click **Logical Drive → Remote Mirroring → Remove Mirror Relationship**. 4. In its respective Subsystem Management window, select the logical drive that you want to be the primary logical drive. Click **Logical Drive → Remote Mirroring → Create**. Follow the instructions in the Create Remote Mirror wizard to re-create the mirror relationship For step-by-step instructions, see "Changing a primary logical drive to a secondary drive" on page 215 or the Subsystem Management window online help.

Table 19. General Remote Mirror Option problems (continued)

Problem	Cause	Resolution
Both the primary and secondary logical drives are displayed as being the secondary logical drive.	In response to a dual primary logical drive condition, a role reversal was carried out and the primary logical drive was demoted to the secondary logical drive role. The secondary storage subsystem is operational, but unreachable because of a link failure. The forced demotion of the primary logical drive has resulted in both the primary and secondary logical drives being displayed in the secondary logical drive role.	If the mirror logical drive pair status is `Synchronized`, complete step 1 and step 2. Otherwise, complete step 3 and step 4. 1. Determine which of the logical drives in the mirrored logical drive pair must be the primary logical drive. 2. Choose the logical drive that must be in the primary logical drive role, then click **Storage Subsystem → Change → Role to Primary**. A resynchronization automatically occurs. 3. Delete the mirror relationship from either storage subsystem. Select either secondary logical drive in its respective Subsystem Management window and click **Logical Drive → Remote Mirroring → Remove Mirror Relationship**. **Note:** The mirror relationship for the remote logical drive is not removed if there is a connection problem between the two storage subsystems. If the mirror relationship remains on the remote logical drive after the previous action, select that logical drive from its respective Subsystem Management window and click **Logical Drive → Remote Mirroring → Remove Mirror Relationship**. 4. In its respective Subsystem Management window, select the logical drive that you want to be the secondary logical drive. Click **Logical Drive→ Remote Mirroring → Create**. Follow the instructions in the Create Remote Mirror wizard to re-create the mirror relationship. For step-by-step instructions, see "Changing a secondary logical drive to a primary drive" on page 214 or the Subsystem Management window online help.

Table 19. General Remote Mirror Option problems (continued)

Problem	Cause	Resolution
The primary logical drive or secondary logical drive displays as missing.	A physical logical drive that a remote logical drive mirror depends on (primary logical drive, secondary logical drive) is removed, and the logical drive is now displayed under the missing logical drives node in the Logical view of the Subsystem Management window.	If missing logical drives are detected because drives have accidentally been removed, or are detected as missing because of a loss of power to the storage expansion enclosures. You can recover these logical drives by completing the following steps: 1. Reinsert the drives back into the storage expansion enclosure. 2. Make sure that the storage expansion enclosure power supplies are properly connected to an operating power source and have an `Optimal` status. For more information, see the Recovery Guru or contact your IBM technical-support representative. If the missing logical drive is no longer required, it can be deleted. **Attention:** Deleting a missing logical drive is a permanent action. Any associated logical drives or logical drive-to-LUN mappings are also deleted. For more information, see the Recovery Guru or the Subsystem Management window online help.
The mirror relationship was removed successfully from the primary side, but not from the secondary side.	When removing a mirror relationship, a link failure occurred between the primary and secondary storage subsystems and an error message displays. The Subsystem Management window for the primary storage subsystem indicates that the mirror relationship was removed successfully; however, the Subsystem Management window for the secondary storage subsystem indicates that the mirror relationship still exists.	Open the Subsystem Management window for the secondary storage subsystem and remove the mirror relationship. For step-by-step instructions, see "Removing mirror relationships" on page 183 or the Subsystem Management window online help.

Table 19. General Remote Mirror Option problems (continued)

Problem	Cause	Resolution
The mirror relationship was removed successfully from the secondary side, but not from the primary side.	When removing a mirror relationship, a link failure occurred between the primary and secondary storage subsystems. The Subsystem Management window for the secondary storage subsystem indicates that the mirror relationship is removed successfully; however, the Subsystem Management window for the primary storage subsystem indicates that the mirror relationship still exists, with the primary logical drive showing an `Unresponsive` status.	Open the Subsystem Management window for the primary storage subsystem and remove the mirror relationship. For step-by-step instructions, see "Removing mirror relationships" on page 183 or the Subsystem Management window online help.
The primary logical drive is showing an `Unsynchronized` status.	The remote logical drive mirror is in an `Unsynchronized` status because the data that is mirrored between the primary logical drive and the secondary logical drive is no longer identical. Usual causes for this status include link errors, a failed primary logical drive or secondary logical drive, or a dual primary or dual secondary error condition. While the remote logical drive mirror is in an `Unsynchronized` status, no mirroring activity takes place. **Note:** 1. The remote mirror link and the mirror logical drive pair status depends on I/O requests, especially I/O write requests to the primary logical drive. If there are no I/O requests, the displayed status of the mirror link and the mirror logical drive pair in the Storage Manager client might be incorrect. 2. Generate I/O write requests to the primary logical drive to force the storage subsystems updating the remote mirror status.	When the controller owner of the primary logical drive can communicate with the controller owner of the secondary logical drive and the logical drive is online and optimal, a full synchronization automatically takes place. When a full synchronization begins, the remote logical drive mirror transitions to a mirror `Synchronization-in-Progress` status. For information about monitoring the status of a remote logical drive mirror, see the Subsystem Management window online help.

Table 19. General Remote Mirror Option problems (continued)

Problem	Cause	Resolution
An error message indicates that the Remote Mirror Option is out of compliance.	The Remote Mirror Option is out of compliance. This normally occurs if a storage subsystem with logical drives that are participating in remote logical drive mirroring is moved into the primary storage subsystem and one of the following conditions now exists: • The Remote Mirror Option is not enabled on the selected storage subsystem. • The Remote Mirror Option is enabled, but the current number of remote logical drive mirrors that are defined on the primary storage subsystem exceeds the number of mirror relationships that are allowed for this storage subsystem.	If the Remote Mirror Option is not enabled for the primary storage subsystem: 1. Obtain a premium feature key for this feature from your IBM technical-support representative. 2. Enable the Remote Mirror Option. For step-by-step instructions, see "Enabling the Remote Mirror Option" on page 170, or the Subsystem Management window online help. If the Remote Mirror Option is enabled, but the current number of mirror relationships on the storage subsystem exceeds the number of mirror relationships that are allowed for the storage subsystem, reduce the number of mirror relationships to equal or less than the number of mirror relationships allowed. The maximum number of mirror relationships that are allowed is 64. For step-by step instructions, see "Removing mirror relationships" on page 183 or the Subsystem Management window online help.
The remote logical drive candidate is unresponsive and cannot be updated.	The primary storage subsystem is unable to notify the secondary storage subsystem that its worldwide name (WWN) has changed. This might be the result of a controller in the primary storage subsystem being swapped or removed. Storage subsystem recovery procedures that result in configurations being reset and can also cause a change to the WWN. The first write operation to the primary logical drive causes the mirrored logical drive pair to transition into an `Unsynchronized` status.	1. Remove all the existing mirror relationships from the primary storage subsystem. For step-by-step instructions, see "Removing mirror relationships" on page 183 or the Subsystem Management window online help. 2. Reestablish the required mirror relationships. For step-by step instructions, see "Creating mirror relationships" on page 177 or the Subsystem Management window online help.
There is a long boot time for Windows 2000 hosts with secondary volumes mapped.	A Windows 2000 host can take up to two hours to boot if all of the following statements are true: • The storage management software is installed on the host. • The Remote Volume Mirroring premium feature is enabled. • One or more secondary volumes are mapped to the host.	Do not map the secondary volumes to the host until they are needed for data access. If the host needs to be restarted, and the secondary volumes are mapped to that host, unmap the secondary volumes until the host has completed the restart. Remap the secondary volumes only when they are needed for data access. Because Windows does not allow mounting the file system as read-only, do not mount the secondary logical drive to the Windows hosts.

General switch troubleshooting

Table 20 describes some of the common switch-related problems that you might encounter when using the Remote Mirror Option. The troubleshooting information provided relates to switches that are supported for use with Storage Manager. For a list of supported switches, see the *IBM System Storage DS Storage Manager Version 10 Installation and Support Guide* for your operating system.

Information about the probable cause and how you can resolve for each problem is provided. If your problem is not addressed in this section, see the remaining sections in this chapter before contacting your IBM technical-support representative.

Table 20. General switch problems

Problem	Cause	Resolution
The host is unable to detect primary and secondary storage subsystems that are participating in remote logical drive mirroring.	When two or more switches are cascaded together and have the same domain ID, host computers are unable to locate the target device. Each switch must have a unique domain ID when attempting to cascade two switches together.	Change the domain ID of one or more of your switches, ensuring that each one is unique. A domain ID must be a unique number between 1 and 239, which is used to identify the switch to a Fibre Channel fabric. For more information about setting domain IDs, see your switch documentation.

Inappropriate Fibre Channel fabric configurations

Table 21 describes Fibre Channel fabric configuration problems that you might encounter after you have configured your storage subsystems and have activated and enabled the Remote Mirror Option.

Information about the probable cause and how you can resolve each problem is provided. If your problem is not addressed in this section, see the remaining sections in this chapter before you contact your IBM technical-support representative.

