BladeStore Storage Manager Remote Volume Mirroring

Feature Guide for Version 8.3x

P/N 96105, First Edition

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Document Description

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This document describes the Remote Volume Mirroring premium feature of BladeStore Storage Manager version 8.36 (or later) and will remain the official reference source for all revisions/releases of this product until rescinded by an update.

Intended Readers

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

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Chapter 1

Remote Volume Mirroring Feature Concepts and Requirements

This chapter introduces the basic concepts of the Remote Volume Mirroring feature, describing Remote Volume Mirroring, how information is replicated between disk subsystems, the software and hardware required, and the recommended system configurations. Additionally, this chapter presents how to configure other premium features to properly function with the Remote Volume Mirroring premium feature.

Once you have an understanding of the basic Remote Volume Mirroring concepts, read the software and hardware requirements and recommended configurations. Complete the checklists provided to ensure that all the hardware and software requirements have been met before configuring your systems for the Remote Volume Mirroring premium feature.

Introduction to Remote Volume Mirroring

The Remote Volume Mirroring premium feature is used for online, real-time replication of data between disk subsystems over a remote distance. In the event of a disaster or catastrophic failure at one disk subsystem, you can promote a second disk subsystem to take over responsibility for computing services.

This section introduces you to primary, secondary, and mirror repository volumes, and describes how they interact to replicate data between disk subsystems using the Remote Volume Mirroring feature.

Primary and Secondary Volumes

When you create a remote volume mirror, a mirrored volume pair is created and consists of a primary volume at a primary disk subsystem and a secondary volume at a secondary disk subsystem. A standard volume may only be included in one mirrored volume pair. There can be up to 8 defined mirrors on an 9176 disk subsystem and up to 32 defined mirrors on an D178 or D280 disk subsystem.

The primary volume is the volume that accepts host I/O and stores application data. When the mirror relationship is first created, data from the primary volume is copied in its entirety to the secondary volume. This process is known as a full synchronization and is directed by the controller owner of the primary volume. During a full synchronization, the primary volume remains fully accessible for all normal I/O operations.

The controller owner of the primary volume initiates remote writes to the secondary volume to keep the data on the two volumes synchronized. Whenever the data on the primary volume and the secondary volume becomes unsynchronized, the controller owner of the primary volume initiates a full synchronization.

The secondary volume maintains a mirror (or copy) of the data on its associated primary volume. The controller owner of the secondary volume receives remote writes from the primary volume controller owner, but will not accept host read or write requests.

The secondary volume remains unavailable to host applications while mirroring is underway. In the event of a disaster or catastrophic failure of the primary site, a role reversal can be performed to promote the secondary volume to a primary role. Hosts will then be able to access the newly promoted volume and business operations can continue.

Figure 1-1 shows the primary and secondary volumes displayed in the Array Management Window for the primary disk subsystem and the secondary disk subsystem.

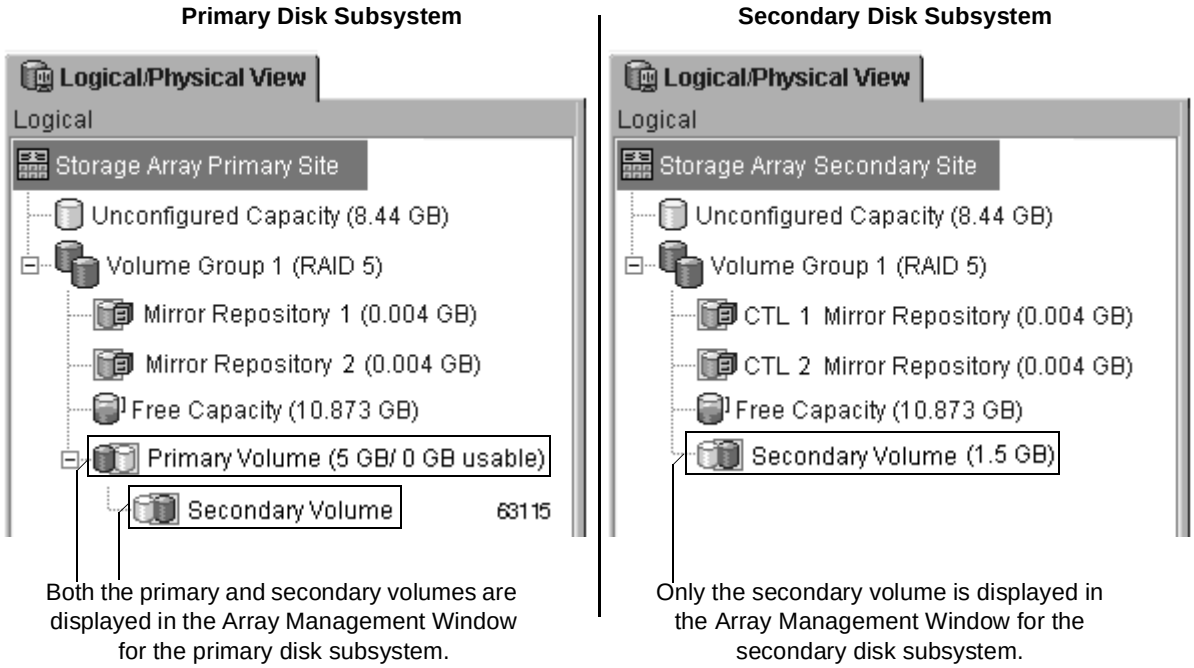

Figure 1-1 Primary and Secondary Volumes Displayed in the Array Management Window

Mirror Repository Volumes

A mirror repository volume is a special volume in the disk subsystem created as a resource for the controller owner of the primary volume in a Remote Volume Mirror. The controller stores mirroring information on this volume, including information about remote writes that are not yet complete. The controller can use this information to recover from controller resets and accidental powering-down of disk subsystems.

When you activate the Remote Volume Mirroring premium feature on the disk subsystem, you create two mirror repository volumes, one for each controller in the disk subsystem. An individual mirror repository volume is not needed for each Remote Volume Mirror.

When you create the mirror repository volumes, you specify the location of the volumes. You can either use existing free capacity or you can create a volume group for the volumes from unconfigured capacity and then specify the RAID level.

Figure 1-2 on page 1-4 shows the mirror repository volumes displayed in the Array Management Window for the primary disk subsystem.

Because of the critical nature of the data being stored, the RAID level of mirror repository volumes must not be RAID 0 (for data striping). The required size of each volume is 4 MB, or 8 MB total for both mirror repository volumes of a dual controller array.

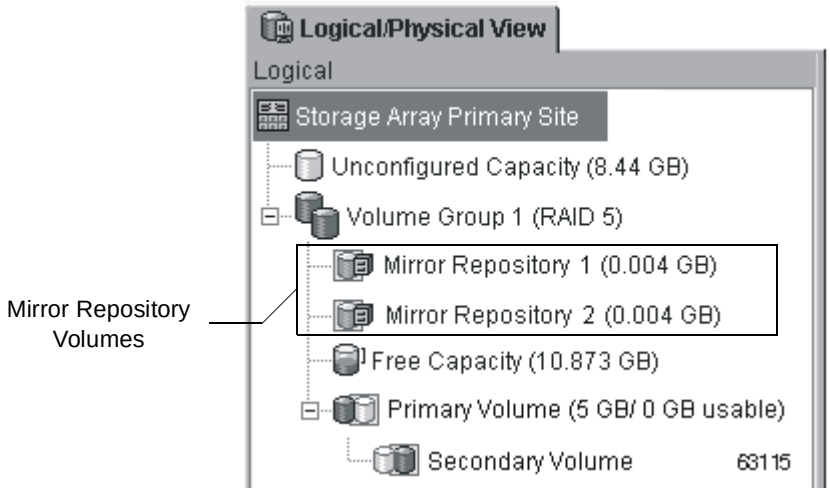

Figure 1-2 Mirror Repository Volumes Displayed in the Array Management Window

Mirror Relationships

Prior to creating a mirror relationship, the Remote Volume Mirroring premium feature must be enabled on both the primary and secondary disk subsystems. A secondary volume candidate must be created on the secondary site if one does not already exist and must be a standard volume of equal or greater capacity than the associated primary volume.

When secondary volume candidates are available, a mirror relationship can be established in the storage management software by identifying the disk subsystem containing the primary volume and the disk subsystem containing the secondary volume.

When the mirror relationship is first created, a full synchronization automatically occurs, with data from the primary volume copied in its entirety to the secondary volume. For more information on creating mirror relationships, refer to “Using the Remote Volume Mirroring Premium Feature” in Chapter 3.

Data Replication

Data replication between the primary volume and the secondary volume is managed by the controllers and is transparent to host machines and applications. This section describes how data is replicated between disk subsystems participating in Remote Volume Mirroring and the actions taken by the controller owner of the primary volume if a link interruption occurs between disk subsystems.

When the controller owner of the primary volume receives a write request from a host, the controller first logs information about the write to a mirror repository volume, then writes the data to the primary volume. The controller then initiates a remote write operation to copy the affected data blocks to the secondary volume at the secondary disk subsystem.

After the host write request has been written to the primary volume and the data has been successfully copied to the secondary volume, the controller removes the log record on the mirror repository volume and sends an I/O completion indication back to the host system. See Figure 1-3 for a graphical representation of the data replication process.

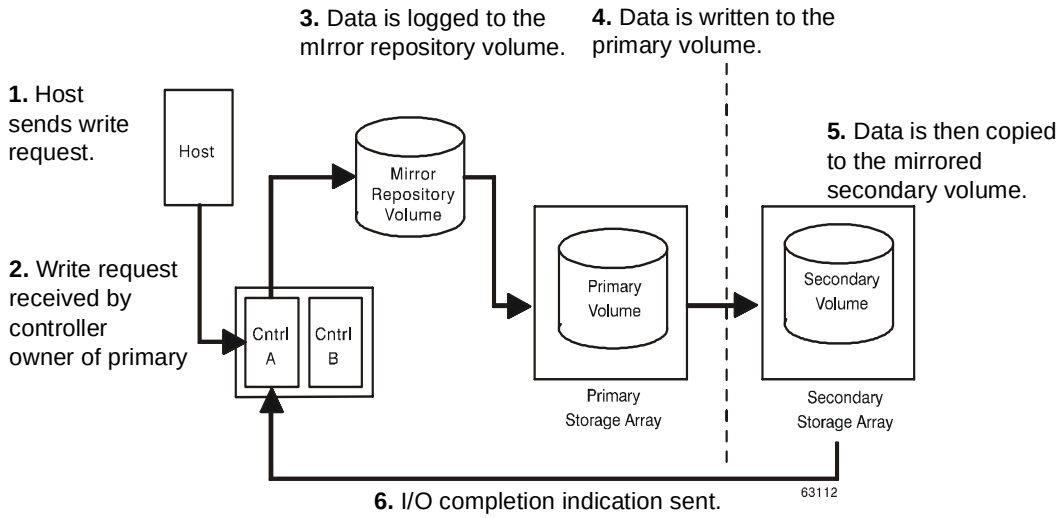

Figure 1-3 Data Replication Between Disk Subsystems

Because the controller does not send the I/O completion to the host until the data has been copied to both the primary and secondary volumes, this mirroring operation is called synchronous.

When a read request is received from a host system, the controller owner of the primary volume handles the request normally and no communication takes place between the primary and secondary disk subsystems.

Link Interruptions or Secondary Volume Errors

When processing write requests, the primary controller may be able to write to the primary volume, but a link interruption prevents communication with the remote secondary controller.

In this case, the remote write cannot complete to the secondary volume and the primary and secondary volumes are no longer correctly mirrored. The primary controller transitions the mirrored pair into an Unsynchronized status and sends an I/O completion to the primary host, as shown in Figure 1-4. The primary host can continue to write to the primary volume but remote writes will not take place.

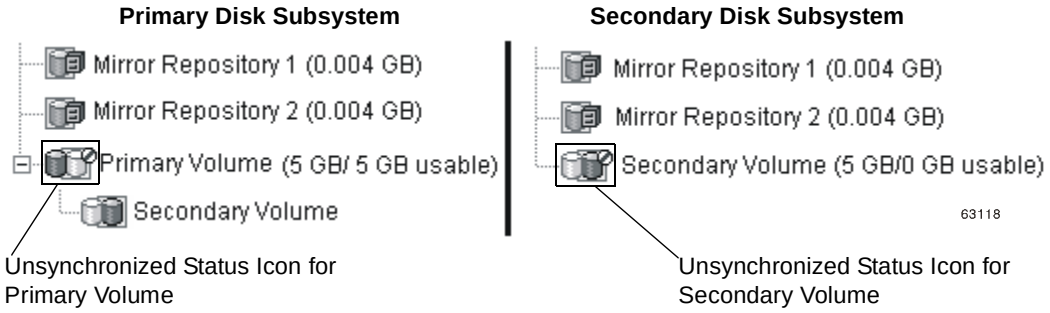

Figure 1-4 Mirrored Volume Pair in Unsynchronized Status

When connectivity is restored between the controller owner of the primary volume and the controller owner of the secondary volume, a full synchronization will automatically take place. The mirrored pair will then transition from an Unsynchronized status to a Synchronization in Progress status, as shown in Figure 1-5.

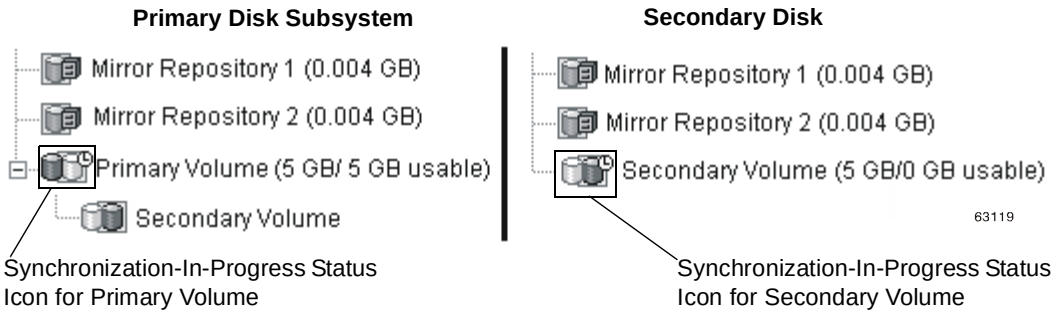

Figure 1-5 Mirrored Volume Pair in Synchronization-in-Progress Status

The primary controller will also mark the mirrored pair as Unsynchronized when a volume error on the secondary side prevents the remote write from completing. For example, an offline or a failed secondary volume can cause the Remote Volume Mirror to become Unsynchronized. When the volume error is corrected (the secondary volume is placed online or recovered to an Optimal status), then a full synchronization automatically begins, and the mirrored pair transitions to a Synchronization in Progress status.

For more information on Remote Volume Mirroring statuses, refer to Chapter 3, “Using the Remote Volume Mirroring Premium Feature.”.