Table 21. Fibre Channel fabric configuration problems

Problem	Cause	Resolution
The primary logical drive is unable to contact the Fibre Channel fabric.	Usually, this error occurs because of a failed Fibre Channel fabric or because of cabling problems between the primary and secondary storage subsystems that are participating in a remote logical drive mirror.	• If the Fibre Channel fabric has failed, repair or replace the failed fabric. • If the Fibre Channel fabric is operational, check the configuration cabling. The cable must not go through a hub or be connected directly between storage subsystems. Make sure that the cable is attached through a switch. For step-by-step instructions to configure storage subsystems for remote logical drive mirroring, see Chapter 10, “Installing hardware and software for the Enhanced Remote Mirroring Option,” on page 151.

Table 21. Fibre Channel fabric configuration problems (continued)

Problem	Cause	Resolution
The primary logical drive is unable to communicate with the secondary storage subsystem. The primary storage subsystem can still communicate with the fabric.	Usually, this error occurs when the secondary storage subsystem has lost power or when network problems exist between the secondary storage subsystem and the fabric.	• The secondary storage subsystem has no power. If the secondary storage subsystem has no power and is not operational, restore power to the storage subsystem. For information about powering on storage subsystems, see your hardware documentation. • The secondary storage subsystem has power and is operational. Check the network status. Make sure that the secondary storage subsystem is visible on the network. Make sure that the cables are correctly connected. For step-by-step instructions to configure storage subsystems for remote logical drive mirroring, see Chapter 10, "Installing hardware and software for the Enhanced Remote Mirroring Option," on page 151.

Storage subsystem component failures

Table 22 describes how physical or logical storage subsystem component failures can impact remote logical drive mirroring functionality. Information about the probable cause and how you can resolve each problem is provided. If your problem is not addressed in this section, see the remaining sections in this chapter before you contact your IBM technical-support representative.

Table 22. Storage subsystem component failures

Problem	Cause	Resolution
A FlashCopy logical drive that was created for a primary logical drive indicates that it has failed, after its role in the remote mirroring relationship has been changed to secondary.	The base logical drive for the FlashCopy logical drive is a primary logical drive that is involved in a mirror relationship. A role reversal was performed, which demoted the primary logical drive to secondary logical drive status, resulting in a FlashCopy logical drive on the secondary logical drive. The base logical drive for a FlashCopy logical drive cannot be a candidate for the secondary logical drive role in a remote logical drive mirror. Therefore, the FlashCopy logical drive has failed.	Complete a role reversal to promote the secondary logical drive to the primary logical drive role. After the role reversal is complete, the FlashCopy logical drive returns to `Optimal` status. For step-by-step instructions, see "Changing a secondary logical drive to a primary drive" on page 214 or the Subsystem Management window online help.

Table 22. Storage subsystem component failures (continued)

Problem	Cause	Resolution
The primary storage subsystem controller indicates that it has failed.	Failure of the owning controller on the primary storage subsystem usually causes the associated multipath driver on the attached host computer to transfer ownership of the alternate controller on the primary storage subsystem. When this occurs, the alternate controller on the primary storage subsystem begins forwarding newly-written data to its peer on the secondary storage subsystem. The secondary controller takes ownership of the logical drive from its (secondary) peer controller. This is a reactive event; it occurs because of the arrival of a write request from the primary storage subsystem to the non-owning controller on the secondary storage subsystem.	Allow the ownership transfer to complete. Operations continue in a normal fashion, with the alternate (usually the non-preferred) controller on the primary storage subsystem interacting with the alternate controller on the secondary storage subsystem. Failure of the non-owning controller on the primary storage subsystem has no direct impact on the status of the remote logical drive mirrors.
The secondary storage subsystem controller indicates that it has failed.	One of the following scenarios has occurred: • Controller A on the secondary storage subsystem has failed while Controller A is the owner of the primary logical drive. • Controller B on the secondary storage subsystem has failed while Controller B is the owner of the primary logical drive. In both scenarios, the mirrored logical drive pair transitions to the `Unsynchronized` status.	Restore the failed controller. For detailed recovery procedures, see the Recovery Guru. After the failed controller is restored, the primary storage subsystem automatically transitions to a `Synchronizing` status.

Remote Mirror critical events

Critical major event log (MEL) events are generated when an error occurs that can affect data availability or that results in a degraded mode of operation. The storage management software responds by alerting the appropriate administrators by email, SNMP trap, or other configured devices. Because administrative action is required to correct the problem, the storage subsystem generally enters a `Needs Attention` status. This causes the appropriate indications to be presented through the storage management software and an associated Recovery Guru procedure to be displayed when requested by the end user.

Critical events table

Table 23 provides a description of critical MEL events, with a brief explanation of what caused the event to be triggered, and how you can resolve the problem. If your problem is not addressed in this section, see the remaining sections in this chapter before you contact your IBM technical-support representative.

Table 23. Remote Mirror critical events

Problem	Cause	Resolution
Mirrored pair becomes unsynchronized.	This event is logged when a remote logical drive mirror transitions to an `Unsynchronized` status, from either a `Synchronizing` or `Optimal` status.	See the associated Recovery Guru message for specific recovery procedures.

Table 23. Remote Mirror critical events (continued)

Problem	Cause	Resolution
Dual-role conflict detected.	This event is logged when a dual-role conflict is detected, and is usually the result of a role reversal. Because both sides of the mirrored logical drive pair are in the same primary or secondary logical drive role, both the primary and secondary storage subsystems will report this MEL event.	See the associated Recovery Guru message for specific recovery procedures.
Communication error with the secondary logical drive on the secondary remote storage subsystem.	This event is logged when an interruption in the link that cannot be recovered by the firmware Fibre Channel device driver is detected. Error codes and recovery procedures assist you in finding the exact cause of the communication problem between storage subsystems that are participating in a mirror relationship.	See the associated Recovery Guru message for specific recovery procedures.
Worldwide name (WWN) change notification failed.	This event is logged when a storage subsystem detects during startup processing that its WWN has changed. The WWN can only change if both controllers of the array are exchanged while the array is powered off. When the firmware detects this name change, it attempts to notify any remote storage subsystem that had previously been participating in a mirroring relationship with any logical drive on the array.	See the associated Recovery Guru message for specific recovery procedures.

Problem resolution scenarios

The following scenarios present resolutions or workarounds to potential problems when using Remote Mirroring:

Problem:

When you create a remote mirror of a FlashCopy base logical drive, the following scenario is possible.

- First, you have created a FlashCopy of a base logical drive and the base logical drive is receiving I/O.
- Second, you decide to create a remote mirror relationship, using the base logical drive as the primary logical drive in the remote mirror pair.
- As you create the remote mirror relationship, the FlashCopy logical drive fails.

Workaround:

Quiesce I/O to the base logical drive while you are creating the remote mirror relationship. Alternatively, if the remote mirror relationship is created before you create the FlashCopy logical drive, this event will not occur.

Problem:

When alternately switching the roles of the logical drives in a remote mirrored relationship back and forth, Windows NT 4.0 and Windows 2000 might cache the file or files on the logical drive (disk) in memory and use the cached data instead of going out to the disk to get the data. This Windows operating system behavior might make the data look like it was not synchronized between logical drives in a remote mirror relationship.

Resolution:

Unmount the primary logical drive in the server before demoting it to the secondary role. In a Microsoft Windows environment, shut down the server that the primary logical drive is mapped to. Then, promote the secondary logical drive to the primary role and hot_add it to the appropriate server.

If the logical drive is of the Dynamic Disk type, you might be able to resolve the situation without shutting down the server. Complete the following steps:

1. In the server that has the primary logical drive, run the SMrepassist program in the Storage Manager utility directory with the `-f` option to flush the cached data to disk.
2. Promote the secondary logical drive and hot_add it to the appropriate server.
3. Before you promote the logical drive to the primary role in the original server, force a failure to the disk by running **chkdsk** on the disk.
4. Promote the logical drive to primary role in the original server and hot_add it.
5. You might have to reactivate the disk after it is hot_added to the server.

If the server environment prevents the server from being restarted and the logical drive is of the Basic Disk type, complete the following steps:

1. In the server that has the primary logical drive, run the SMrepassist program in the Storage Manager util directory with the `-f` option to flush the cached data to disk.
2. Use the Storage Manager to remove the LUN mapping of the logical drive that had the primary role from its server (host computer).
3. Promote the secondary role LUN to the primary role and hot_add it in the appropriate server assuming that the LUN mapping is already defined for this server in the storage subsystem.
4. Before you promote the logical drive to the primary role in the original server, run the Hot_add program or initiate a Scan for Hardware Changes task in the original server. This removes the logical drive from the available disks. In Windows 2000, you might see `Unsafe Removal of Devices` messages.
5. Use the Storage Manager to add the LUN mapping of the logical drive that will be promoted to primary role to the original server (host computer).
6. Promote the logical drive to primary role and hot_add it in the original server. If you are unable to hot_add the logical drive or the data still seems to be mismatched, you must restart the server.