Connectivity and Input/Output

The Remote Volume Mirroring feature requires a dedicated host port for mirroring data between disk subsystems. This section describes the typical configurations used to connect disk subsystems for Remote Volume Mirroring, controller ownership of volumes within disk subsystems, the maximum disk subsystem distance permitted, and some general performance considerations.

After the Remote Volume Mirroring feature has been activated, one Fibre Channel host-side I/O port on each controller is solely dedicated to mirroring operations. For example, in the primary disk subsystem, controller ports A2 and B2 are dedicated to mirroring operations. In the secondary disk subsystem, controller ports A2 and B2 are also dedicated to mirroring operations.

Any host-initiated I/O operations will not be accepted by the dedicated port, and any requests received on this dedicated port will only be accepted from another controller participating in the mirror relationship.

Controller ports dedicated to Remote Volume Mirroring must be attached to a Fibre Channel fabric environment with support for the Directory Service and Name Service interfaces.

Fibre Channel Fabric Configurations

Three Fibre Channel fabric configurations are supported in this version of the storage management software. The level of redundancy available will depend on the type of configuration selected.

- **Highest Availability Campus Configuration** – A fully redundant configuration which consists of a primary disk subsystem and a secondary disk subsystem. For more information, refer to “Highest Availability Campus Configuration” on page 1-20.
- **Campus Configuration** – A lower-cost configuration which consists of a primary disk subsystem and a secondary disk subsystem. For more information, refer to “Campus Configuration” on page 1-21.
- **Intra-Site Configuration** – Lowest-cost configuration where the primary disk subsystem and secondary disk subsystem are located within the same site. For more information, refer to “Intra-Site Configuration” on page 1-22.

For instructions on how to configure disk subsystems, refer to Chapter 2, “Hardware and Software Installation.”

Volume Ownership

The controller owner of the primary volume will only attempt to communicate with its mirrored controller in the secondary disk subsystem. As shown in Figure 1-6, Controller A in the primary disk subsystem only attempts communication with Controller A in the secondary disk subsystem.

The controller (A or B) that owns the primary volume determines the controller owner of the secondary volume. If the primary volume is owned by Controller A on the primary disk subsystem, the secondary volume is, therefore, owned by Controller A on the secondary disk subsystem. If primary Controller A cannot communicate with secondary Controller A, no controller ownership changes take place.

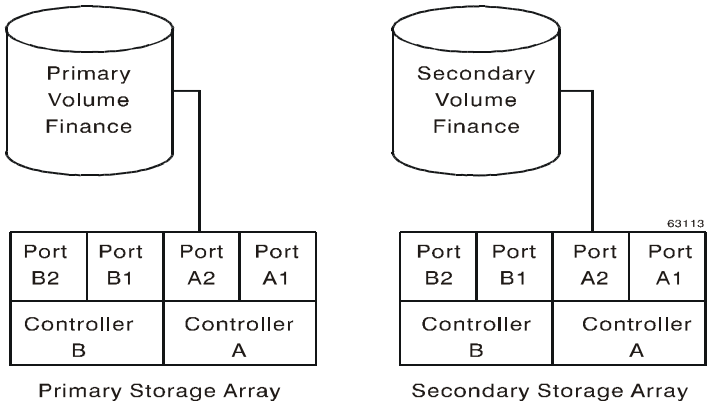

Figure 1-6 Controller A as Controller Owner

When an I/O path error causes a volume ownership change on the primary disk subsystem, or if the storage administrator changes the controller owner of the primary volume, the next remote write processed will automatically trigger an ownership change on the secondary disk subsystem.

As shown in Figure 1-7, if a primary volume is owned by Controller A and the controller owner is changed to Controller B, the next remote write will change the controller owner of the secondary volume from Controller A to Controller B.

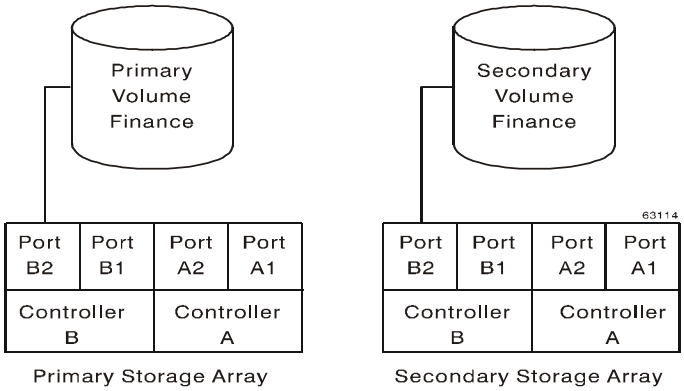

Figure 1-7 Controller B as Controller Owner

Because controller ownership changes on the secondary disk subsystem are controlled by the primary controller, they do not require any special intervention and cannot be manually changed by the storage administrator.

Distance Between Primary and Secondary Disk Subsystem

The maximum distance permitted between disk subsystems participating in a mirror relationship is governed by the distance limits of the Fibre Channel links. Using standard Single-Mode Fiber technology, a maximum link distance of 10km between disk subsystems can be achieved.

IMPORTANT Specialized third-party products allow for greater distances to be supported between disk subsystems in a Fibre Channel environment. However, in this version of the storage management software, distances between disk subsystems have been tested and verified up to 10km.

General Performance Considerations

The following general performance considerations should be noted when creating Remote Volume Mirrors.

- The controller owner of a primary volume performs a full synchronization in the background while processing local I/O writes to the primary volume and associated remote writes to the secondary volume. Because the full synchronization diverts controller processing resources from I/O activity, it can have a performance impact to the host application.

  To reduce the performance impact, you can set the Synchronization Priority Level to determine how the controller owner will prioritize the full synchronization relative to other I/O activity. The following are some basic guidelines to setting the Synchronization Priority Level.

  - A full synchronization at the Lowest Synchronization Priority Level will take approximately eight times as long as a full synchronization at the Highest Synchronization Priority Level.
  - A full synchronization at the Low Synchronization Priority Level will take approximately six times as long as a full synchronization at the Highest Synchronization Priority Level.
  - A full synchronization at the Medium Synchronization Priority Level will take approximately three and a half times as long as a full synchronization at the Highest Synchronization Priority Level.
  - A full synchronization at the High Synchronization Priority Level will take approximately twice as long as a full synchronization at the Highest Synchronization Priority Level.

  For more information on setting the Synchronization Priority Level, refer to Chapter 3, “Using the Remote Volume Mirroring Premium Feature.”

- When the mirrored volume pair is in a Synchronization in Progress status, all host write data is copied to the remote system in processing the I/O. Both controller I/O bandwidth and I/O latency can affect host write performance. Host read performance is not affected by the mirroring relationship.
- The time that it takes for data to be copied from the primary volume to the secondary volume may impact overall performance and is primarily because of the delay and overhead of copying data to the Remote Volume Mirror. Some delay may also occur because of the limit to the number of simultaneous writes.

Using Other Premium Features and Remote Volume Mirroring

This section describes how the Remote Volume Mirroring premium feature can be used in conjunction with other premium features available in this version of the storage management software.

SANshare Storage Partitioning

SANshare Storage Partitioning is a premium feature that enables hosts to share access to volumes in a disk subsystem. A storage partition is created when you define a collection of hosts (a host group) or a single host and then define a volume-to-logical unit number (LUN) mapping. This mapping allows you to define what host group or host will have access to a particular volume in the disk subsystem.

Figure 1-8 shows the Mappings View of the Array Management Window, where Primary Volume Accounting has been included in a partition accessible by Host Group Campus East, and Secondary Volume Accounting 2 has been included a partition accessible by Host Group Campus West.

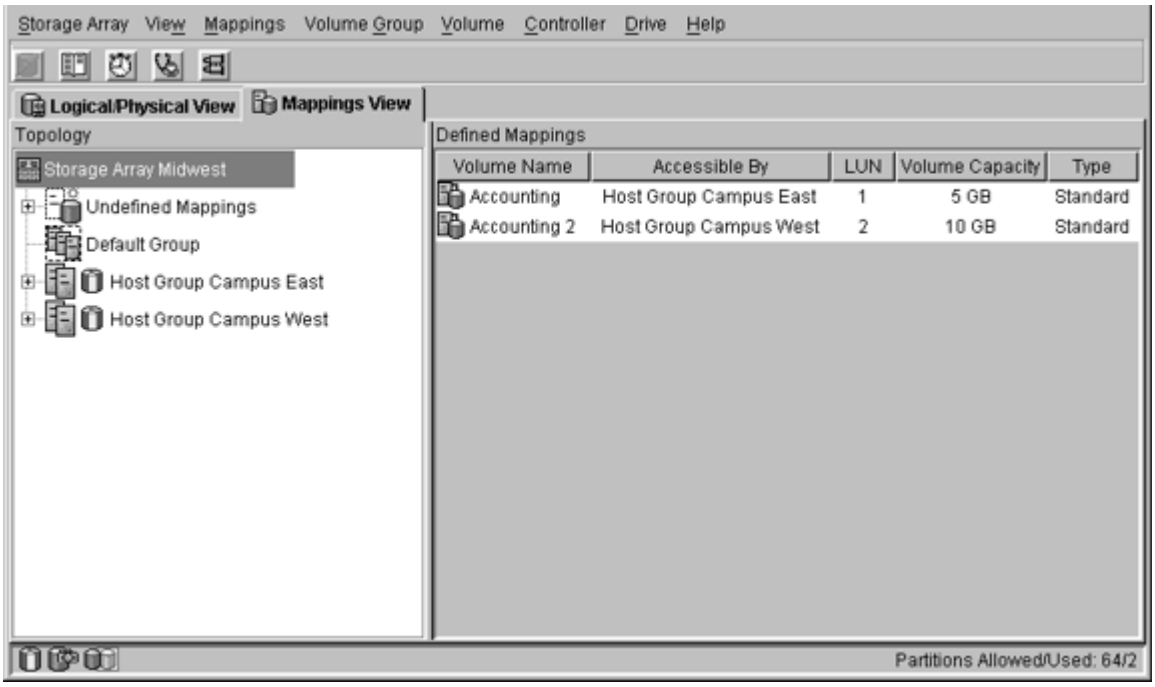

Figure 1-8 SANshare Storage Partitioning Example

The storage partition definitions for the primary and secondary disk subsystems are independent of each other. If these definitions are put in place while the volume is in a secondary role, it will reduce the administrative effort associated with site recovery if it becomes necessary to promote the volume to a primary role. For more information on defining storage partitions, refer to the Array Management Window online help.

Snapshot Volumes

A snapshot volume is a point-in-time image of a volume and is typically created so that an application, such as a backup application, can access the snapshot volume and read the data while the base volume remains online and accessible to hosts.

The volume for which the point-in-time image is created is known as the base volume and must be a standard volume in the disk subsystem. For the Remote Volume Mirroring feature, the base volume of a snapshot volume is permitted to be a candidate for the primary volume in a mirror relationship. The snapshot repository volume stores information about all data altered since the snapshot was created. Figure 1-9 shows the primary volume (also the base volume for the snapshot volume), the secondary volume, and the snapshot volume in the Array Management Window for the primary disk subsystem.

IMPORTANT The secondary volume of a mirror relationship *cannot* be a base volume with an associated snapshot volume.

Secondary volumes are restricted from being the base volume for a snapshot volume because any full synchronization process would fill the snapshot repository volume, resulting in a failed snapshot volume.

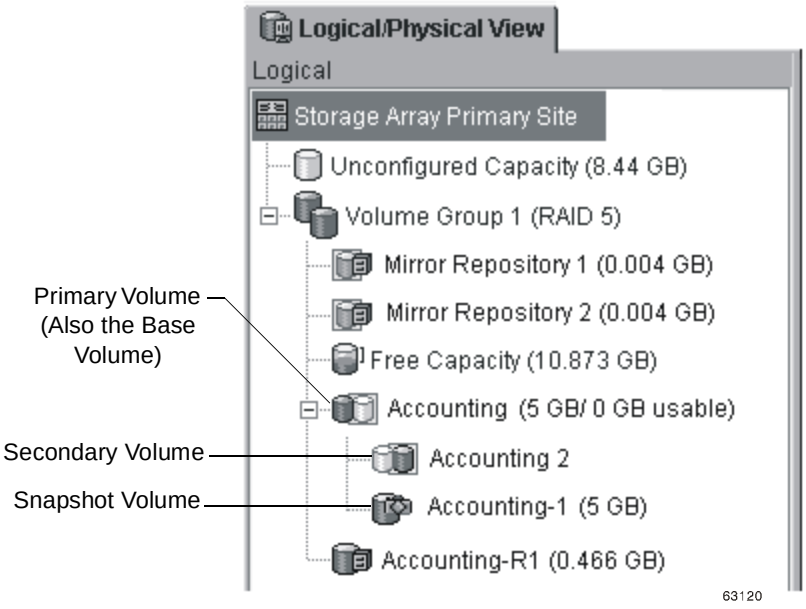

Figure 1-9 Snapshot Volume Included in a Mirror Relationship

Snapshot Volume Failure

In this version of the storage management software, snapshot volumes based on the primary volume of a mirrored volume pair are permitted.

If a role reversal is performed and the primary volume is demoted to the secondary volume role, all snapshot volumes associated with the demoted primary volume will be failed.

IMPORTANT A secondary volume *cannot* be selected to be the base volume of a snapshot volume.

As shown in Figure 1-10, Primary Volume Accounting and Secondary Volume Accounting 2 are displayed in the Logical View of the Array Management Window for the primary disk subsystem. A snapshot volume of Primary Volume Accounting has been created.

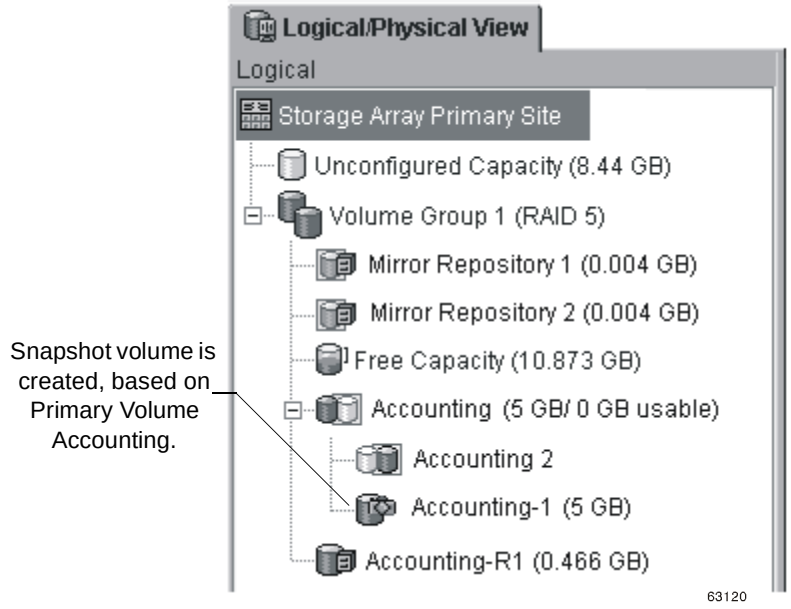

Figure 1-10 Snapshot Volume Associated with Primary Volume Accounting

If a role reversal is performed, Primary Volume Accounting is demoted to a secondary role and the snapshot volume fails, as shown in Figure 1-11. This is because the Secondary Volume Accounting 2 is now considered as the base volume of the snapshot volume, which is not permitted.