Appendix A. Upgrading controller firmware

The Remote Mirror Option is designed so that it is not necessary for the primary storage subsystem and the secondary storage subsystem to run exactly the same controller firmware level. All inter-controller operations (including those needed for propagation of newly-written data from the primary logical drive to the secondary logical drive) are implemented so as to support mixed firmware levels to the greatest extent possible. This allows firmware upgrades to be performed on both the primary and secondary storage subsystems without any loss of data. This is also true in the case that the controller firmware of the storage subsystem at the primary site is version 06.10.xx.xx and the controller firmware of the one at the secondary site is version 05.xx.xx.xx and vice versa. The capabilities of the remote mirror depend on the version of the controller firmware installed at the storage subsystem where the primary logical drive of remote mirror located.

The key data availability operations, including promotion from the secondary logical drive to the primary logical drive, are allowed in mixed firmware levels. However, to avoid restrictions in Remote Mirroring configuration operations due to a mixed primary and secondary storage subsystem controller firmware environment, always upgrade the firmware to the same levels. In a mixed firmware level environment, the following configuration requests are the only ones that can be completed: mirror deletion, changing the logical drive user label, and changing the synchronization priority. All other mirror configuration functions are not allowed.

Important: Make sure that the storage subsystems are in Optimal state before attempting controller firmware and NVSRAM download. Use the Recovery Guru in the Storage Manager subsystem window to correct any problems before downloading the firmware.

Upgrades to controller firmware are completed in different ways depending on whether the primary controller currently has the Enhanced Remote Mirroring Option, or the earlier Remote Mirror Option installed. Follow the steps below, based on the remote mirroring version installed.

Upgrading controller firmware with Enhanced Remote Mirroring installed

This section describes the procedure that you must follow to upgrade controller firmware (version 05.2xx.xx or later) if you are currently running the Enhanced Remote Mirroring Option on the primary controller. Performing firmware upgrades on storage subsystems that are participating in mirror relationships in sequence detailed in the steps below.

1. Download the firmware to the primary storage subsystem.
2. Download firmware to the secondary storage subsystem.

The Enhanced Remote Mirroring controller firmware will cache the write I/Os during the unsynchronized period and will complete these cached writes only after the secondary storage subsystem has completed the firmware download.

Note: For more information about upgrading controller firmware, including detailed procedures, see the *IBM DS Storage Manager 9 Installation and Support Guide* for your operating system.

Upgrading controller firmware with the previous Remote Mirror Option installed

This section describes the procedure that you must follow to upgrade controller firmware (version 05.2xx.xx or later) if the storage subsystems are using the earlier version of the Remote Mirror Option. The sequence for firmware upgrades on storage subsystems that are participating in mirror relationships is detailed in the steps below.

Important: By following this sequence, it is possible to avoid transitions of the mirrored logical drive pair to an `Unsynchronized` status, avoiding the need for a full resynchronization afterwards. The secondary array is offline for some interval while the firmware updates are performed (using the previous Remote Mirror functionality), which will cause the remote mirror status to change to Unsynchronized. This will require full resynchronization when the firmware download operation is complete. To minimize the resynchronization process, one has to stop I/Os to the primary storage subsystem while upgrading the secondary storage subsystem.

1. Stop I/O to programs that operate on all the affected primary logical drives that are temporarily inactive.
2. Download firmware to the secondary storage subsystem.

   Resume program access to the primary logical drives. You can operate the primary storage subsystem with a different firmware level than the secondary storage subsystem for a time, but the inter-controller protocols for data replication do not support such interactions.
3. Download the firmware to the primary storage subsystem.

Resynchronization of the primary and secondary storage subsystems will then be initiated.

Appendix B. Accessibility

This section provides information about alternate keyboard navigation, which is a Storage Manager accessibility feature. Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully.

With the alternate keyboard operations that are described in this section, you can use keys or key combinations to complete Storage Manager tasks and initiate many menu actions that can also be done with a mouse.

Note: In addition to the keyboard operations that are described in this section, the Storage Manager version 9.14 - 10.10 (and later) software installation packages for Windows include a screen reader software interface.

To enable the screen reader, select **Custom Installation** when using the installation wizard to install Storage Manager 9.14 - 10.10 (or later) on a Windows host/management station. Then, in the Select Product Features window, select **Java™ Access Bridge**, in addition to the other required host software components.

Table 24 defines the keyboard operations that enable you to navigate, select, or activate user interface components. The following terms are used in the table:

- *Navigate* means to move the input focus from one user interface component to another.
- *Select* means to choose one or more components, typically for a subsequent action.
- *Activate* means to carry out the action of a particular component.

Note: In general, navigation between components requires the following keys:

- **Tab** - Moves keyboard focus to the next component or to the first member of the next group of components
- **Shift-Tab** - Moves keyboard focus to the previous component or to the first component in the previous group of components
- **Arrow keys** - Move keyboard focus within the individual components of a group of components

Table 24. DS Storage Manager alternate keyboard operations

Short cut	Action
F1	Open the Help.
F10	Move keyboard focus to main menu bar and post first menu; use the arrow keys to navigate through the available options.
Alt+F4	Close the management window.
Alt+F6	Move keyboard focus between dialogs (non-modal) and between management windows.

Table 24. DS Storage Manager alternate keyboard operations (continued)

Short cut	Action
Alt+ underlined letter	Access menu items, buttons, and other interface components with the keys associated with the underlined letters. For the menu options, select the Alt + underlined letter combination to access a main menu, and then select the underlined letter to access the individual menu item. For other interface components, use the Alt + underlined letter combination.
Ctrl+F1	Display or conceal a tool tip when keyboard focus is on the toolbar.
Spacebar	Select an item or activate a hyperlink.
Ctrl+Spacebar (Contiguous/Non-contiguous) AMW Logical/Physical View	Select multiple drives in the Physical View. To select multiple drives, select one drive by pressing Spacebar, and then press Tab to switch focus to the next drive you want to select; press Ctrl+Spacebar to select the drive. If you press Spacebar alone when multiple drives are selected then all selections are removed. Use the Ctrl+Spacebar combination to deselect a drive when multiple drives are selected. This behavior is the same for contiguous and noncontiguous selection of drives.
End, Page Down	Move keyboard focus to the last item in the list.
Esc	Close the current dialog. Does not require keyboard focus.
Home, Page Up	Move keyboard focus to the first item in the list.
Shift+Tab	Move keyboard focus through components in the reverse direction.
Ctrl+Tab	Move keyboard focus from a table to the next user interface component.
Tab	Navigate keyboard focus between components or select a hyperlink.
Down arrow	Move keyboard focus down one item in the list.
Left arrow	Move keyboard focus to the left.
Right arrow	Move keyboard focus to the right.
Up arrow	Move keyboard focus up one item in the list.

Appendix C. Getting help and technical assistance

If you need help, service, or technical assistance or just want more information about IBM products, you will find a wide variety of sources available from IBM to assist you.

Use this information to obtain additional information about IBM and IBM products, determine what to do if you experience a problem with your IBM system or optional device, and determine whom to call for service, if it is necessary.

Before you call

Before you call, make sure that you have taken these steps to try to solve the problem yourself.

If you believe that you require IBM to perform warranty service on your IBM product, the IBM service technicians will be able to assist you more efficiently if you prepare before you call.

- Check for updated firmware and operating-system device drivers for your IBM product. The IBM Warranty terms and conditions state that you, the owner of the IBM product, are responsible for maintaining and updating all software and firmware for the product (unless it is covered by an additional maintenance contract). Your IBM service technician will request that you upgrade your software and firmware if the problem has a documented solution within a software upgrade.

  You can obtain the latest downloads for your IBM product from http://www.ibm.com/support/fixcentral/systemx/groupView?query.productGroup=ibm%2FSystemx ..
- If you have installed new hardware or software in your environment, check http://www.ibm.com/systems/info/x86servers/serverproven/compat/us/ to make sure that the hardware and software is supported by your IBM product.
- Use the troubleshooting information in your system documentation, and use the diagnostic tools that come with your IBM product. Information about diagnostic tools is in the *Problem Determination and Service Guide* on the IBM *Documentation* CD that comes with your product.
- Go to http://www.ibm.com/systems/support/ to check for information to help you solve the problem.
- Gather the following information to provide to IBM service. This data will help IBM service quickly provide a solution to your problem and ensure that you receive the level of service for which you might have contracted.
  - Hardware and Software Maintenance agreement contract numbers, if applicable
  - Machine type number (IBM 4-digit machine identifier)
  - Model number
  - Serial number
  - Current system UEFI (or BIOS) and firmware levels
  - Other pertinent information such as error messages and logs
- Go to http://www.ibm.com/support/electronic/ to submit an Electronic Service Request. Submitting an Electronic Service Request will start the process of

determining a solution to your problem by making the pertinent information available to IBM service quickly and efficiently. IBM service technicians can start working on your solution as soon as you have completed and submitted an Electronic Service Request.

Using the documentation

Information about your IBM system and preinstalled software, if any, or optional device is available in the documentation that comes with the product. That documentation can include printed documents, online documents, readme files, and help files.

See the troubleshooting information in your system documentation for instructions for using the diagnostic programs. The troubleshooting information or the diagnostic programs might tell you that you need additional or updated device drivers or other software. IBM maintains pages on the World Wide Web where you can get the latest technical information and download device drivers and updates. To access these pages, go to http://www.ibm.com/systems/support/ .

You can find the most up-to-date information for System x products at http://www.ibm.com/systems/x/ .