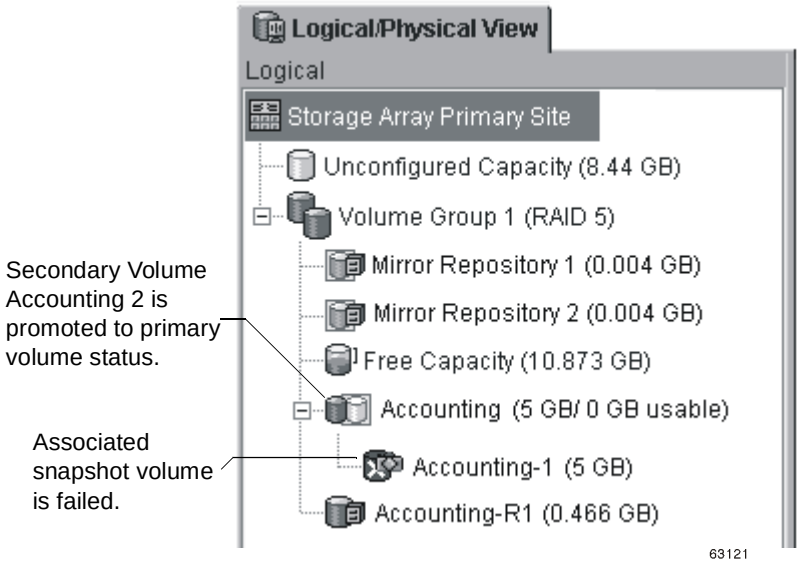

Figure 1-11 Snapshot Volume Failure Because of Role Reversal

If a snapshot volume fails as the result of a role reversal, you will need to perform another role reversal to promote the secondary volume back to a primary role. After the role reversal is complete, the snapshot volume will return to an Optimal status. For more information, refer to Chapter 5, “Troubleshooting.”

Hardware and Software Requirements

This section describes the minimum hardware requirements for the Remote Volume Mirroring feature. A list of the certified host bus adapters for each operating system is provided.

The minimum software requirements for the Remote Volume Mirroring feature are provided, together with the host operating systems certified for use with this version of the storage management software.

Hardware Requirements

The following are the minimum hardware requirements needed when configuring your system to use the Remote Volume Mirroring premium feature. The list includes components that are supplementary to the standard required for a basic disk subsystem environment as described in the *Control Module and Blade Module Site Preparation Guide*.

- Minimum of two multi-ported disk subsystems
- RAID controllers with two or more host ports (9176 or D178)
- **Switches** – These devices are used to connect multiple hosts with multiple disk subsystems in a controlled environment. Multiple switches can be connected over a distance up to 10km (6.25 miles) to create a fabric environment.

  The certified switches for use with the Remote Volume Mirroring feature are as follows.

  - **Brocade Silkworm 2400** – 8-port, 1 Gigabit/sec (Highest Availability Campus Configuration and Intra-Site Configuration only)
  - **Brocade Silkworm 2800** – 16-port, 1 Gigabit/sec
  - **Brocade Silkworm 3800** – 16-port, 2 Gigabit/sec
  - **QLogic SANbox 2-16** – 16-port, 2 Gigabit/sec
- **Short or Medium Range Fibre Channel Cables** – To connect the hosts and disk subsystems to the switches.
- **Long Range Fibre Channel Cables (Campus Configurations only)** – These cables are up to 10km (6.25 miles) in length. These are used to connect Fibre Channel switches to complete long distance fabrics.

Certified Fibre Channel Host Bus Adapters

Table 1-1 lists the Fibre Channel host bus adapters (HBA) by operating system that have been certified to be used with the Remote Volume Mirroring feature.

Table 1-1 Certified Host Bus Adapters

Operating System	1 Gigabit/sec HBAs	2 Gigabit/sec HBAs
Windows NT 4.0 SP 6a Server Edition	• QLogic: 2200F/66; 2202F/66; 2300F/66; 2302F • LSI: 44929G	• QLogic: 2300F • LSI: 44929G
Windows 2000 SP 2 Server Edition	• QLogic: 2200F/66; 2202F/66; 2300F/66; 2302F • LSI 44929G	• QLogic: 2300F; 2310 (at PCI speed only) • LSI 44929G, 44919
Solaris 2.6, 2.7 (Solaris 7), 2.8, (Solaris 8)	• JNI Sbus • JNI PCI current TL-based: FC64-1063, FCI-1063 • JNI Emerald III Sbus (for throughput applications ONLY): FCE2-1063 • LSI 44929G PCI	• LSI: 44929G; 40919 PCI • JJNI FCE-6460; FCE 1473
HP-UX 11.0 and higher	• A3404A (K series) • A3591B (D, R series) • A3740 (N, L, V series) • A5158A (N, L, V)	Not applicable.
Linux (Red Hat 6.x)	QLogic: 2300F	QLogic: 2310/2312F
Netware 5.1	QLogic: 2200F/66 (on NetWare 5.1 only), 2300F	QLogic: 2300F, 2310/2312
IRIX 6.5.14 or higher	QLogic: 2200F/66, 2300F	QLogic: 2300F, 2310 (at PCI speed only)
AIX 4.3.3 or higher	BM 6228 (Emulex 9002)	BM 6228 (Emulex 9002)

Software Requirements

The following are the minimum software requirements needed when configuring your system to use the Remote Volume Mirroring premium feature.

- BladeStore Storage Manager for Version 8.20
- Controller Firmware Version 5.20
- Remote Volume Mirroring Feature Key

Certified Host Operating Systems

Hosts accessing mirrored volumes should be running one of the following certified operating systems when using the Remote Volume Mirroring feature.

- Windows NT 4.0 SP 6a Server Edition
- Windows 2000 SP 2
- Windows 98
- Solaris 2.6, 2.7 (Solaris 7), 2.8 (Solaris 8)
- HP-UX 11.0 or higher
- Linux (Red Hat 6.x)
- Netware 5.1
- IRIX 6.5.14 or higher
- AIX 4.3.3 or higher

Recommended Configurations

This section describes the key configurations supported for Remote Volume Mirroring in this version of the storage management software. The level of redundancy will be determined by the type of configuration chosen.

Highest Availability Campus Configuration

The Highest Availability Campus Configuration is a fully redundant configuration, and consists of two disk subsystems and four switches connected using a Fibre Channel fabric as shown in Figure 1-12. The primary disk subsystem and secondary disk subsystem may have a maximum connection distance of up to 10km (or 6.25 miles).

For detailed instructions on setting up this configuration, refer to Chapter 2, “Hardware and Software Installation.”

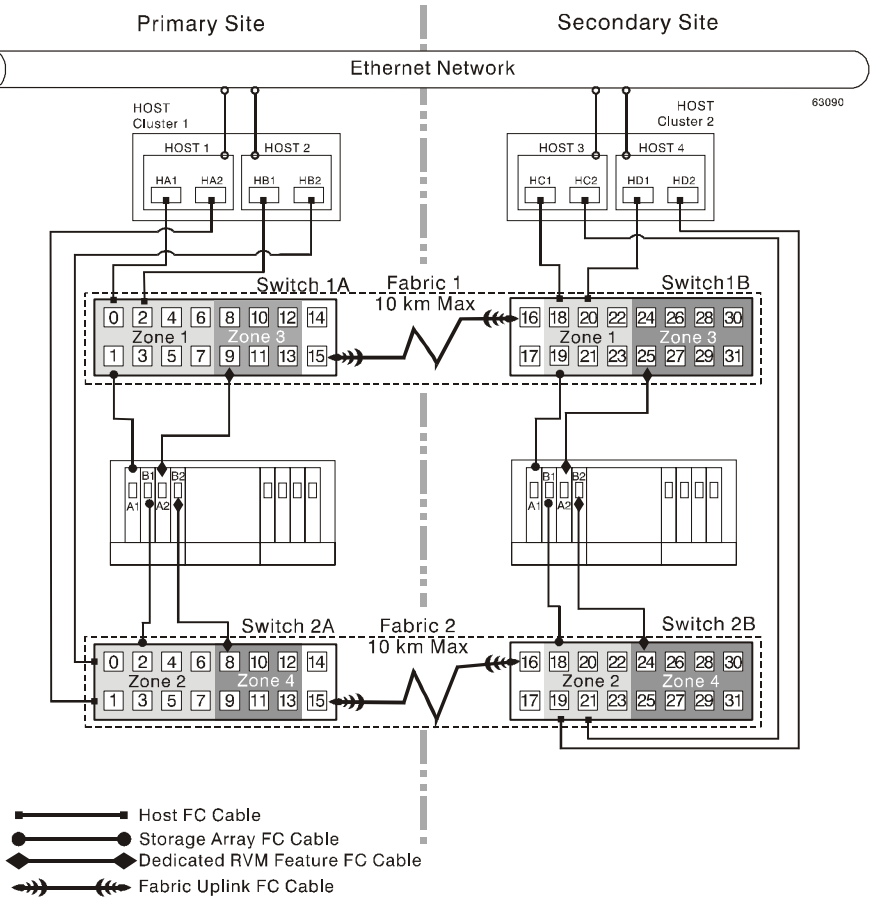

Figure 1-12 Highest Availability Campus Configuration

Campus Configuration

The Campus Configuration is a lower-cost configuration and consists of two disk subsystems and two switches, connected using a Fibre Channel fabric as shown in Figure 1-13. The primary disk subsystem and secondary disk subsystem may have a maximum connection distance of up to 10km (or 6.25 miles).

For detailed instructions on setting up this configuration, refer to Chapter 2, "Hardware and Software Installation."

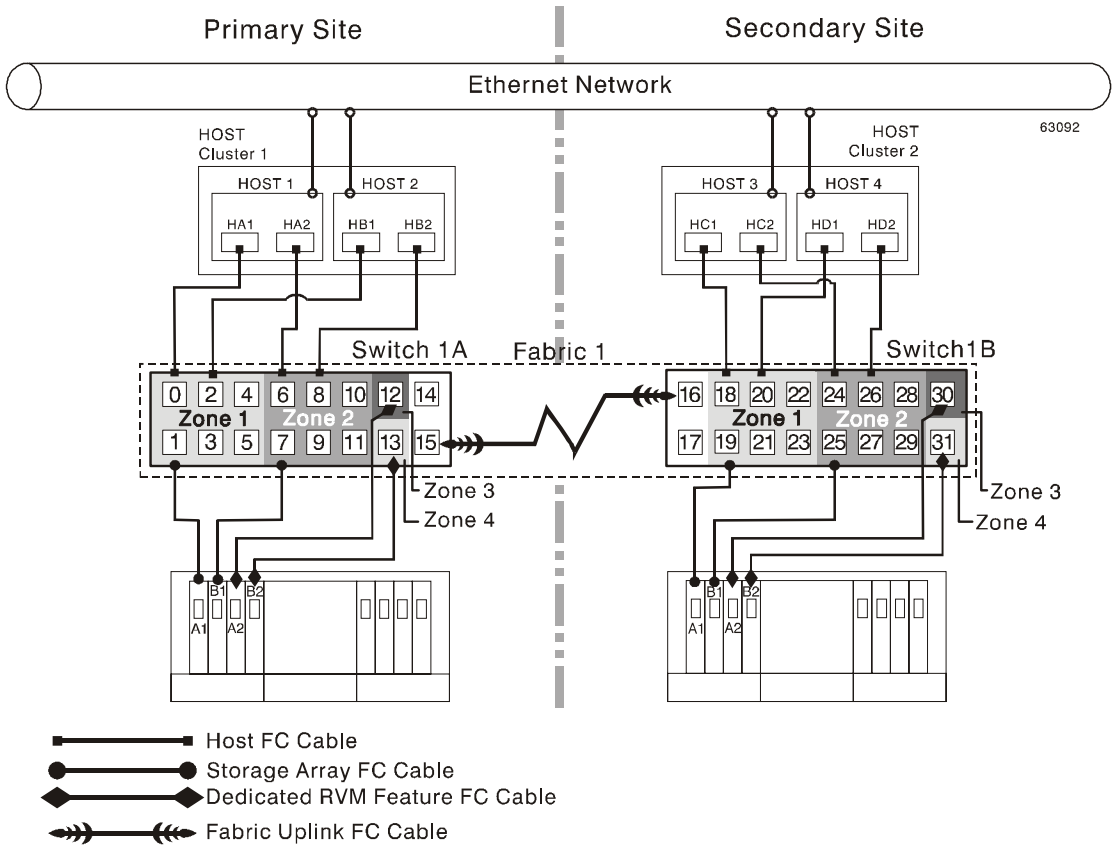

Figure 1-13 Campus Configuration

Intra-Site Configuration

The Intra-Site Configuration is the lowest-cost configuration which consists of two disk subsystems and two switches, connected using a Fibre Channel fabric as shown in Figure 1-14. The primary disk subsystem and secondary disk subsystem may have a maximum connection distance of up to 500m (or 0.32 miles) and would typically be located in the same building or in the same room.

For detailed instructions on setting up this configuration, refer to Chapter 2, “Hardware and Software Installation.”