Getting help and information from the World Wide Web

On the World Wide Web, up-to-date information about IBM systems, optional devices, services, and support is available at http://www.ibm.com/systems/support/ .

You can find the most up-to-date product information for System x products at http://www.ibm.com/systems/x/ .

Software service and support

Through IBM Support Line, you can get telephone assistance, for a fee, with usage, configuration, and software problems with your IBM products.

For more information about Support Line and other IBM services, see http://www.ibm.com/services/us/index.wss or see http://www.ibm.com/planetwide/ for support telephone numbers. In the U.S. and Canada, call 1-800-IBM-SERV (1-800-426-7378).

Hardware service and support

You can receive hardware service through your IBM reseller or IBM Services.

To locate a reseller authorized by IBM to provide warranty service, go to http://www.ibm.com/partnerworld/ and click **Find Business Partners** on the right side of the page. For IBM support telephone numbers, see http://www.ibm.com/planetwide/ . In the U.S. and Canada, call 1-800-IBM-SERV (1-800-426-7378).

In the U.S. and Canada, hardware service and support is available 24 hours a day, 7 days a week. In the U.K., these services are available Monday through Friday, from 9 a.m. to 6 p.m.

Taiwan contact information

This topic contains the product service contact information for Taiwan.

IBM Taiwan Product Service Contact Information:
IBM Taiwan Corporation
3F, No 7, Song Ren Rd., Taipei Taiwan
Tel: 0800-016-888

台灣IBM 產品服務聯絡方式：
台灣國際商業機器股份有限公司
台北市松仁路7號3樓
電話：0800-016-888

f2c00790

Notices

This information was developed for products and services offered in the U.S.A.

IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information on the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service.

IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not grant you any license to these patents. You can send license inquiries, in writing, to:

IBM Director of Licensing
IBM Corporation
North Castle Drive
Armonk, NY 10504-1785
U.S.A.

For license inquiries regarding double-byte character set (DBCS) information, contact the IBM Intellectual Property Department in your country or send inquiries, in writing, to:

Intellectual Property Licensing
Legal and Intellectual Property Law
IBM Japan, Ltd.
19-21, Nihonbashi-Hakozakicho, Chuo-ku
Tokyo 103-8510, Japan

The following paragraph does not apply to the United Kingdom or any other country where such provisions are inconsistent with local law:
INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some states do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

Any references in this information to non-IBM websites are provided for convenience only and do not in any manner serve as an endorsement of those websites. The materials at those websites are not part of the materials for this IBM product and use of those websites is at your own risk.

IBM may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you.

Licensees of this program who wish to have information about it for the purpose of enabling: (i) the exchange of information between independently created programs and other programs (including this one) and (ii) the mutual use of the information which has been exchanged, should contact:

IBM Corporation
Almaden Research
650 Harry Road
Bldg 80, D3-304, Department 277
San Jose, CA 95120-6099
U.S.A.

Such information may be available, subject to appropriate terms and conditions, including in some cases, payment of a fee.

The licensed program described in this document and all licensed material available for it are provided by IBM under terms of the IBM Customer Agreement, IBM International Program License Agreement or any equivalent agreement between us.

Any performance data contained herein was determined in a controlled environment. Therefore, the results obtained in other operating environments may vary significantly. Some measurements may have been made on development-level systems and there is no guarantee that these measurements will be the same on generally available systems. Furthermore, some measurements may have been estimated through extrapolation. Actual results may vary. Users of this document should verify the applicable data for their specific environment.

Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

All statements regarding IBM's future direction or intent are subject to change or withdrawal without notice, and represent goals and objectives only.

All IBM prices shown are IBM's suggested retail prices, are current and are subject to change without notice. Dealer prices may vary.

This information is for planning purposes only. The information herein is subject to change before the products described become available.

This information contains examples of data and reports used in daily business operations. To illustrate them as completely as possible, the examples include the names of individuals, companies, brands, and products. All of these names are fictitious and any similarity to the names and addresses used by an actual business enterprise is entirely coincidental.

COPYRIGHT LICENSE:

This information contains sample application programs in source language, which illustrate programming techniques on various operating platforms. You may copy, modify, and distribute these sample programs in any form without payment to IBM, for the purposes of developing, using, marketing or distributing application programs conforming to the application programming interface for the operating platform for which the sample programs are written. These examples have not been thoroughly tested under all conditions. IBM, therefore, cannot guarantee or imply reliability, serviceability, or function of these programs. The sample programs are provided "AS IS", without warranty of any kind. IBM shall not be liable for any damages arising out of your use of the sample programs.

Each copy or any portion of these sample programs or any derivative work, must include a copyright notice as follows:

© (your company name) (year). Portions of this code are derived from IBM Corp. Sample Programs.

© Copyright IBM Corp. _enter the year or years_.

If you are viewing this information softcopy, the photographs and color illustrations may not appear.

Trademarks

IBM, the IBM logo, and ibm.com® are trademarks or registered trademarks of International Business Machines Corp., registered in many jurisdictions worldwide. Other product and service names might be trademarks of IBM or other companies. A current list of IBM trademarks is available on the web at Copyright and trademark information at www.ibm.com/legal/copytrade.shtml.

Adobe, the Adobe logo, PostScript, and the PostScript logo are either registered trademarks or trademarks of Adobe Systems Incorporated in the United States, and/or other countries.

Intel, Intel logo, Intel Inside, Intel Inside logo, Intel Centrino, Intel Centrino logo, Celeron, Intel Xeon, Intel SpeedStep, Itanium, and Pentium are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries.

Linux is a registered trademark of Linus Torvalds in the United States, other countries, or both.

Microsoft, Windows, Windows NT, and the Windows logo are trademarks of Microsoft Corporation in the United States, other countries, or both.

UNIX is a registered trademark of The Open Group in the United States and other countries.

Java and all Java-based trademarks and logos are trademarks or registered trademarks of Oracle and/or its affiliates.

Important notes

Processor speed indicates the internal clock speed of the microprocessor; other factors also affect application performance.

This product is not intended to be connected directly or indirectly by any means whatsoever to interfaces of public telecommunications networks, nor is it intended to be used in a public services network.

CD or DVD drive speed is the variable read rate. Actual speeds vary and are often less than the possible maximum.

When referring to processor storage, real and virtual storage, or channel volume, KB stands for 1024 bytes, MB stands for 1,048,576 bytes, and GB stands for 1,073,741,824 bytes.

When referring to hard disk drive capacity or communications volume, MB stands for 1,000,000 bytes, and GB stands for 1,000,000,000 bytes. Total user-accessible capacity can vary depending on operating environments.

Maximum internal hard disk drive capacities assume the replacement of any standard hard disk drives and population of all hard disk drive bays with the largest currently supported drives that are available from IBM.

Maximum memory might require replacement of the standard memory with an optional memory module.

IBM makes no representation or warranties regarding non-IBM products and services that are ServerProven®, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. These products are offered and warranted solely by third parties.

IBM makes no representations or warranties with respect to non-IBM products. Support (if any) for the non-IBM products is provided by the third party, not IBM.

Some software might differ from its retail version (if available) and might not include user manuals or all program functionality.

Particulate contamination

Attention: Airborne particulates (including metal flakes or particles) and reactive gases acting alone or in combination with other environmental factors such as humidity or temperature might pose a risk to the device that is described in this document.

Risks that are posed by the presence of excessive particulate levels or concentrations of harmful gases include damage that might cause the device to malfunction or cease functioning altogether. This specification sets forth limits for particulates and gases that are intended to avoid such damage. The limits must not be viewed or used as definitive limits, because numerous other factors, such as temperature or moisture content of the air, can influence the impact of particulates or environmental corrosives and gaseous contaminant transfer. In the absence of specific limits that are set forth in this document, you must implement practices that maintain particulate and gas levels that are consistent with the protection of human health and safety. If IBM determines that the levels of particulates or gases in your environment have caused damage to the device, IBM may condition provision of repair or replacement of devices or parts on implementation of appropriate remedial measures to mitigate such environmental contamination. Implementation of such remedial measures is a customer responsibility.

Table 25. Limits for particulates and gases

Contaminant	Limits
Particulate	• The room air must be continuously filtered with 40% atmospheric dust spot efficiency (MERV 9) according to ASHRAE Standard 52.21. • Air that enters a data center must be filtered to 99.97% efficiency or greater, using high-efficiency particulate air (HEPA) filters that meet MIL-STD-282. • The deliquescent relative humidity of the particulate contamination must be more than 60%2. • The room must be free of conductive contamination such as zinc whiskers.
Gaseous	• Copper: Class G1 as per ANSI/ISA 71.04-19853 • Silver: Corrosion rate of less than 300 Å in 30 days
1 ASHRAE 52.2-2008 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size. Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. 2 The deliquescent relative humidity of particulate contamination is the relative humidity at which the dust absorbs enough water to become wet and promote ionic conduction. 3 ANSI/ISA-71.04-1985. Environmental conditions for process measurement and control systems: Airborne contaminants. Instrument Society of America, Research Triangle Park, North Carolina, U.S.A.	

Documentation format

The publications for this product are in Adobe Portable Document Format (PDF) and should be compliant with accessibility standards. If you experience difficulties when you use the PDF files and want to request a web-based format or accessible PDF document for a publication, direct your mail to the following address:

Information Development
IBM Corporation
205/A015
3039 E. Cornwallis Road
P.O. Box 12195
Research Triangle Park, North Carolina 27709-2195
U.S.A.