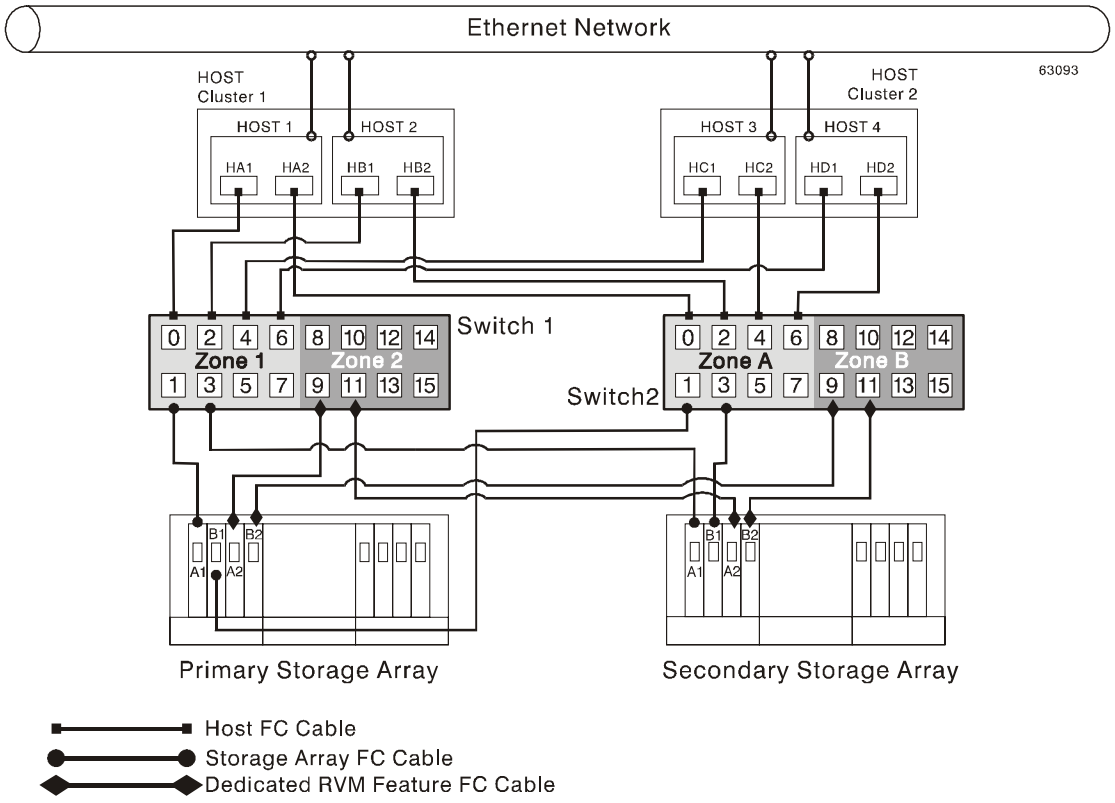

Figure 1-14 Intra-Site Configuration

Hardware and Software Checklist

Complete the following checklists to ensure that all the required hardware and software components have been configured properly.

Hardware Checklist

Complete the following tasks before starting the storage management software.

Table 1-2 Hardware Checklist

	Task Description	Validation Activity
1	Ensure that the minimum hardware requirements have been met. For a complete list of the hardware requirements, refer to "Hardware Requirements" on page 1-17.	❑ Completed.
2	Ensure your primary and secondary disk subsystems have been properly configured. Refer to the *BladeStore Storage Manager Installation Guide* for disk subsystem configuration information.	❑ Completed.
3	Ensure that your switches and cables have been properly configured. For more information on configuring switches for use with the Remote Volume Mirroring feature, refer to Chapter 2, "Hardware and Software Installation."	❑ Completed.

Software Checklist

Complete the following tasks before establishing mirror relationships in your disk subsystems.

Table 1-3 Software Checklist

Task Description	Validation Activity
1 Ensure that data on the primary and secondary disk subsystems participating in Remote Volume Mirroring have been backed up.	❑ Completed.
2 Ensure that the correct version of firmware and storage management software has been installed. For more information on upgrading firmware or installing the storage management software, refer to Chapter 2, “Hardware and Software Installation.”	❑ Completed.
3 Ensure that the Remote Volume Mirroring premium feature has been enabled on both the primary and secondary disk subsystems. For information on enabling premium features, refer to Chapter 2, “Hardware and Software Installation.” or the Array Management Window online help.	❑ Completed.
4 Ensure that the Remote Volume Mirroring feature has been activated and that a mirror repository volume has been created for each controller on the primary disk subsystem. For more information on activating the Remote Volume Mirroring feature, refer to Chapter 3, “Using the Remote Volume Mirroring Premium Feature.”	❑ Completed.
5 Ensure that the required primary and secondary volumes have been created on the primary and secondary disk subsystems. For more information on establishing a mirror relationship, refer to Chapter 3, “Using the Remote Volume Mirroring Premium Feature.”	❑ Completed.

Chapter 2

Hardware and Software Installation

This chapter presents information necessary to install hardware and software to run the Remote Volume Mirroring premium feature. The beginning of the chapter explores the steps that need to be completed before any hardware or software installation. Next, hardware installation procedures are presented, followed by software installation procedures. This chapter is to be followed sequentially, from start to end.

Pre-Installation Requirements

This section provides necessary pre-installation information, such as site preparation, hardware and software requirements, and concepts that should be reviewed and completed before beginning any hardware or software installation procedures.

Site Preparation

The Remote Volume Mirroring feature utilizes Fibre Channel switches creating a fabric environment for data replication. These switches require only minimal additional site preparation requirements beyond basic disk subsystem operation.

For basic site preparation considerations including the use of Fibre Channel cables and connections, refer to the *Control Module and Blade Module Site Preparation Guide*.

For additional site preparation considerations concerning the Fibre Channel switches, including power requirements and physical dimensions/requirements, refer to the documentation provided by the switch manufacturer.

Hardware and Software Requirements

Ensure that all of the required hardware and software are available before proceeding. For a list of requirements, refer to “Hardware and Software Requirements” in Chapter 1.

Switch Zoning Overview

Because of possible restrictions at the host level, the supported Remote Volume Mirroring configurations contain Fibre Channel switches zoned so a single host adapter can access only one controller per disk subsystem. Additionally, all configurations utilize a separate zone for the ports reserved for the Remote Volume Mirroring feature.

IMPORTANT The uplink port that connects (cascades) switches within a fabric should not be zoned.

Switch zoning configurations are typically set up using management software provided by the manufacturer of the Fibre Channel switch. This software should be included with the materials provided when the switch was purchased.

When two or more Fibre Channel switches are cascaded together, the switch management software will combine the ports for all switches that are linked. For example, if two 16-port Fibre Channel switches are cascaded with a physical connection using a Fibre Channel cable, the switch management software will show ports 0 through 31 participating in the fabric rather than 2 switches each with ports 0 through 15. Therefore, a zone that is created containing any of these ports can exist on multiple cascaded switches.

In Figure 2-1, the top set of switches are on the same network and cascaded, therefore Zone 1 is the same zone on Switch 1A as Zone 1 on Switch 1B. The bottom set of switches are on the same network, but are not cascaded. Even though both contain a Zone 1 (shown as Zone A in Switch 2), these zones are independent of each other.

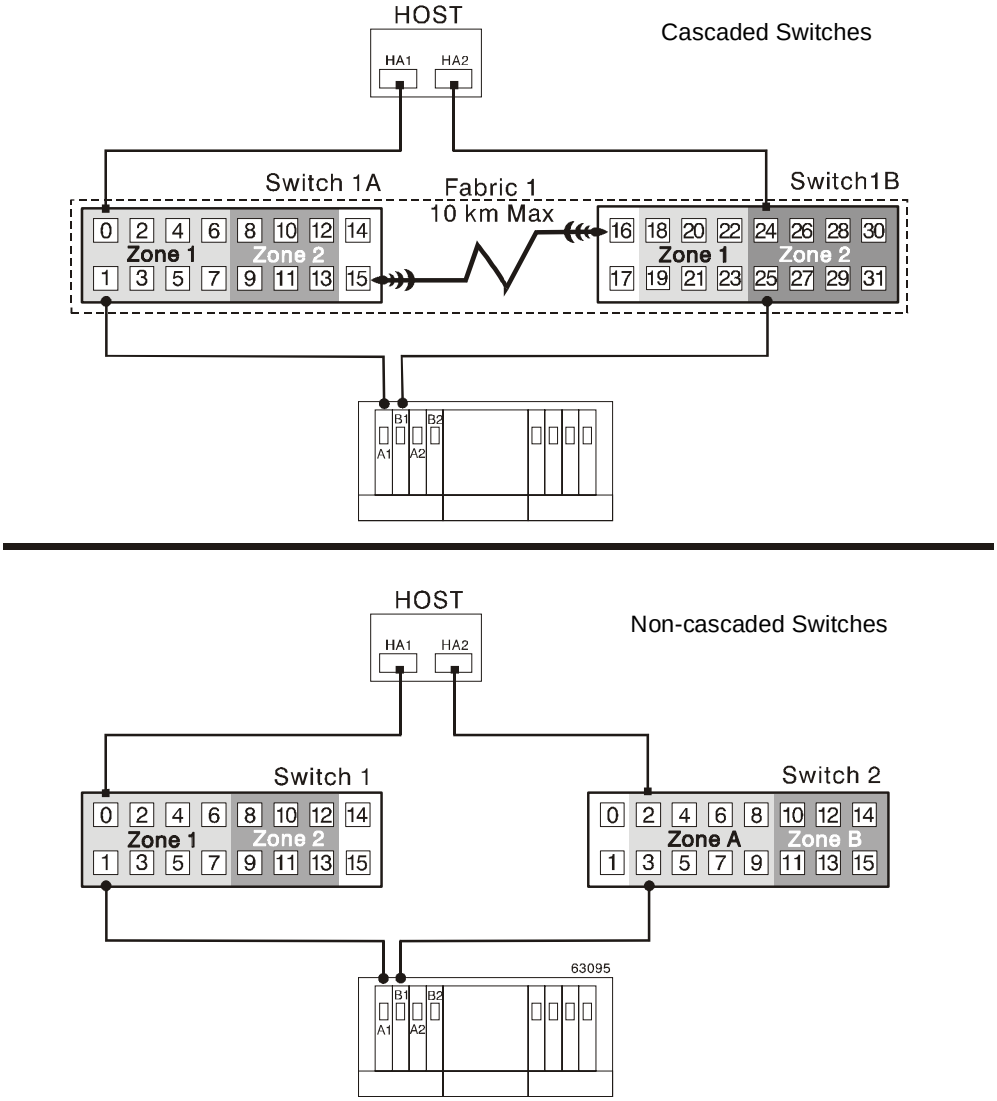

Figure 2-1 Switch Zoning in Cascaded and Non-Cascaded Fibre Channel Switches

For more information about Fibre Channel switch zoning or setting up a zone configuration, refer to the manufacturer's documentation provided with the switch.

Because of the varying Remote Volume Mirroring configurations, the switch zone settings are presented proceeding each configuration in this chapter.

Hardware Installation

This section describes the procedures necessary to properly connect and configure one or more disk subsystems for use with the Remote Volume Mirroring feature.

The configurations covered in this section are as follows.

- **Highest Availability Campus Configuration** – This is the recommended configuration for the Remote Volume Mirroring feature. Four total switches (two at each site) provide for complete redundancy in the Fibre Channel switches and fabrics in addition to all disk subsystem components and hosts. There is no single point of failure in this configuration. To begin installing hardware for this configuration, go to the next section, "Highest Availability Campus Configuration."
- **Campus Configuration** – This configuration is not fully redundant because the number of Fibre Channel switches is reduced from four to two and the number of fabrics from two to one. Consequently, this makes the switches and fabrics a single point of failure. A switch failure does not usually result in a loss of data, but does affect data synchronization until the error is corrected. Therefore, the Highest Availability Campus Configuration is the recommended configuration because data synchronization can continue for any single switch failure. This configuration essentially allows the minimum required components to successfully operate the Remote Volume Mirroring premium feature between two sites up to 10 km (6.25 miles). To begin installing hardware for this configuration, go to "Campus Configuration" on page 2-11.
- **Intra-Site Configuration** – This configuration is similar to the Campus Configuration because there are only two switches. However, no multiple-switch fabrics exist in this configuration. Since all hosts and disk subsystems are in proximity of both Fibre Channel switches, full redundancy can be obtained within the site since each controller path is connected to a different switch. Despite being a fully redundant configuration, the Highest Availability Campus Configuration is still recommended because of disaster recovery implications. The single site creates a single point of failure if a disaster affects the entire site. To begin installing hardware for this configuration, go to "Intra-Site Configuration" on page 2-16.

For a list of required materials to complete any hardware installation, refer to "Hardware and Software Requirements" in Chapter 1.

Highest Availability Campus Configuration

IMPORTANT The Highest Availability Campus Configuration is the recommended configuration for the Remote Volume Mirroring feature.

This configuration has two Fibre Channel switches at both the primary and secondary sites to provide for complete failover and redundancy for failures in Fibre Channel switches and cables, in addition to any host or disk subsystem failure. 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.

Figure 2-2 shows the Highest Availability Campus Configuration after installation is complete.

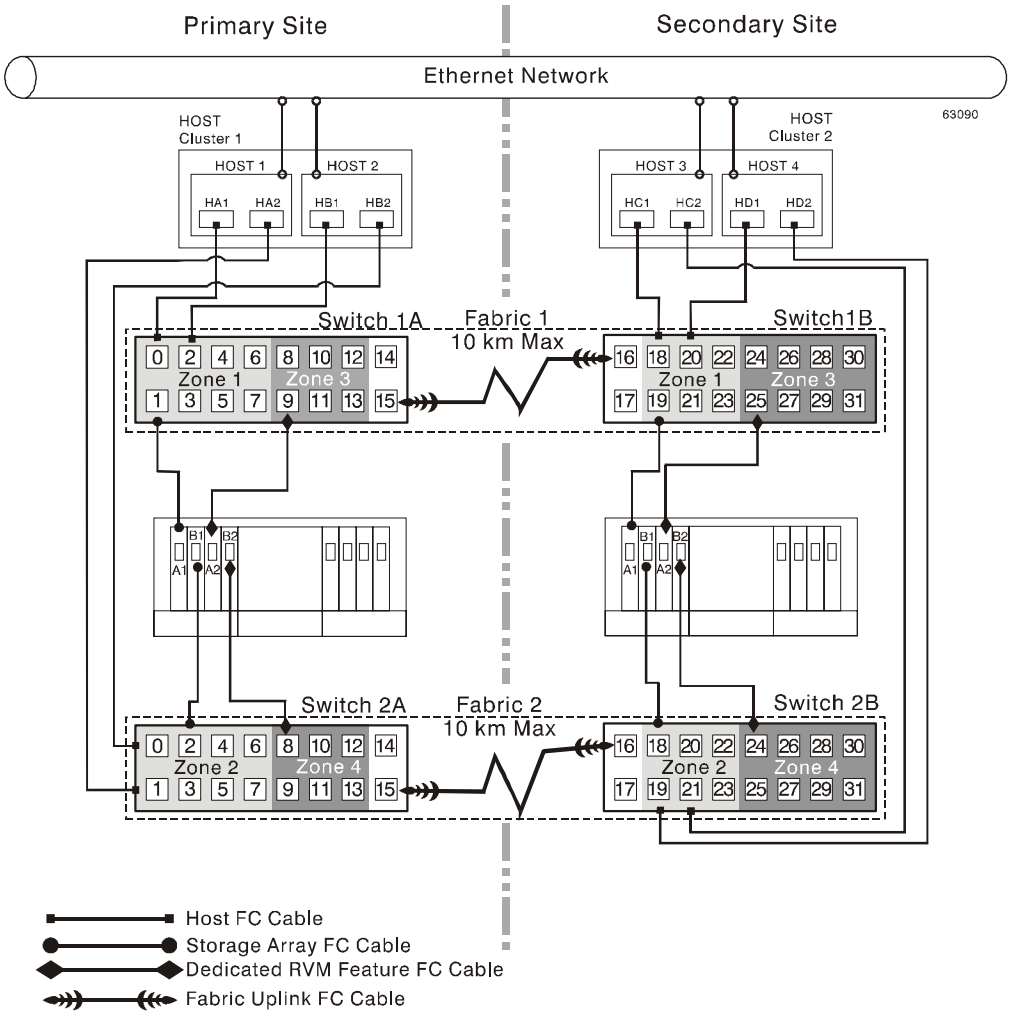

Figure 2-2 Highest Availability Campus Configuration

Switch Zoning for the Highest Availability Campus Configuration

This configuration allows for a separate zone for each reserved port for the Remote Volume Mirroring feature.