In the request, be sure to include the publication part number and title.

When you send information to IBM, you grant IBM a nonexclusive right to use or distribute the information in any way it believes appropriate without incurring any obligation to you.

Electronic emission notices

Federal Communications Commission statement

This explains the Federal Communications Commission's (FCC) statement.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can

radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, might cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. IBM is not responsible for any radio or television interference caused by using other than recommended cables and connectors, or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device might not cause harmful interference, and (2) this device must accept any interference received, including interference that might cause undesired operation.

Industry Canada compliance statement

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conform à la norme NMB-003 du Canada.

Australia and New Zealand Class A Statement

Attention: This is a Class A product. In a domestic environment this product might cause radio interference in which case the user might be required to take adequate measures.

European Union Electromagnetic Compatibility Directive

This product is in conformity with the protection requirements of European Union (EU) Council Directive 2004/108/EC on the approximation of the laws of the Member States relating to electromagnetic compatibility. IBM cannot accept responsibility for any failure to satisfy the protection requirements resulting from a non-recommended modification of the product, including the fitting of non-IBM option cards.

Attention: This is an EN 55022 Class A product. In a domestic environment this product might cause radio interference in which case the user might be required to take adequate measures.

Responsible Manufacturer:

International Business Machines Corp.
New Orchard Road
Armonk, New York 10504
914-499-1900

European community contact:

IBM Deutschland GmbH
Technical Regulations, Department M372
IBM-Allee 1, 71139 Ehningen, Germany
Tele: +49 7032 15 2941
e-mail: lugi@de.ibm.com

Germany Electromagnetic compatibility directive

Deutschsprachiger EU Hinweis: Hinweis für Geräte der Klasse A EU-Richtlinie zur Elektromagnetischen Verträglichkeit

Dieses Produkt entspricht den Schutzanforderungen der EU-Richtlinie 2004/108/EG zur Angleichung der Rechtsvorschriften über die elektromagnetische Verträglichkeit in den EU-Mitgliedsstaaten und hält die Grenzwerte der EN 55022 Klasse A ein.

Um dieses sicherzustellen, sind die Geräte wie in den Handbüchern beschrieben zu installieren und zu betreiben. Des Weiteren dürfen auch nur von der IBM empfohlene Kabel angeschlossen werden. IBM übernimmt keine Verantwortung für die Einhaltung der Schutzanforderungen, wenn das Produkt ohne Zustimmung der IBM verändert bzw. wenn Erweiterungskomponenten von Fremdherstellern ohne Empfehlung der IBM gesteckt/eingebaut werden.

EN 55022 Klasse A Geräte müssen mit folgendem Warnhinweis versehen werden:

"Warnung: Dieses ist eine Einrichtung der Klasse A. Diese Einrichtung kann im Wohnbereich Funk-Störungen verursachen; in diesem Fall kann vom Betreiber verlangt werden, angemessene Mabnahmen zu ergreifen und dafür aufzukommen."

Deutschland: Einhaltung des Gesetzes über die elektromagnetische Verträglichkeit von Geräten

Dieses Produkt entspricht dem "Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG)." Dies ist die Umsetzung der EU-Richtlinie 2004/108/EG in der Bundesrepublik Deutschland.

Zulassungsbescheinigung laut dem Deutschen Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG) (bzw. der EMC EG Richtlinie 2004/108/EG) für Geräte der Klasse A

Dieses Gerät ist berechtigt, in übereinstimmung mit dem Deutschen EMVG das EG-Konformitätszeichen - CE - zu führen.

Verantwortlich für die Einhaltung der EMV Vorschriften ist der Hersteller:

```
International Business Machines Corp.
New Orchard Road
Armonk,New York 10504
Tel: 914-499-1900
```

Der verantwortliche Ansprechpartner des Herstellers in der EU ist:

IBM Deutschland GmbH
Technical Regulations, Abteilung M372
IBM-Allee 1, 71139 Ehningen, Germany
Tele: +49 7032 15 2941
e-mail: lugi@de.ibm.com

Generelle Informationen:

Das Gerät erfüllt die Schutzanforderungen nach EN 55024 und EN 55022 Klasse A.

Japan Voluntary Control Council for Interference (VCCI) Class A Statement

この装置は、クラス A 情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。 VCCI-A

Japan Electronics and Information Technology Industries Association (JEITA) Statement (less than or equal to 20 A per phase)

高調波ガイドライン適合品 jjieta1

Korean Communications Commission (KCC) Class A Statement

이 기기는 업무용(A급)으로 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.

Russia Electromagnetic Interference (EMI) Class A Statement

ВНИМАНИЕ! Настоящее изделие относится к классу А.
В жилых помещениях оно может создавать
радиопомехи, для снижения которых необходимы
дополнительные меры rusemi

People's Republic of China Class A Electronic Emission statement

中华人民共和国“A类”警告声明

声 明

此为A级产品，在生活环境中，该产品可能会造成无线电干扰。在这种情况下，可能需要用户对其干扰采取切实可行的措施。

Taiwan Class A compliance statement

警告使用者:
這是甲類的資訊產品，在
居住的環境中使用時，可
能會造成射頻干擾，在這
種情況下，使用者會被要
求採取某些適當的對策。taiemi

Glossary

This glossary provides definitions for the terminology and abbreviations used in IBM System Storage DS4000 and DS5000 publications.

If you do not find the term you are looking for, see the *IBM Glossary of Computing Terms* located at the following website:

www.ibm.com/ibm/terminology

This glossary also includes terms and definitions from:

- *Information Technology Vocabulary* by Subcommittee 1, Joint Technical Committee 1, of the International Organization for Standardization and the International Electrotechnical Commission (ISO/IEC JTC1/SC1). Definitions are identified by the symbol (I) after the definition; definitions taken from draft international standards, committee drafts, and working papers by ISO/IEC JTC1/SC1 are identified by the symbol (T) after the definition, indicating that final agreement has not yet been reached among the participating National Bodies of SC1.
- *IBM Glossary of Computing Terms*. New York: McGraw-Hill, 1994.

The following cross-reference conventions are used in this glossary:

See Refers you to (a) a term that is the expanded form of an abbreviation or acronym, or (b) a synonym or more preferred term.

See also
Refers you to a related term.

Abstract Windowing Toolkit (AWT)
A Java graphical user interface (GUI).

accelerated graphics port (AGP)
A bus specification that gives low-cost 3D graphics cards faster access to main memory on personal computers than the usual peripheral component interconnect (PCI) bus. AGP reduces the overall cost of creating high-end graphics subsystems by using existing system memory.

access logical drive
A special logical drive that allows the host-agent to communicate with the controllers in the storage subsystem.

adapter
A printed circuit assembly that transmits user data input/output (I/O) between the internal bus of the host system and the external Fibre Channel (FC) link and vice versa. Also called an I/O adapter, host adapter, or FC adapter.

advanced technology (AT) bus architecture
A bus standard for IBM compatibles. It extends the XT bus architecture to 16 bits and also allows for bus mastering, although only the first 16 MB of main memory are available for direct access.

agent A server program that receives virtual connections from the network manager (the client program) in a Simple Network Management Protocol-Transmission Control Protocol/Internet Protocol (SNMP-TCP/IP) network-managing environment.

AGP See *accelerated graphics port*.

AL_PA
See *arbitrated loop physical address*.

arbitrated loop
One of three existing Fibre Channel topologies, in which 2 - 126 ports are interconnected serially in a single loop circuit. Access to the Fibre Channel-Arbitrated Loop (FC-AL) is controlled by an arbitration scheme. The FC-AL topology supports all classes of service and guarantees in-order delivery of FC frames when the originator and responder are on the same FC-AL. The default topology for the disk array is arbitrated loop. An arbitrated loop is sometimes referred to as a Stealth Mode.

arbitrated loop physical address (AL_PA)
An 8-bit value that is used to uniquely identify an individual port within a loop. A loop can have one or more AL_PAs.

array A collection of Fibre Channel or SATA hard drives that are logically grouped together. All the drives in the array are assigned the same RAID level. An array is

sometimes referred to as a "RAID set." See also *redundant array of independent disks (RAID)*, *RAID level*.

Global Copy
In remote mirroring, an option that allows the primary controller to return a write I/O request completion to the host server before data has been successfully written by the secondary controller. See also *Global Copy*, *remote mirroring*, *Global Copy*,*Global Mirroring*.

AT See *advanced technology (AT) bus architecture*.

ATA See *AT-attached*.

AT-attached
Peripheral devices that are compatible with the original IBM AT computer standard in which signals on a 40-pin AT-attached (ATA) ribbon cable followed the timings and constraints of the Industry Standard Architecture (ISA) system bus on the IBM PC AT computer. Equivalent to integrated drive electronics (IDE).

auto-volume transfer/auto-disk transfer (AVT/ADT)
A function that provides automatic failover in case of controller failure on a storage subsystem.

AVT/ADT
See *auto-volume transfer/auto-disk transfer*.

AWT See *Abstract Windowing Toolkit*.

basic input/output system (BIOS)
The personal computer code that controls basic hardware operations, such as interactions with diskette drives, hard disk drives, and the keyboard.

BIOS See *basic input/output system*.