The switches do not need to be zoned exactly as presented in this configuration. However, the following are requirements when zoning switches for the Highest Availability Campus Configuration.

- There will be a total of four zones in this configuration.
  - Zones 1 and 3 will exist on Fabric 1 (Switch 1A at the primary Site, and Switch 1B at the secondary site).
  - Zones 2 and 4 will exist on Fabric 2 (Switch 2A at the primary Site, and Switch 2B at the secondary site).
- Configure the zones on the switch so that there is one port per zone for a disk subsystem connection and one port per zone for each host.
- The uplink port must not be zoned on any Fibre Channel switch.
- Switches are zoned so that a single host adapter can access only one controller per disk subsystem.

The switches in Figure 2-3 contain 16 ports each, which leaves many unused ports per switch. The remaining ports can be distributed among the other zones. However, it is recommended that most remaining ports be assigned to the zones containing the host connections (Zones 1 and 2 in Figure 2-3). This will allow easy set up for additional hosts to connect to the environment.

Figure 2-3 shows how the four switches are zoned for the Highest Availability Campus Configuration.

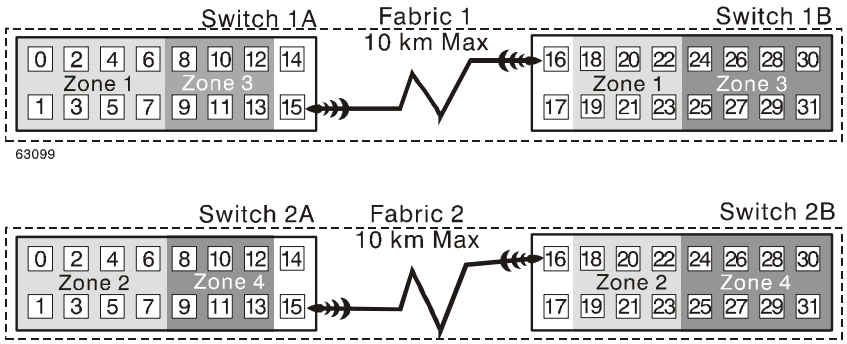

Figure 2-3 Switch Zoning for the Highest Availability Campus Configuration

Given the requirements and the zoning shown in Figure 2-3, ensure that all four switches are properly zoned before proceeding. For more information on Zoning switches, refer to "Switch Zoning Overview" on page 2-2.

Cabling for the Highest Availability Campus Configuration

Table 2-1 is provided for a convenient reference of port connections.

Table 2-1 Text Table for Highest Availability Campus Configuration Connections

Primary Site		Zone	Por	Connect To/From
	Switch 1A	1	0	Host 1, HBA 1 (HA1)
			1	Controller Port A1
			2	Additional Host, HBA 1 (Optional)
			3	Additional Host, HBA 1 (Optional)
			4	Additional Host, HBA 1 (Optional)
			5	Additional Host, HBA 1 (Optional)
			6	Additional Host, HBA 1 (Optional)
			7	Additional Host, HBA 1 (Optional)
		3	8	Unused
			9	Controller Port A2 (Dedicated RVM Port)
			10	Unused
			11	Unused
			12	Unused
			13	Unused
		None	14	Spare (May be added to either Zone)
		None	15	Uplink with Switch 1B
	Switch 2A	2	0	Host 2, HBA 2 (HB2)
			1	Host 1, HBA 2 (HB2)
			2	Controller Port B1
			3	Additional Host, HBA 2 (Optional)
			4	Additional Host, HBA 2 (Optional)
			5	Additional Host, HBA 2 (Optional)
			6	Additional Host, HBA 2 (Optional)
			7	Additional Host, HBA 2 (Optional)
		4	8	Controller Port B2 (Dedicated RVM Port)
			9	Unused
			10	Unused
			11	Unused
			12	Unused
			13	Unused
		None	14	Spare (May be added to either Zone)
		None	15	Uplink with Switch 2B

Secondary Site		Zone	Por	Connect To/From
	Switch 1B	None	16	Uplink with Switch 1A
		None	17	Spare (May be added to either Zone)
		1	18	Host 3, HBA 1 (HC1)
			19	Controller Port A1
			20	Host 4, HBA 1 (HD1)
			21	Additional Host, HBA 1 (Optional)
			22	Additional Host, HBA 1 (Optional)
			23	Additional Host, HBA 1 (Optional)
		3	24	Unused
			25	Controller Port A2 (Dedicated RVM Port)
			26	Unused
			27	Unused
			28	Unused
			29	Unused
			30	Unused
			31	Unused
	Switch 2B	None	16	Uplink with Switch 2A
		None	17	Spare (May be added to either Zone)
		2	18	Controller Port B1
			19	Host 4, HBA 2 (HD2)
			20	Additional Host, HBA 2 (Optional)
			21	Host 3, HBA 2 (HC2)
			22	Additional Host, HBA 2 (Optional)
			23	Additional Host, HBA 2 (Optional)
		4	24	Controller Port B2 (Dedicated RVM Port)
			25	Unused
			26	Unused
			27	Unused
			28	Unused
			29	Unused
			30	Unused
			31	Unused

IMPORTANT Begin the installation at the primary site. Repeat these steps for the secondary site when instructed to do so.

After the four Fibre Channel Switches are properly zoned, complete the following procedure to set up the Highest Availability Campus Configuration for the Remote Volume Mirroring feature.

NOTE All connections are completed using Fibre Channel cables of appropriate length.

1 Is Remote Volume Mirroring feature equipment being added to an existing disk subsystem environment?

- **Yes** – Stop I/O from all hosts before proceeding. Go to step 2.
- **No** – This is a new disk subsystem installation. Go to step 3.

2 Power down all disk subsystems, hosts, Fibre Channel switches, and all other equipment in the disk subsystem environment.

3 Ensure that cabling between all control modules and blade modules is complete as presented in the *Control Module and Blade Module Installation Guide*.

IMPORTANT Depending on which site is being configured, Switch 1 represents Switch 1A for the primary site, and Switch 1B for the secondary site. This applies to Switch 2 as well.

---

4 Connect the primary host bus adapter (H*x*1) for each local host to an available port in Zone 1 of Switch 1 (Figure 2-4).

NOTE The cables can be connected to *any* port in the proper zone of the switch.

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5 Connect the secondary host bus adapter (H*x*2) for each host at this site to an available port in Zone 2 of Switch 2 (Figure 2-4).

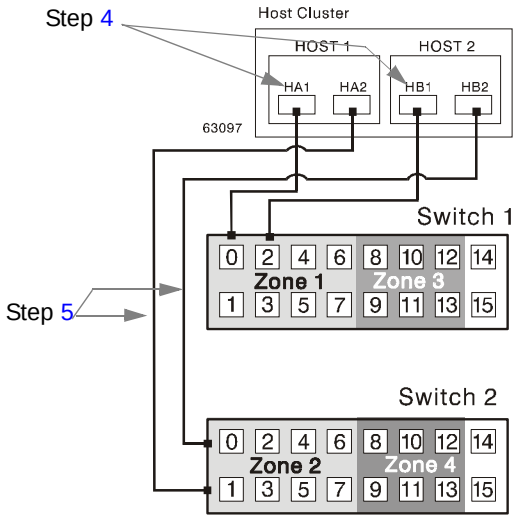

Figure 2-4 Host Bus Adapter Connections to Fibre Channel Switches

6 Connect controller port A1 of the disk subsystem to an available port in Zone 1 of Switch 1 (Figure 2-5).

7 Connect controller port B1 of the disk subsystem to an available port in Zone 2 of Switch 2 (Figure 2-5).

8 Connect controller port A2 of the disk subsystem to an available port in Zone 3 of Switch 1 (Figure 2-5).

9 Connect controller port B2 of the disk subsystem to an available port in Zone 4 of Switch 2 (Figure 2-5).

NOTE Controller ports A2 and B2 are reserved for mirror relationship synchronization upon activation of the Remote Volume Mirroring feature. For more information, refer to "Connectivity and Input/Output" in Chapter 1.

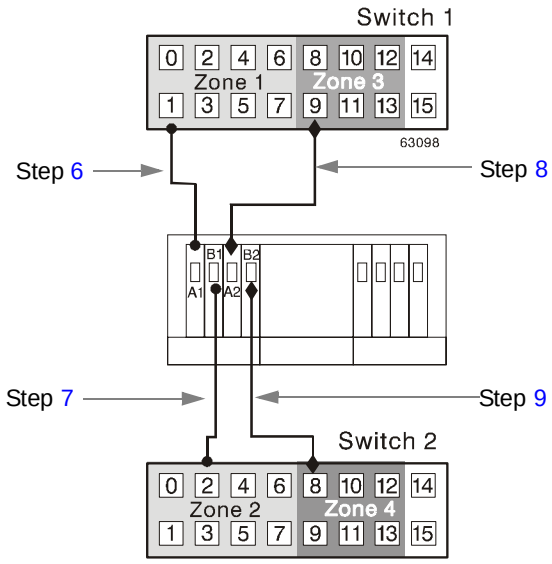

Figure 2-5 Disk Subsystem Connections to Fibre Channel Switches

10 The primary site cabling is now complete. Is the secondary site cabling complete?

- **No** – Repeat steps 1 through 9 for the secondary site.
- **Yes** – Go to step 11 on page 2-10.

11 Complete the fabric environment for Switch 1 by connecting Switch 1A with Switch 1B. Connect each end of a long range Fibre Channel cable (up to 10 km in length) to an unzoned port in each switch (Figure 2-6).

12 Repeat step 11 for Switch 2A and 2B to complete the fabric environment for Switch 2 (Figure 2-6).

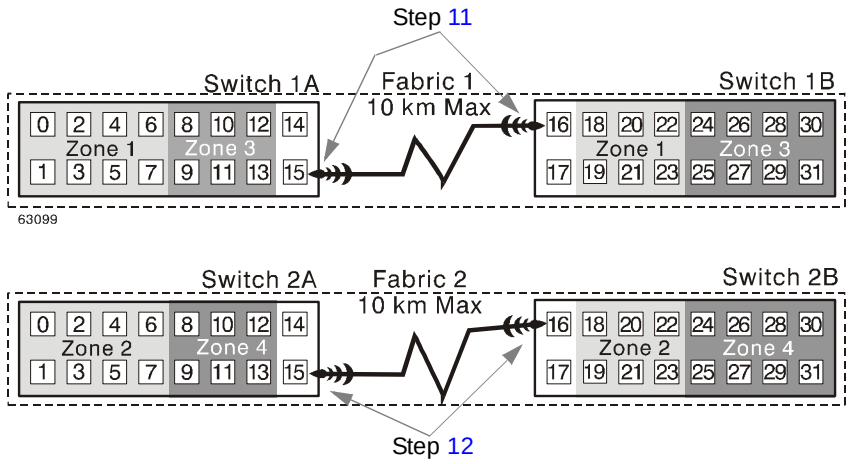

Figure 2-6 Connecting Switches over a Remote Network to Complete Fabric Environments

13 Cabling for the Highest Availability Campus Configuration is complete. Repeat step 4 on page 2-8 through step 10 on page 2-9 for any additional disk subsystems that exist in the same cabinet that will use the Remote Volume Mirroring feature.

14 Power up all disk subsystems, hosts, Fibre Channel switches, and any other hardware at both sites that was powered down in step 2 on page 2-8.

15 Hardware installation is complete. The next step will be to configure the storage management software to support mirror relationships. Go to "Software Installation" on page 2-22.

Campus Configuration

This 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 Volume Mirroring ports, but is a single point of failure for switches. If a switch at either site fails, the Remote Volume Mirroring Feature cannot function. For this reason, the Highest Availability Campus Configuration is highly recommended for total environment redundancy.

Figure 2-7 shows the Campus Configuration after installation is complete.

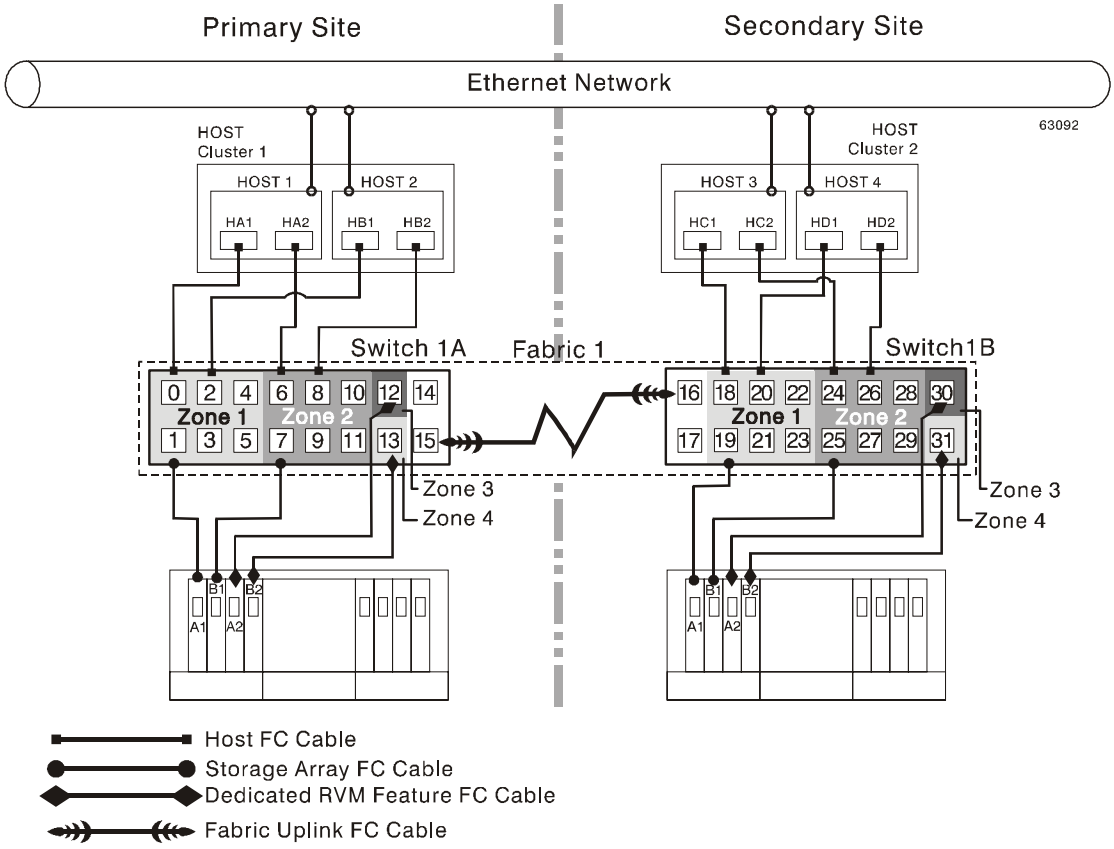

Figure 2-7 Campus Configuration

Switch Zoning for the Campus Configuration

This configuration allows for a separate zone for each reserved port for the Remote Volume Mirroring feature.

The switches do not need to be zoned exactly as presented in this configuration. However, the following are requirements when zoning switches for the Campus Configuration.

- There will be a total of four zones in this configuration.
  - All zones will exist on Fabric 1 (Switch 1A at the primary site, and Switch 1B at the secondary site).
  - Zones 3 and 4 will be reserved for the dedicated Remote Volume Mirroring Feature connections.
- Configure the zones on the switches so that there is one port per zone for a disk subsystem connection and one port per zone for each host.
- The uplink port must not be zoned on either Fibre Channel switch.
- Switches are zoned so that a single host adapter can access only one controller per disk subsystem.

The switches in Figure 2-8 contain 16 ports each, which leaves many unused ports per switch. The remaining ports can be distributed among the other zones. However, it is recommended that most remaining ports be assigned to the zones containing the host connections (Zone 1 in Figure 2-8). This will allow easy set up for additional hosts to connect to the environment.

Figure 2-8 shows how the two switches are zoned for the Campus Configuration.

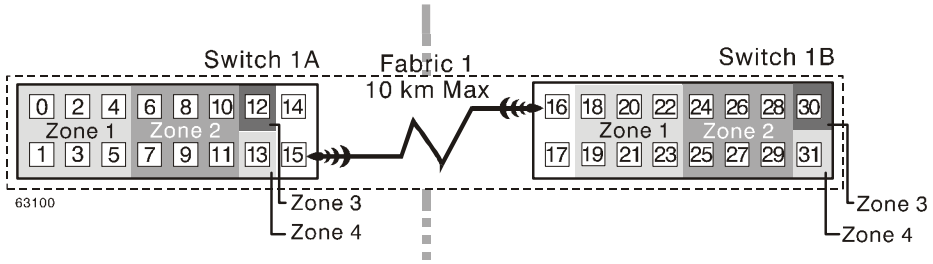

Figure 2-8 Switch Zoning for the Campus Configuration

Given the requirements and the zoning example shown in Figure 2-8, ensure that both switches are properly zoned before proceeding. For more information on Zoning switches, refer to “Switch Zoning Overview” on page 2-2.

Cabling for the Campus Configuration

Table 2-2 is provided for a convenient reference of port connections.

Table 2-2 Text Table for Campus Configuration Connections

Switch 1A (Primary Site)				Switch 1B (Secondary Site)			
	Zone	Por	Connect To/From		Zone	Por	Connect To/From
	1	0	Host 1, HBA 1 (HA1)		None	16	Uplink with Switch 1A
		1	Controller Port A1		None	17	Spare (May be added to any Zone)
		2	Host 2, HBA 1 (HB1)		1	18	Host 3, HBA 1 (HC1)
		3	Additional Host, HBA 1 (Optional)			19	Controller Port A1
		4	Additional Host, HBA 1 (Optional)			20	Host 4, HBA 1 (HD1)
		5	Additional Host, HBA 1 (Optional)			21	Additional Host, HBA 1 (Optional)
	2	6	Host 1, HBA 2 (HA2)			22	Additional Host, HBA 1 (Optional)
		7	Controller Port B1			23	Additional Host, HBA 1 (Optional)
		8	Host 2, HBA 2 (HB2)		3	24	Host 3, HBA 2 (HC2)
		9	Additional Host, HBA 2 (Optional)			25	Controller Port B1
		10	Additional Host, HBA 2 (Optional)			26	Host 4, HBA 2 (HD2)
		11	Additional Host, HBA 2 (Optional)			27	Additional Host, HBA 2 (Optional)
	3	12	Controller Port A2 (Dedicated RVM Port)			28	Additional Host, HBA 2 (Optional)
	4	13	Controller Port B2 (Dedicated RVM Port)			29	Additional Host, HBA 2 (Optional)
	None	14	Spare (May be added to any Zone)		3	30	Controller Port A2 (Dedicated RVM Port)
	None	15	Uplink with Switch 1B		4	31	Controller Port B2 (Dedicated RVM Port)

IMPORTANT Begin the installation at the primary site. Repeat these steps for the secondary site when instructed to do so.

After both Fibre Channel Switches are properly zoned, complete the following procedure to set up the Campus Configuration for the Remote Volume Mirroring feature.

NOTE All connections are completed using Fibre Channel cables of appropriate length.

1. Is Remote Volume Mirroring feature equipment being added to an existing disk subsystem environment?
   - **Yes** – Stop I/O from all hosts before proceeding. Go to step 2.
   - **No** – This is a new disk subsystem installation. Go to step 3.
2. Power down all disk subsystems, hosts, Fibre Channel switches, and all other equipment in the disk subsystem environment.
3. Ensure that basic cabling between all control modules and blade modules is complete as presented in the *Control Module and Blade Module Installation Guide*.

IMPORTANT Depending on which site is being configured, Switch 1 represents Switch 1A for the primary site, and Switch 1B for the secondary site.

4 Connect the primary host bus adapter (H*x*1) for each host at this site to an available port in Zone 1 of Switch 1 (Figure 2-9).

NOTE The cables can be connected to *any* port in the proper zone of the switch.

5 Connect the secondary host bus adapter (H*x*2) for each host at this site to an available port in Zone 2 of Switch 1 (Figure 2-9).

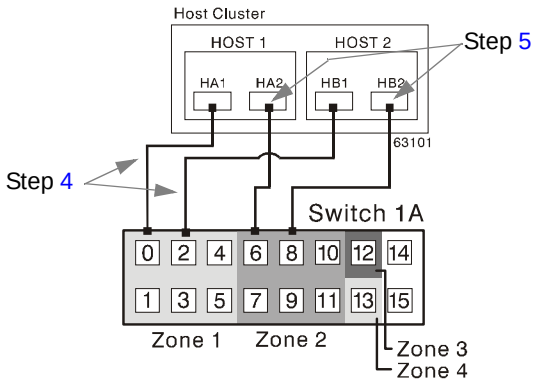

Figure 2-9 Host Bus Adapter Connections to Fibre Channel Switches

6 Connect controller port A1 of the disk subsystem to an available port in Zone 1 of Switch 1 (Figure 2-10).

7 Connect controller port B1 of the disk subsystem to an available port in Zone 2 of Switch 1 (Figure 2-10).

8 Connect controller port A2 of the disk subsystem to an available port in Zone 3 of Switch 1 (Figure 2-10).

9 Connect controller port B2 of the disk subsystem to an available port in Zone 4 of Switch 1 (Figure 2-10).

NOTE Controller ports A2 and B2 are reserved for mirror relationship synchronization upon activation of the Remote Volume Mirroring feature. For more information, refer to "Connectivity and Input/Output" in Chapter 1.

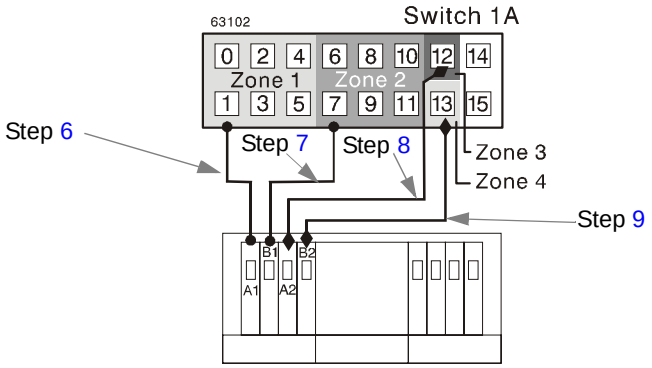

Figure 2-10 Disk Subsystem Connections to Fibre Channel Switches

10 The primary site cabling is now complete. Is the secondary site cabling complete?

- **No** – Repeat steps 1 through 9 for the secondary site.
- **Yes** – Go to step 11.

11 Complete Fabric 1 by connecting Switch 1A with Switch 1B. Connect each end of a long range Fibre Channel cable (up to 10 km in length) to an unzoned port in each switch (Figure 2-11).

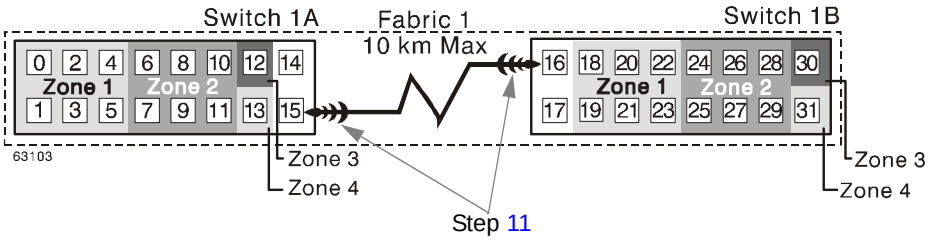

Figure 2-11 Connecting Switches over a Remote Network to Complete the Fabric Environment

12 Cabling for the Campus Configuration is complete. Repeat steps 4 through 10 for any additional disk subsystems that exist in the same cabinet that will use the Remote Volume Mirroring feature.

13 Power up all disk subsystems, hosts, Fibre Channel switches, and any other hardware at both sites that was powered down in step 2 on page 2-13.

14 Hardware installation is complete. The next step will be to configure the storage management software to support mirror relationships. Go to "Software Installation" on page 2-22.

Intra-Site Configuration

This configuration is used in environments where a long distance fabric is not required because of the close proximity of the hosts and disk subsystems. The configuration is still redundant for host bus adapters, controllers, Remote Volume Mirroring ports, and switches, but is a single point of failure for the site since all equipment can be destroyed by the same disaster. For this reason, the Highest Availability Campus Configuration is highly recommended for total environment redundancy.

IMPORTANT A switch failure in this configuration does not affect data access, however, an unsynchronized mirror state may occur as a result.

Figure 2-12 shows the Intra-Site Configuration after installation is complete.

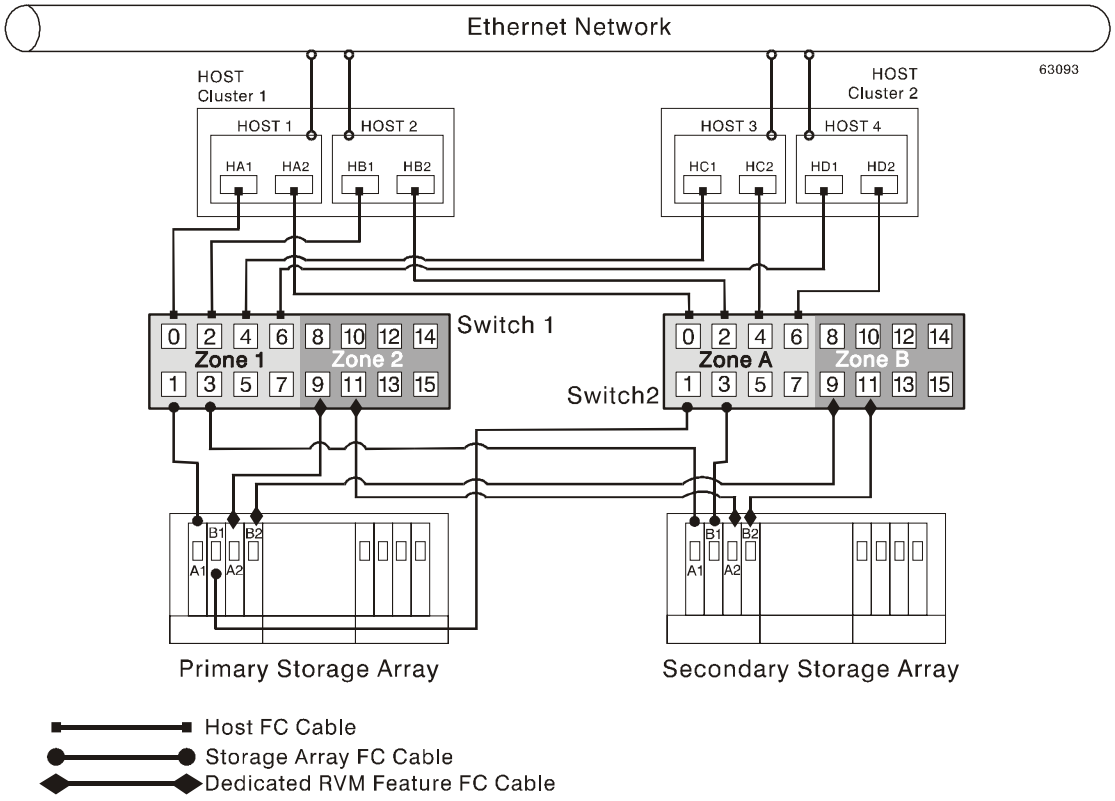

Figure 2-12 Intra-Site Configuration

Switch Zoning for the Intra-Site Configuration

This configuration is designed for switch redundancy. However, the switches are not cascaded, and are, therefore, independent of each other. The switches do not need to be zoned exactly as presented in this configuration. However, the following are requirements when zoning switches for the Intra-Site Configuration.

IMPORTANT Switch 2 contains Zones A and B to show that there is no relationship between Switch 1 and Switch 2, contrary to the other configurations.

- There will be a total of four zones in this configuration.
  - Zones 1 and 2 will exist on Switch 1.
  - Zones A and B will exist on Switch 2.
- Configure the zones on the switch so that there is one port per zone for a disk subsystem connection and one port per zone for each host.
- Switches are zoned so that a single host adapter can only access one controller per disk subsystem.

The switches in Figure 2-13 contain 16 ports each, which leaves many unused ports per switch. The remaining ports can be distributed among the other zones. However, it is recommended that most remaining ports be assigned to the zones containing the host connections (Zone 1 and Zone A in Figure 2-13). This will allow easy set up for additional hosts to connect to the environment.

In this example, the switches use half of the ports for each zone for simplicity, although Zone 2 and Zone B require less ports.

Figure 2-13 Switch Zoning for the Intra-Site Configuration

Given the requirements and the zoning example shown in Figure 2-13, ensure both switches are properly zoned before proceeding. For more information on zoning switches, refer to “Switch Zoning Overview” on page 2-2.

Cabling for the Intra-Site Configuration

Table 2-3 is provided for a convenient reference to port connections.