BOOTP
See *bootstrap protocol*.

bootstrap protocol (BOOTP)
In Transmission Control Protocol/Internet Protocol (TCP/IP) networking, an alternative protocol by which a diskless machine can obtain its Internet Protocol (IP) address and such configuration information as IP addresses of various servers from a BOOTP server.

bridge A storage area network (SAN) device that provides physical and transport conversion, such as Fibre Channel to small computer system interface (SCSI) bridge.

bridge group
A bridge and the collection of devices connected to it.

broadcast
The simultaneous transmission of data to more than one destination.

cathode ray tube (CRT)
A display device in which controlled electron beams are used to display alphanumeric or graphical data on an electroluminescent screen.

client A computer system or process that requests a service of another computer system or process that is typically referred to as a server. Multiple clients can share access to a common server.

command
A statement used to initiate an action or start a service. A command consists of the command name abbreviation, and its parameters and flags if applicable. A command can be issued by typing it on a command line or selecting it from a menu.

community string
The name of a community contained in each Simple Network Management Protocol (SNMP) message.

concurrent download
A method of downloading and installing firmware that does not require the user to stop I/O to the controllers during the process.

CRC See *cyclic redundancy check*.

CRT See *cathode ray tube*.

CRU See *customer replaceable unit*.

customer replaceable unit (CRU)
An assembly or part that a customer can replace in its entirety when any of its components fail. Contrast with *field replaceable unit (FRU)*.

cyclic redundancy check (CRC)
(1) A redundancy check in which the check key is generated by a cyclic algorithm. (2) An error detection technique performed at both the sending and receiving stations.

dac See *disk array controller*.

dar See *disk array router*.

DASD
See *direct access storage device*.

data striping
See *striping*.

default host group
A logical collection of discovered host ports, defined host computers, and defined host groups in the storage-partition topology that fulfill the following requirements:

- Are not involved in specific logical drive-to-LUN mappings
- Share access to logical drives with default logical drive-to-LUN mappings

device type
Identifier used to place devices in the physical map, such as the switch, hub, or storage.

DHCP See *Dynamic Host Configuration Protocol*.

direct access storage device (DASD)
A device in which access time is effectively independent of the location of the data. Information is entered and retrieved without reference to previously accessed data. (For example, a disk drive is a DASD, in contrast with a tape drive, which stores data as a linear sequence.) DASDs include both fixed and removable storage devices.

direct memory access (DMA)
The transfer of data between memory and an input/output (I/O) device without processor intervention.

disk array controller (dac)
A disk array controller device that represents the two controllers of an array. See also *disk array router*.

disk array router (dar)
A disk array router that represents an entire array, including current and deferred paths to all logical unit numbers (LUNs) (hdisks on AIX operating system). See also *disk array controller*.

DMA See *direct memory access*.

domain
The most significant byte in the node port (N_port) identifier for the Fibre Channel (FC) device. It is not used in the Fibre Channel-small computer system interface (FC-SCSI) hardware path ID. It is required to be the same for all SCSI targets logically connected to an FC adapter.

DRAM
See *dynamic random access memory*.

Dynamic Host Configuration Protocol (DHCP)
A protocol defined by the Internet Engineering Task Force that is used for dynamically assigning Internet Protocol (IP) addresses to computers in a network.

dynamic random access memory (DRAM)
A storage in which the cells require repetitive application of control signals to retain stored data.

ECC See *error correction coding*.

EEPROM
See *electrically erasable programmable read-only memory*.

EISA See *Extended Industry Standard Architecture*.

electrically erasable programmable read-only memory (EEPROM)
A type of memory chip which can retain its contents without consistent electrical power. Unlike the PROM which can be programmed only once, the EEPROM can be erased electrically. Because it can only be reprogrammed a limited number of times before it wears out, it is appropriate for storing small amounts of data that are changed infrequently.

electrostatic discharge (ESD)
The flow of current that results when objects that have a static charge come into close enough proximity to discharge.

environmental service module (ESM) canister
A component in a storage expansion enclosure that monitors the environmental condition of the components in that enclosure. Not all storage subsystems have ESM canisters.

E_port See *expansion port*.

error correction coding (ECC)
A method for encoding data so that transmission errors can be detected and corrected by examining the data on the receiving end. Most ECCs are characterized by the maximum number of errors they can detect and correct.

ESD See *electrostatic discharge*.

ESM canister
See *environmental service module canister*.

EXP See *storage expansion enclosure*.

expansion port (E_port)
A port that connects the switches for two fabrics.

Extended Industry Standard Architecture (EISA)
A bus standard for IBM compatibles that extends the Industry Standard Architecture (ISA) bus architecture to 32 bits and allows more than one central processing unit (CPU) to share the bus. See also *Industry Standard Architecture*.

fabric A Fibre Channel entity which interconnects and facilitates logins of N_ports attached to it. The fabric is responsible for routing frames between source and destination N_ports using address information in the frame header. A fabric can be as simple as a point-to-point channel between two N-ports, or as complex as a frame-routing switch that provides multiple and redundant internal pathways within the fabric between F_ports.

fabric port (F_port)
In a fabric, an access point for connecting a user's N_port. An F_port facilitates N_port logins to the fabric from nodes connected to the fabric. An F_port is addressable by the N_port connected to it. See also *fabric*.

FC See *Fibre Channel*.

FC-AL See *arbitrated loop*.

feature enable identifier
A unique identifier for the storage subsystem, which is used in the process of generating a premium feature key. See also *premium feature key*.

Fibre Channel (FC)
A set of standards for a serial input/output (I/O) bus capable of transferring data between two ports at up to 100 Mbps, with standards proposals to go to higher speeds. FC supports point-to-point, arbitrated loop, and switched topologies.

Fibre Channel-Arbitrated Loop (FC-AL)
See *arbitrated loop*.

Fibre Channel Protocol (FCP) for small computer system interface (SCSI)
A high-level Fibre Channel mapping layer (FC-4) that uses lower-level Fibre Channel (FC-PH) services to transmit SCSI commands, data, and status information between a SCSI initiator and a SCSI target across the FC link with FC frame and sequence formats.

field replaceable unit (FRU)
An assembly that is replaced in its entirety when any one of its components fails. In some cases, a field replaceable unit might contain other field replaceable units. Contrast with *customer replaceable unit (CRU)*.

FlashCopy
A premium feature for DS4000 and DS5000 that can make an instantaneous copy of the data in a logical drive.

F_port See *fabric port*.

FRU See *field replaceable unit*.

GBIC See *gigabit interface converter*

gigabit interface converter (GBIC)
A transceiver that performs serial, optical-to-electrical, and electrical-to-optical signal conversions for high-speed networking. A GBIC can be hot swapped. See also *small form-factor pluggable*.

Global Copy
Refers to a remote logical drive mirror pair that is set up using Global Copy without the write consistency group option. This is also referred to as "Enhanced Global Mirroring without Consistency Group." Global Copy does not make sure that write requests to multiple primary logical drives are carried out in the same order on the secondary logical drives as they are on the primary logical drives. If it is critical that writes to the primary logical drives are carried out in the same order in the appropriate secondary logical drives, Global Mirroring must be used instead of Global Copy. See also *asynchronous write mode*, *Global Mirroring*, *remote mirroring*, *Metro Mirroring*.

Global Mirroring
Refers to a remote logical drive mirror pair that is set up using Global Copy with

the write consistency group option. This is also referred to as "Enhanced Global Mirroring with Consistency Group." Global Mirroring makes sure that write requests to multiple primary logical drives are carried out in the same order on the secondary logical drives as they are on the primary logical drives, preventing data on the secondary logical drives from becoming inconsistent with the data on the primary logical drives. See also *asynchronous write mode*, *Global Copy*, *remote mirroring*, *Metro Mirroring*.

graphical user interface (GUI)
A type of computer interface that presents a visual metaphor of a real-world scene, often of a desktop, by combining high-resolution graphics, pointing devices, menu bars and other menus, overlapping windows, icons, and the object-action relationship.

GUI See *graphical user interface.*

HBA See *host bus adapter*.

hdisk An AIX term representing a logical unit number (LUN) on an array.

host A system that is directly attached to the storage subsystem through a Fibre Channel input/output (I/O) path. This system is used to serve data (typically in the form of files) from the storage subsystem. A system can be both a management station and a host simultaneously.

host bus adapter (HBA)
An interface between the Fibre Channel network and a workstation or server.

host computer
See *host*.

host group
An entity in the storage partition topology that defines a logical collection of host computers that require shared access to one or more logical drives.

host port
Ports that physically reside on the host adapters and are automatically discovered by the Storage Manager software. To give a host computer access to a partition, its associated host ports must be defined.

hot swap
To replace a hardware component without turning off the system.

hub In a network, a point at which circuits are either connected or switched. For example, in a star network, the hub is the central node; in a star/ring network, it is the location of wiring concentrators.

IBMSAN driver
The device driver that is used in a Novell NetWare environment to provide multipath input/output (I/O) support to the storage controller.

IC See *integrated circuit*.

IDE See *integrated drive electronics*.

in-band
Transmission of management protocol over the Fibre Channel transport.

Industry Standard Architecture (ISA)
Unofficial name for the bus architecture of the IBM PC/XT personal computer. This bus design included expansion slots for plugging in various adapter boards. Early versions had an 8-bit data path, later expanded to 16 bits. The "Extended Industry Standard Architecture" (EISA) further expanded the data path to 32 bits. See also *Extended Industry Standard Architecture*.

initial program load (IPL)
The initialization procedure that causes an operating system to commence operation. Also referred to as a system restart, system startup, and boot.

integrated circuit (IC)
A microelectronic semiconductor device that consists of many interconnected transistors and other components. ICs are constructed on a small rectangle cut from a silicon crystal or other semiconductor material. The small size of these circuits allows high speed, low power dissipation, and reduced manufacturing cost compared with board-level integration. Also known as a *chip*.

integrated drive electronics (IDE)
A disk drive interface based on the 16-bit IBM personal computer Industry Standard Architecture (ISA) in which the controller electronics reside on the drive itself, eliminating the need for a separate

adapter card. Also known as an Advanced Technology Attachment Interface (ATA).

Internet Protocol (IP)
A protocol that routes data through a network or interconnected networks. IP acts as an intermediary between the higher protocol layers and the physical network.

Internet Protocol (IP) address
The unique 32-bit address that specifies the location of each device or workstation on the Internet. For example, 9.67.97.103 is an IP address.

interrupt request (IRQ)
A type of input found on many processors that causes the processor to suspend normal processing temporarily and start running an interrupt handler routine. Some processors have several interrupt request inputs that allow different priority interrupts.

IP See *Internet Protocol*.

IPL See *initial program load*.

IRQ See *interrupt request*.

ISA See *Industry Standard Architecture*.

Java Runtime Environment (JRE)
A subset of the Java Development Kit (JDK) for end users and developers who want to redistribute the Java Runtime Environment (JRE). The JRE consists of the Java virtual machine, the Java Core Classes, and supporting files.

JRE See *Java Runtime Environment*.

label A discovered or user entered property value that is displayed underneath each device in the Physical and Data Path maps.

LAN See *local area network*.

LBA See *logical block address*.

local area network (LAN)
A computer network located on a user's premises within a limited geographic area.

logical block address (LBA)
The address of a logical block. Logical block addresses are typically used in hosts' I/O commands. The SCSI disk command protocol, for example, uses logical block addresses.

logical partition (LPAR)
A subset of a single system that contains resources (processors, memory, and input/output devices). A logical partition operates as an independent system. If hardware requirements are met, multiple logical partitions can exist within a system.

A fixed-size portion of a logical drive. A logical partition is the same size as the physical partitions in its array. Unless the logical drive of which it is a part is mirrored, each logical partition corresponds to, and its contents are stored on, a single physical partition.

One to three physical partitions (copies). The number of logical partitions within a logical drive is variable.

logical unit number (LUN)
An identifier used on a small computer system interface (SCSI) bus to distinguish among up to eight devices (logical units) with the same SCSI ID.

loop address
The unique ID of a node in Fibre Channel loop topology sometimes referred to as a loop ID.

loop group
A collection of storage area network (SAN) devices that are interconnected serially in a single loop circuit.

loop port
A node port (N_port) or fabric port (F_port) that supports arbitrated loop functions associated with an arbitrated loop topology.

LPAR See *logical partition*.

LUN See *logical unit number*.

MAC See *medium access control*.

management information base (MIB)
The information that is on an agent. It is an abstraction of configuration and status information.

man pages
In UNIX-based operating systems, online documentation for operating system commands, subroutines, system calls, file

formats, special files, stand-alone utilities, and miscellaneous facilities. Invoked by the **man** command.

MCA See *micro channel architecture*.

media scan
A media scan is a background process that runs on all logical drives in the storage subsystem for which it has been enabled, providing error detection on the drive media. The media scan process scans all logical drive data to verify that it can be accessed, and optionally scans the logical drive redundancy information.

medium access control (MAC)
In local area networks (LANs), the sublayer of the data link control layer that supports medium-dependent functions and uses the services of the physical layer to provide services to the logical link control sublayer. The MAC sublayer includes the method of determining when a device has access to the transmission medium.

Metro Mirroring
This term is used to refer to a remote logical drive mirror pair which is set up with Metro Mirror. See also *remote mirroring*, *Global Mirroring*.

MIB See *management information base*.

micro channel architecture (MCA)
Hardware that is used for PS/2 Model 50 computers and above to provide better growth potential and performance characteristics when compared with the original personal computer design.

Microsoft Cluster Server (MSCS)
MSCS, a feature of Windows NT Server (Enterprise Edition), supports the connection of two servers into a cluster for higher availability and easier manageability. MSCS can automatically detect and recover from server or application failures. It can also be used to balance server workload and provide for planned maintenance.

mini hub
An interface card or port device that receives shortwave Fibre Channel GBICs or SFPs. These devices enable redundant Fibre Channel connections from the host computers, either directly or through a Fibre Channel switch or managed hub, over optical fiber cables to the storage server controllers. Each controller is responsible for two mini hubs. Each mini hub has two ports. Four host ports (two on each controller) provide a cluster solution without use of a switch. Two host-side mini hubs are shipped as standard. See also *host port, gigabit interface converter (GBIC), small form-factor pluggable (SFP)*.

mirroring
A fault-tolerance technique in which information on a hard disk is duplicated on additional hard disks. See also *remote mirroring*.

model The model identification that is assigned to a device by its manufacturer.

MSCS See *Microsoft Cluster Server*.

network management station (NMS)
In the Simple Network Management Protocol (SNMP), a station that runs management application programs that monitor and control network elements.

NMI See *non-maskable interrupt*.

NMS See *network management station*.

non-maskable interrupt (NMI)
A hardware interrupt that another service request cannot overrule (mask). An NMI bypasses and takes priority over interrupt requests generated by software, the keyboard, and other such devices and is issued to the microprocessor only in disastrous circumstances, such as severe memory errors or impending power failures.

node A physical device that allows for the transmission of data within a network.

node port (N_port)
A Fibre Channel defined hardware entity that performs data communications over the Fibre Channel link. It is identifiable by a unique worldwide name. It can act as an originator or a responder.

nonvolatile storage (NVS)
A storage device whose contents are not lost when power is cut off.

N_port
See *node port*.

NVS See *nonvolatile storage*.

NVSRAM
Nonvolatile storage random access memory. See *nonvolatile storage*.

Object Data Manager (ODM)
An AIX proprietary storage mechanism for ASCII stanza files that are edited as part of configuring a drive into the kernel.

ODM See *Object Data Manager*.

out-of-band
Transmission of management protocols outside of the Fibre Channel network, typically over Ethernet.

partitioning
See *storage partition*.

parity check
A test to determine whether the number of ones (or zeros) in an array of binary digits is odd or even.

A mathematical operation on the numerical representation of the information communicated between two pieces. For example, if parity is odd, any character represented by an even number has a bit added to it, making it odd, and an information receiver checks that each unit of information has an odd value.

PCI local bus
See *peripheral component interconnect local bus*.

PDF See *portable document format*.

performance events
Events related to thresholds set on storage area network (SAN) performance.

peripheral component interconnect local bus (PCI local bus)
A local bus for PCs, from Intel Corporation, that provides a high-speed data path between the CPU and up to 10 peripherals (video, disk, network, and so on). The PCI bus coexists in the PC with the Industry Standard Architecture (ISA) or Extended Industry Standard Architecture (EISA) bus. ISA and EISA boards plug into an IA or EISA slot, while high-speed PCI controllers plug into a PCI slot. See also *Industry Standard Architecture*, *Extended Industry Standard Architecture*.

polling delay
The time in seconds between successive discovery processes during which discovery is inactive.

port A part of the system unit or remote controller to which cables for external devices (such as display stations, terminals, printers, switches, or external storage units) are attached. The port is an access point for data entry or exit. A device can contain one or more ports.

portable document format (PDF)
A standard specified by Adobe Systems, Incorporated, for the electronic distribution of documents. PDF files are compact; can be distributed globally by email, the web, intranets, CD-ROM or DVD-ROM; and can be viewed with the Acrobat Reader, which is software from Adobe Systems that can be downloaded at no cost from the Adobe Systems home page.

premium feature key
A file that the storage subsystem controller uses to enable an authorized premium feature. The file contains the feature enable identifier of the storage subsystem for which the premium feature is authorized, and data about the premium feature. See also *feature enable identifier*.

private loop
A freestanding arbitrated loop with no fabric attachment. See also *arbitrated loop*.

program temporary fix (PTF)
A temporary solution or bypass of a problem diagnosed by IBM Corporation in a current unaltered release of the program.

PTF See *program temporary fix*.

RAID See *redundant array of independent disks (RAID)*.

RAID level
An array RAID level is a number that refers to the method used to achieve redundancy and fault tolerance in the array. See also *array, redundant array of independent disks (RAID)*.

RAID set
See *array*.

RAM See *random-access memory*.

random-access memory (RAM)
A temporary storage location in which the central processing unit (CPU) stores and executes its processes. Contrast with *DASD*.