Table 2-3 Text Table for Intra-Site Configuration Connections

	Zone	Por	Connect To/From
Switch 1	1	0	Host 1, HBA 1 (HA1)
		1	Controller Port A1 (Primary Disk Subsystem)
		2	Host 2, HBA 1 (HB1)
		3	Controller Port A1 (Secondary Disk Subsystem)
		4	Host 3, HBA 1 (HC1)
		5	Additional Host, HBA 1 (Optional)
		6	Host 4, HBA 1 (HD1)
		7	Additional Host, HBA 1 (Optional)
	2	8	Unused
		9	Controller Port A2 (Primary Disk Subsystem - Dedicated RVM Port)
		10	Unused
		11	Controller Port A2 (Secondary Disk Subsystem - Dedicated RVM
		12	Unused
		13	Unused
		14	Unused
		15	Unused
	Zone	**Por**	**Connect To/From**
Switch 2	A	0	Host 1, HBA 2 (HA2)
		1	Controller Port B1 (Primary Disk Subsystem)
		2	Host 2, HBA 2 (HB2)
		3	Controller Port B1 (Secondary Disk Subsystem)
		4	Host 3, HBA 2 (HC2)
		5	Additional Host, HBA 2 (Optional)
		6	Host 4, HBA 2 (HD2)
		7	Additional Host, HBA 2 (Optional)
	B	8	Unused
		9	Controller Port B2 (Primary Disk Subsystem - Dedicated RVM Port)
		10	Unused
		11	Controller Port B2 (Secondary Disk Subsystem - Dedicated RVM
		12	Unused
		13	Unused
		14	Unused
		15	Unused

After both Fibre Channel Switches are properly zoned, complete the following procedure to set up the Intra-Site Configuration for the Remote Volume Mirroring feature.

NOTE All connections are completed using Fibre Channel cables of appropriate length.

1 Is Remote Volume Mirroring feature equipment being added to an existing disk subsystem environment?

- **Yes** – Stop I/O from all hosts before proceeding. Go to step 2.
- **No** – This is a new disk subsystem installation. Go to step 3.

2 Power down all disk subsystems, hosts, Fibre Channel switches, and all other equipment in the disk subsystem environment.

3 Ensure that basic cabling between all control modules and blade modules is complete on both disk subsystems as presented in the *Control Module and Blade Module Installation Guide*.

4 Connect the primary host bus adapter for each host (H*x*1) to an available port in Zone 1 of Switch 1 (Figure 2-14).

NOTE The cables can be connected to *any* port in the proper zone of the switch.

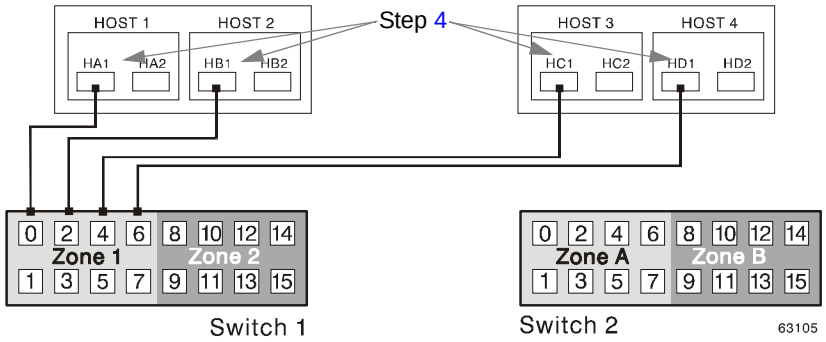

Figure 2-14 Primary Host Bus Adapter Connections to Fibre Channel Switches

5 Connect the secondary host bus adapter (H*x*2) for each host to an available port in Zone A of Switch 2 (Figure 2-15).

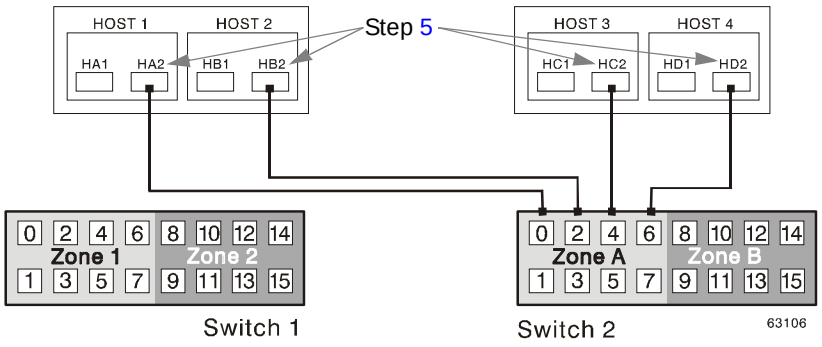

Figure 2-15 Secondary Host Bus Adapter Connections to Fibre Channel Switches

6 Connect controller port A1 of the primary disk subsystem to an available port in Zone 1 of Switch 1 (Figure 2-16).

7 Connect controller port B1 of the primary disk subsystem to an available port in Zone A of Switch 2 (Figure 2-16).

8 Connect controller port A2 of the primary disk subsystem to an available port in Zone 2 of Switch 1 (Figure 2-16).

9 Connect controller port B2 of the primary disk subsystem to an available port in Zone B of Switch 2 (Figure 2-16).

NOTE Controller Ports A2 and B2 are reserved for mirror relationship synchronization upon activation of the Remote Volume Mirroring feature. For more information, refer to "Connectivity and Input/Output" in Chapter 1.

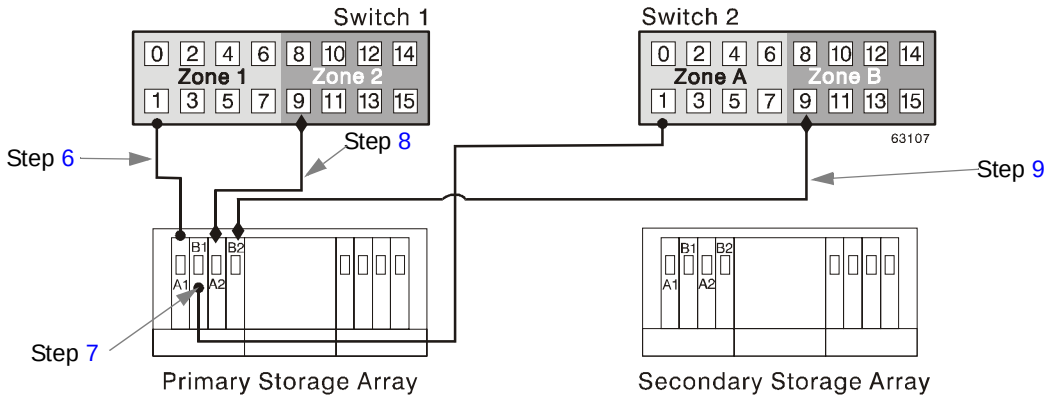

Figure 2-16 Primary Disk Subsystem Connections to Fibre Channel Switches

10 Connect controller port A1 of the secondary disk subsystem to an available port in Zone 1 of Switch 1 (Figure 2-17).

11 Connect controller port B1 of the secondary disk subsystem to an available port in Zone A of Switch 2 (Figure 2-17).

12 Connect controller port A2 of the secondary disk subsystem to an available port in Zone 2 of Switch 1 (Figure 2-17).

13 Connect controller port B2 of the secondary disk subsystem to an available port in Zone B of Switch 2 (Figure 2-17).

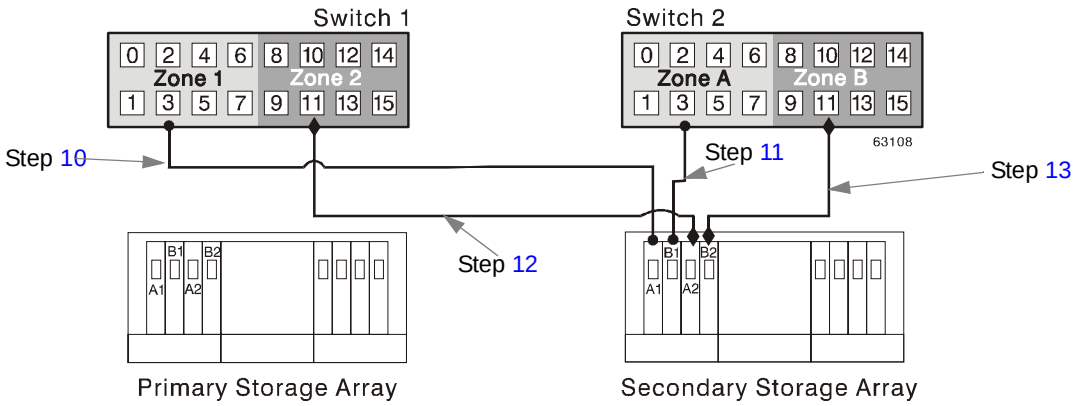

Figure 2-17 Secondary Disk Subsystem Connections to Fibre Channel Switches

14 Cabling for the Intra-Site Configuration is complete. Repeat steps 4 through 13 for any additional disk subsystems that exist in the same cabinet that will use the Remote Volume Mirroring feature.

15 Power up all disk subsystems, hosts, Fibre Channel switches, and any other hardware that was powered down in step 2 on page 2-19.

16 Hardware installation is complete. The next step will be to configure the storage management software to support mirror relationships. Go to "Software Installation" on page 2-22.

Software Installation

The Remote Volume Mirroring premium feature is automatically included as part of the BladeStore Storage Manager version 8.20 and 8.3x installation. However, the feature is not enabled or activated by default after installation.

IMPORTANT All disk subsystems participating in mirror relationships must have firmware version 05.2x.xx.xx or higher installed. For more information about upgrading firmware, refer to *BladeStore Storage Manager Installation Guide*.

For more information about installing BladeStore Storage Manager, refer to *BladeStore Storage Manager Installation Guide*.

For more information about enabling or activating the Remote Volume Mirroring premium feature, refer to "Enabling and Activating the Remote Volume Mirroring Feature" in Chapter 3.

Verifying Installation and Configuration

All hardware and software is now set up to support mirror relationships through the Remote Volume Mirroring feature. However, before creating mirror relationships, ensure that all required components are working properly.

Complete the following procedure for each disk subsystem that will participate 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, refer to *BladeStore Storage Manager Installation Guide* for operating system specific procedures.

2. Is this the first time the storage management software has been started?

   - **Yes** – Go to step 3.
   - **No** – Go to step 4.

3. Start the storage management software (for the first time).

   a. Select OK when prompted for Automatic Discovery of devices.

   b. Ensure that all disk subsystems designated to participate in mirror relationships are displayed in the Device Tree view of the Enterprise Management Window.

      NOTE If the disk subsystems do not appear, refer to Chapter 5, "Troubleshooting."

4. Start the storage management software (not for the first time).
   a. From the Enterprise Management Window, select Tools >> Automatic Discovery.
   b. Select OK.
   c. Verify that all disk subsystems designated to participate in mirror relationships are displayed in the Device Tree view of the Enterprise Management Window.
   d. If the disk subsystems do not appear, refer to Chapter 5, “Troubleshooting.”
5. From the Enterprise Management Window, select a disk subsystem that will participate in mirror relationships.
6. Select Tools >> Manage Device to open the Array Management Window for that disk subsystem.
7. From the Array Management Window, select Help >> About.
8. Verify that the version of the storage management software is 08.2x.xx.xx or higher. If this requirement is not met, refer to *BladeStore Storage Manager Installation Guide* for storage management software upgrade procedures.
9. Select OK.
10. From the Array Management Window, select View >> Disk Subsystem Profile.
11. Under the All tab, verify that the current firmware version is 05.2x.xx.xx or higher. If this requirement is not met, refer to *BladeStore Storage Manager Installation Guide* for firmware upgrade procedures.
12. Select Close.
13. Observe the Remote Mirroring premium feature icon in the premium feature status area. The icon represents a Disabled/Deactivated status of the Remote Volume Mirroring feature.
14. To begin working with Mirror Relationships, go to Chapter 3, “Using the Remote Volume Mirroring Premium Feature.”

Chapter 3

Using the Remote Volume Mirroring Premium Feature

This chapter consists of procedures necessary to perform the major tasks associated with the Remote Volume Mirroring feature. The chapter is organized sequentially; after the feature has been enabled and activated, mirror relationships can be created and then maintained. The final section is provided for reference only and may be required when a mirror relationship is no longer needed.

Enabling and Activating the Remote Volume Mirroring Feature

The Remote Volume Mirroring premium feature must be enabled and activated before any mirror relationships can be created. First, determine the status of the Remote Volume Mirroring feature. After determining the status, the feature will need to be enabled and activated in order to perform all functions of the Remote Volume Mirroring feature.

Determining Remote Volume Mirroring Feature Status

There are four possible statuses of the Remote Volume Mirroring feature: Disabled/Deactivated, Disabled/Activated, Enabled/Deactivated, and Enabled/Activated.

IMPORTANT The Remote Volume Mirroring feature must be in an Enabled/Activated state on the secondary disk subsystem as well as the primary disk subsystem to utilize all the functionality of the feature.

The current status can be determined by hovering the mouse pointer over the Remote Volume Mirroring feature icon in the premium feature status area of the Array Management Window, as shown in Figure 3-1.

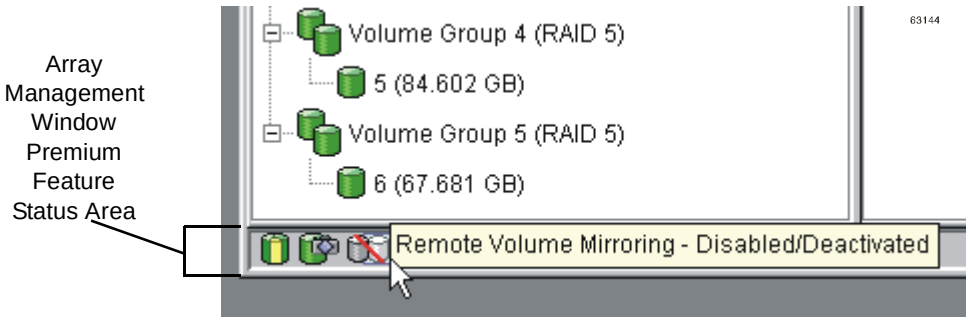

Figure 3-1 Remote Volume Mirroring Feature Status

IMPORTANT The Remote Volume Mirroring feature status for the primary disk subsystem is managed independently from the secondary disk subsystem. To determine the status for both disk subsystems, select each disk subsystem independently, then determine the status.

The status of the Remote Volume Mirroring feature is one of the following.