RDAC
See *redundant disk array controller*.

read-only memory (ROM)
Memory in which stored data cannot be changed by the user except under special conditions.

recoverable virtual shared disk (RVSD)
A virtual shared disk on a server node configured to provide continuous access to data and file systems in a cluster.

redundant array of independent disks (RAID)
A collection of disk drives (*array*) that appears as a single logical drive to the server, which is fault tolerant through an assigned method of data striping, mirroring, or parity checking. Each array is assigned a RAID level, which is a specific number that refers to the method used to achieve redundancy and fault tolerance. See also *array, parity check, mirroring, RAID level, striping*.

redundant disk array controller (RDAC)
(1) In hardware, a redundant set of controllers (either active/passive or active/active). (2) In software, a layer that manages the input/output (I/O) through the active controller during normal operation and transparently reroutes I/Os to the other controller in the redundant set if a controller or I/O path fails.

remote mirroring
Online, real-time replication of data between storage subsystems that are maintained on separate media. The Enhanced Remote Mirror Option is a DS4000 and DS5000 premium feature that provides support for remote mirroring. See also *Global Mirroring*, *Metro Mirroring*.

ROM See *read-only memory*.

router A computer that determines the path of network traffic flow. The path selection is made from several paths based on information obtained from specific protocols, algorithms that attempt to identify the shortest or best path, and other criteria such as metrics or protocol-specific destination addresses.

RVSD See *recoverable virtual shared disk*.

SAI See *Storage Array Identifier*.

SA Identifier
See *Storage Array Identifier*.

SAN See *storage area network*.

SATA See *serial ATA*.

scope Defines a group of controllers by their Internet Protocol (IP) addresses. A scope must be created and defined so that dynamic IP addresses can be assigned to controllers on the network.

SCSI See *small computer system interface*.

segmented loop port (SL_port)
A port that allows division of a Fibre Channel private loop into multiple segments. Each segment can pass frames around as an independent loop and can connect through the fabric to other segments of the same loop.

sense data
(1) Data sent with a negative response, indicating the reason for the response. (2) Data describing an I/O error. Sense data is presented to a host system in response to a sense request command.

serial ATA
The standard for a high-speed alternative to small computer system interface (SCSI) hard drives. The SATA-1 standard is equivalent in performance to a 10 000 RPM SCSI drive.

serial storage architecture (SSA)
An interface specification from IBM Corporation in which devices are arranged in a ring topology. SSA, which is compatible with small computer system interface (SCSI) devices, allows full-duplex packet multiplexed serial data transfers at rates of 20 Mbps in each direction.

server A functional hardware and software unit that delivers shared resources to workstation client units on a computer network.

server/device events
Events that occur on the server or a designated device that meet criteria that the user sets.

SFP See *small form-factor pluggable*.

Simple Network Management Protocol (SNMP)
In the Internet suite of protocols, a network management protocol that is used to monitor routers and attached networks. SNMP is an application layer protocol. Information on devices managed is defined and stored in the application's Management Information Base (MIB).

SL_port
See *segmented loop port*.

SMagent
The Storage Manager optional Java-based host-agent software, which can be used on Microsoft Windows, Novell NetWare, HP-UX, and Solaris host systems to manage storage subsystems through the host Fibre Channel connection.

SMclient
The Storage Manager client software, which is a Java-based graphical user interface (GUI) that is used to configure, manage, and troubleshoot storage servers and storage expansion enclosures in a storage subsystem. SMclient can be used on a host system or on a management station.

SMruntime
A Java compiler for the SMclient.

SMutil
The Storage Manager utility software that is used on Microsoft Windows, HP-UX, and Solaris host systems to register and map new logical drives to the operating system. In Microsoft Windows, it also contains a utility to flush the cached data of the operating system for a particular drive before creating a FlashCopy.

small computer system interface (SCSI)
A standard hardware interface that enables a variety of peripheral devices to communicate with one another.

small form-factor pluggable (SFP)
An optical transceiver that is used to convert signals between optical fiber cables and switches. An SFP is smaller than a gigabit interface converter (GBIC). See also *gigabit interface converter*.

SNMP
See *Simple Network Management Protocol* and *SNMPv1*.

SNMP trap event
An event notification sent by the SNMP agent that identifies conditions, such as thresholds, that exceed a predetermined value. See also *Simple Network Management Protocol*.

SNMPv1
The original standard for SNMP is now referred to as SNMPv1, as opposed to SNMPv2, a revision of SNMP. See also *Simple Network Management Protocol*.

SRAM
See *static random access memory*.

SSA See *serial storage architecture*.

static random access memory (SRAM)
Random access memory based on the logic circuit know as flip-flop. It is called static because it retains a value as long as power is supplied, unlike dynamic random access memory (DRAM), which must be regularly refreshed. It is however, still volatile, meaning that it can lose its contents when the power is turned off.

storage area network (SAN)
A dedicated storage network tailored to a specific environment, combining servers, storage products, networking products, software, and services. See also *fabric*.

Storage Array Identifier (SAI or SA Identifier)
The Storage Array Identifier is the identification value used by the Storage Manager host software (SMClient) to uniquely identify each managed storage server. The Storage Manager SMClient program maintains Storage Array Identifier records of previously-discovered storage servers in the host resident file, which allows it to retain discovery information in a persistent fashion.

storage expansion enclosure (EXP)
A feature that can be connected to a system unit to provide additional storage and processing capacity.

storage management station
A system that is used to manage the storage subsystem. A management station does not need to be attached to the storage subsystem through the Fibre Channel input/output (I/O) path.

storage partition
Storage subsystem logical drives that are

visible to a host computer or are shared among host computers that are part of a host group.

storage partition topology
In the Storage Manager client, the Topology view of the Mappings window displays the default host group, the defined host group, the host computer, and host-port nodes. The host port, host computer, and host group topological elements must be defined to grant access to host computers and host groups using logical drive-to-LUN mappings.

striping
Splitting data to be written into equal blocks and writing blocks simultaneously to separate disk drives. Striping maximizes performance to the disks. Reading the data back is also scheduled in parallel, with a block being read concurrently from each disk then reassembled at the host.

subnet
An interconnected but independent segment of a network that is identified by its Internet Protocol (IP) address.

sweep method
A method of sending Simple Network Management Protocol (SNMP) requests for information to all the devices on a subnet by sending the request to every device in the network.

switch A Fibre Channel device that provides full bandwidth per port and high-speed routing of data with link-level addressing.

switch group
A switch and the collection of devices connected to it that are not in other groups.

switch zoning
See *zoning*.

Metro Mirror
In remote mirroring, an option that requires the primary controller to wait for the acknowledgment of a write operation from the secondary controller before returning a write I/O request completion to the host. See also *asynchronous write mode*, *remote mirroring*, *Metro Mirroring*.

system name
Device name assigned by the third-party vendor software.

TCP See *Transmission Control Protocol*.

TCP/IP
See *Transmission Control Protocol/Internet Protocol*.

terminate and stay resident program (TSR program)
A program that installs part of itself as an extension of DOS when it is executed.

topology
The physical or logical arrangement of devices on a network. The three Fibre Channel topologies are fabric, arbitrated loop, and point-to-point. The default topology for the disk array is arbitrated loop.

TL_port
See *translated loop port*.

transceiver
A device that is used to transmit and receive data. Transceiver is an abbreviation of transmitter-receiver.

translated loop port (TL_port)
A port that connects to a private loop and allows connectivity between the private loop devices and off loop devices (devices not connected to that particular TL_port).

Transmission Control Protocol (TCP)
A communication protocol used in the Internet and in any network that follows the Internet Engineering Task Force (IETF) standards for internetwork protocol. TCP provides a reliable host-to-host protocol between hosts in packed-switched communication networks and in interconnected systems of such networks. It uses the Internet Protocol (IP) as the underlying protocol.

Transmission Control Protocol/Internet Protocol (TCP/IP)
A set of communication protocols that provide peer-to-peer connectivity functions for both local and wide-area networks.

trap In the Simple Network Management Protocol (SNMP), a message sent by a managed node (agent function) to a management station to report an exception condition.

trap recipient
Receiver of a forwarded Simple Network Management Protocol (SNMP) trap. Specifically, a trap receiver is defined by an Internet Protocol (IP) address and port to which traps are sent. Presumably, the actual recipient is a software application running at the IP address and listening to the port.

TSR program
See *terminate and stay resident program*.

uninterruptible power supply
A source of power from a battery that is installed between a computer system and its power source. The uninterruptible power supply keeps the system running if a commercial power failure occurs, until an orderly shutdown of the system can be performed.

user action events
Actions that the user takes, such as changes in the storage area network (SAN), changed settings, and so on.

worldwide port name (WWPN)
A unique identifier for a switch on local and global networks.

worldwide name (WWN)
A globally unique 64-bit identifier assigned to each Fibre Channel port.

WORM
See *write-once read-many*.

write-once read many (WORM)
Any type of storage medium to which data can be written only a single time, but can be read from any number of times. After the data is recorded, it cannot be altered.

WWN See *worldwide name*.

zoning
In Fibre Channel environments, the grouping of multiple ports to form a virtual, private, storage network. Ports that are members of a zone can communicate with each other, but are isolated from ports in other zones.

A function that allows segmentation of nodes by address, name, or physical port and is provided by fabric switches or hubs.

Index

F

G

R

S

T

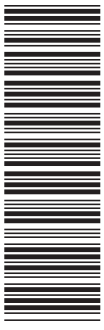
U

V

W

Part Number: 00W1469

Printed in USA



(1P) P/N: 00W1469

GA32-0964-05