- **Disabled/Deactivated** – No functions of the Remote Volume Mirroring feature can be performed. Full Remote Volume Mirroring feature functionality is not available until the feature is enabled and activated. The icon for this state is displayed 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 is greyed out to show it is deactivated. An example of this state is illustrated in Figure 3-1. For more information about enabling the Remote Volume Mirroring feature, refer to "Enabling the Remote Volume Mirroring Feature" on page 3-4. To activate the feature, refer to "Activating the Remote Volume Mirroring Feature" on page 3-5.
- **Disabled/Activated** – The Remote Volume Mirroring feature is disabled, preventing new mirror relationships from being created. However, any pre-existing mirror relationships can be maintained with all functions of the Remote Volume Mirroring feature. The icon displayed for this state is similar to the Disabled/Deactivated state, because the red slash remains to show the feature is disabled. However, the cylinder and its reflection now appear green to show the feature is active. For more information about enabling the Remote Volume Mirroring feature, refer to "Enabling the Remote Volume Mirroring Feature" on page 3-4.
- **Enabled/Deactivated** – The Remote Volume Mirroring feature is enabled, but not activated. The icon displayed for this state is similar to the Disabled/Deactivated state, because the cylinder and its reflection remain grey. However, the red slash no longer appears, therefore, the feature is enabled. To activate the feature, refer to "Activating the Remote Volume Mirroring Feature" on page 3-5.
- **Enabled/Activated** – The Remote Volume Mirroring feature is enabled and active. Mirror relationships can be created and maintained. The icon for this state is displayed in the premium feature status area as a green cylinder with a mirrored reflection. For more information about creating a mirror relationship, refer to "Creating Mirror Relationships" on page 3-7.

Enabling the Remote Volume Mirroring Feature

If the current status of the Remote Volume Mirroring feature is Disabled/Deactivated or Disabled/Activated, complete the following to enable the Remote Volume Mirroring feature.

1. From the Array Management Window, select Disk Subsystem >> Premium Features >> Enable.

   The Select Feature Key File dialog is displayed.

NOTE The Select Feature Key File dialog filters for files with the .key extension.

---

2. Select the folder in which you placed the generated key file.
3. Select the appropriate key file, and then select OK.

   The Enable Premium Feature dialog is displayed.

4. Select Yes.

   The Remote Volume Mirroring premium feature is now enabled. The icon in the premium feature status area no longer displays a red slash. To further verify the status of the feature, select Disk Subsystem >> Premium Features >> List.

5. Repeat step 1 through step 4 for the secondary disk subsystem and any additional disk subsystem that will participate in the Remote Volume Mirroring Feature.
6. Has the Remote Volume Mirroring feature been activated on both primary and secondary disk subsystems?

   - **No** – Go to “Activating the Remote Volume Mirroring Feature.”
   - **Yes** – Go to “Creating Mirror Relationships” on page 3-7.

Activating the Remote Volume Mirroring Feature

Activating the Remote Volume Mirroring feature prepares the disk subsystem to create and configure mirror relationships. After the feature is activated, the secondary ports for each controller are reserved and dedicated to Remote Volume Mirroring feature usage. In addition, a mirror repository volume is automatically created for each controller in the disk subsystem.

If the current status of the Remote Volume Mirroring feature is Enabled/Deactivated, complete the following to activate the premium feature.

1. From the Array Management Window, select Disk Subsystem >> Remote Volume Mirroring >> Activate.

   The Activate Remote Volume Mirroring - Introduction dialog is displayed.

NOTE Select Back at any time to change information in previous dialogs.

---

2. Decide where the mirror repository volumes will reside. Select one of the following:

   - **Use free capacity on existing volume group** – If this option is selected, then a corresponding volume group must be selected as well.

     a. Select a volume group.

     b. Select Next.

     c. Go to step 6 on page 3-6.

   - **Create a new volume group using unconfigured capacity** – If this option is selected, more information must be collected about the new volume group. Go to step 3.

3. In the Create New Volume Group dialog, select the RAID level for the new volume group.

4 Under the drive selection choices, select one of the following:

- **Automatic** – The drives are chosen automatically according to available capacity. Go to step 5.
- **Manual** – This option gives the user the option to specify which drives contain the mirror repository volume.

  IMPORTANT If the RAID level for the new volume group is RAID 1, then the number of drives must be an even number. If an odd number of drives is selected, an error message will display when Apply is selected.

  IMPORTANT RAID 0 is not an option; therefore, the number of drives selected must always be greater than one for all RAID levels.

  IMPORTANT RAID 3 and 5 require a minimum of 3 drives.

  a Select the desired drives. Multiple drives can be selected by pressing Ctrl+click.

  b Select Apply.

5 Select Next.

6 Review the information in the Preview dialog, then select Finish if all information is satisfactory.

7 Is the disk subsystem password protected?

- **Yes** – Go to step 8.
- **No** – Go to step 9.

8 Enter the password and select OK.

9 Review the information in the Completed dialog, then select OK to finish the Remote Volume Mirroring feature activation.

The Remote Volume Mirroring premium feature is now activated. The icon in the premium feature status area changes from grey to green.

10 Repeat step 1 on page 3-5 through step 9 for the secondary disk subsystem and any additional disk subsystem that will participate in the Remote Volume Mirroring Feature.

11 Has the Remote Volume Mirroring feature been enabled on both primary and secondary disk subsystems?

- **No** – Go to “Enabling the Remote Volume Mirroring Feature” on page 3-4.
- **Yes** – Go to “Creating Mirror Relationships.”

Creating Mirror Relationships

The Remote Volume Mirroring premium feature should be enabled and activated prior to creating mirror relationships. After the feature is enabled and activated, the secondary host ports on the disk subsystems are reserved for data synchronization between a primary and secondary volume of a mirror relationship, and mirror relationships can be created.

This section will present information for the following topics.

- How to create volumes to be a primary or secondary volume in a mirror relationship, if not already created.
- How to use the Create Remote Volume Mirror Wizard to create mirror relationships.
- How to view mirror relationship configuration details.

Creating Volumes for Mirror Relationships

Before any mirror relationships can be created, volumes must exist at both the primary and secondary sites. The volume residing in the primary disk subsystem is the primary volume. Similarly, the volume residing in the secondary disk subsystem is the secondary volume.

If a primary volume does not exist, one will need to be created on the primary disk subsystem.

If a secondary volume does not exist, one will need to be created on the secondary disk subsystem.

Consider the following when creating the secondary volume:

- The secondary volume must be of equal or greater size than the primary volume.
- The RAID level of the secondary volume does not have to be the same as the primary volume.

For more information about creating volumes, refer to the Array Management Window online help.

When adequate volumes exist at both sites, mirror relationships can be created using the Remote Volume Mirror Wizard.

Creating a Mirror Relationship Using the Create Remote Volume Mirror Wizard

The Create Remote Volume Mirror Wizard allows a user to create a mirror relationship between a primary volume and a secondary volume.

1. Before beginning the wizard, ensure the following requirements are met.
   - The Remote Volume Mirroring premium feature is enabled on both disk subsystems in which the primary and secondary volumes will reside.
   - The Remote Volume Mirroring feature is activated on both arrays.
   - The disk subsystems are connected through a proper Fibre Channel fabric configuration.
   - The secondary volume is RAID level 0, 1, 3, or 5, and is of equal or greater size than the primary volume.
2. In the Logical/Physical View of the Array Management Window, select the volume that will be the primary volume in the mirror relationship.
3. Select Volume >> Remote Volume Mirroring >> Create.

   The Create Remote Volume Mirror dialog is displayed stating requirements similar to those mentioned at the beginning of this section.
4. Select Next.
5. Perform the procedure in the Select Remote Disk Subsystem dialog.
   a. Select the proper disk subsystem.
   b. Select Next.
6. Select the volume that will be the secondary volume in the mirror relationship.
7. Select Next.
8. Select the Synchronization Priority Level.

NOTE For more information about the Synchronization Priority Level, refer to "Changing the Synchronization Priority Level" on page 3-12.

---

9. Select Finish.
10. If the remote disk subsystem is password protected, proceed to step 11, otherwise, go to step 12.
11. Enter the password and select OK.

12 Create another mirror relationship?

- **Yes –** Complete the following steps:
  - **a** Select the volume that will become the next primary volume.
  - **b** Select Next.
  - **c** Repeat steps 5 through 11 for each additional mirror relationship.
- **No** – Go to step 13.

13 Review the information in the Completed dialog, then select OK to complete the Create Remote Volume Mirror wizard.

The primary and secondary volumes are now displayed with the mirror relationship icons, which will change slightly upon completion of the data synchronization. The amount of time for the data to be synchronized between the two volumes varies proportionally to the size of the volume being mirrored. After the synchronization is complete, the icons will change to the optimal state mirror relationship icons.

NOTE To view all icons associated with the Remote Volume Mirroring feature and obtain a description of their purpose, refer to the Array Management Window online help.

Figure 3-2 shows how the icons appear during and after data synchronization.

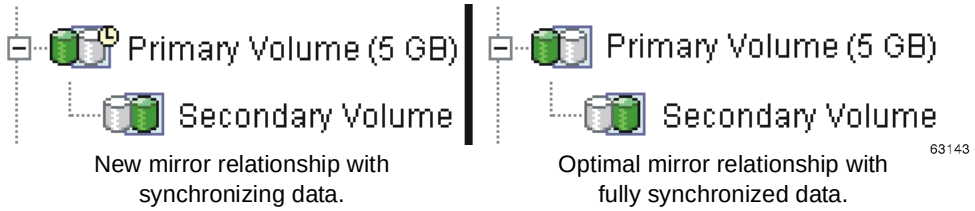

Figure 3-2 Synchronizing (Left) and Optimal (Right) Mirror Relationship

The mirror relationship is now created and ready for data replication.

14 The next step is maintain the mirror relationship. Go to "Maintaining Mirror Relationships" on page 3-10.

Maintaining Mirror Relationships

Once a mirror relationship is active, certain attributes of the relationship can be modified at any time. This section describes how to view information about the mirror relationship, change the synchronization priority level, remove a mirror relationship, and delete volumes participating in a mirror relationship.

Viewing Mirror Relationship Details

The mirror relationship that exists between the primary volume and the secondary volume can be examined by various methods, including: the Disk Subsystem Profile, the Mirroring Properties Dialog, and the View Associated Components dialog.

The Disk Subsystem Profile

The Disk Subsystem Profile is the most efficient way to view information about any or all components of the disk subsystem. Details for all volumes, including the primary, secondary, and mirror repository volumes can all be easily viewed through the Disk Subsystem Profile simultaneously. The Disk Subsystem Profile also contains specific information for components associated with mirror relationships.

Complete the following procedure to display a Disk Subsystem Profile.

1. From the Array Management Window select View >> Disk Subsystem Profile.
2. Select the Volumes tab.
   a. To view information about the mirror relationships that exist on this disk subsystem, select the Mirrors Tab.
   b. To view information about the mirror repository volume, select the Repositories tab.

      NOTE All information shown in the Disk Subsystem Profile can be saved as a .txt file by selecting the Save as... button. The Save Profile dialog that is displayed will have the option of saving the current window, multiple windows, or the entire Disk Subsystem Profile.

End Of Procedure

The Mirroring Properties Dialog

The Mirroring Properties dialog displays all the physical characteristics of a *single volume* in the mirror relationship. The dialog displays the same information as the Disk Subsystem Profile for the selected volume, but is specific *to that volume*. In addition, the synchronization progress is displayed, if the selected volume is synchronizing data with another volume in a mirror relationship.

NOTE Use the following procedure to view the synchronization progress of a recently created mirror relationship.

Complete the following procedure for each volume that needs to be examined in the mirror relationship.

1. Select the primary or secondary volume.
2. Select Volume >> Properties.
3. Select the Mirroring tab.

End Of Procedure

The View Associated Components Dialog

The View Associated Components dialog provides a more graphical representation of the volumes participating in the mirror relationship. In addition, more detail is given for all components, rather than only the selected volume.

Complete the following procedure to view all associated components in a mirror relationship, including primary, secondary, and mirror repository volumes.

1. Select the primary or secondary volume in a mirror relationship.
2. Select View >> Associated Components.

   The View Associated Components dialog is displayed.

End Of Procedure

Changing the Synchronization Priority Level

The Synchronization Priority Level of a mirror relationship defines the amount of system resources used to synchronize the data between the primary and secondary volumes of a mirror relationship. If the highest priority level is selected for a mirror relationship, the data synchronization uses a high amount of system resources to perform the full synchronization, but may decrease performance for host I/O, including other mirror relationships. Conversely, if the lowest synchronization level is selected, there is less impact on complete system performance, but the full synchronization may be slower.

To change the Synchronization Priority Level for a mirror relationship, complete the following procedure.

1. In the Logical/Physical view of the Array Management Window, select a primary volume of a mirror relationship.
2. Select Volume >> Remote Volume Mirroring >> Change >> Synchronization Priority.

   The Change Synchronization Priority dialog is displayed. The primary volume chosen in step 1 is selected by default in the Select Volumes selection area.
3. Select one or more volumes using the Select All button, Ctrl+click, or Shift+click.
4. Select the synchronization priority level by moving the slider bar. The five levels are Lowest, Low, Medium, High, and Highest. All selected volumes will change to the same synchronization priority level.
5. Select OK.
6. Select Yes when the Confirmation dialog is displayed.
7. Select OK when the Completed dialog is displayed.

End Of Procedure

Removing Mirror Relationships

Removing a mirror relationship between a primary and secondary volume does not affect any of the existing data on either volume. The link between the volumes is removed, but the primary volume still continues normal I/O operation. This action can be performed for backup routines, particularly from the secondary volume. A mirror relationship between the two volumes can be re-created unless one of the volumes is deleted.

To remove a mirror relationship between two volumes, complete the following procedure.

1. From the Array Management Window, select a local primary volume or local secondary volume of a mirror relationship.
2. Select Volume >> Remote Volume Mirroring >> Remove Mirror Relationship.

   The Remove Mirror Relationship dialog appears displaying all mirror relationships associated with this disk subsystem.
3. Select one or more mirror relationships to remove using the Select All button, Ctrl+click, or Shift+click.
4. Carefully review the information presented in the Confirmation dialog.
5. Select Yes.

End Of Procedure

Deleting Primary or Secondary Volumes

Deleting a volume participating in a mirror relationship removes the mirror relationship and completely deletes the volume from the disk subsystem. The mirror relationship cannot be redefined until a new volume is created or an alternate volume is chosen to replace the deleted volume.

To delete a primary or secondary volume from a mirror relationship, complete the following procedure.

IMPORTANT This action permanently removes data from the selected volume.

---

1. From the Array Management Window, select the primary or secondary volume that will be deleted.
2. Select Volume >> Delete.

   The following information is displayed in the Delete Remote Volume Mirror dialog.

   IMPORTANT Carefully review the following information before proceeding with step 3.

   ```
   Deleting this volume will destroy all data on it, remove the
   mirror relationship that exists between it and its associated
   volume in the mirror pair, and increase the Free Capacity on the
   volume group.

   NOTE: The Data on the associated volume will not be deleted.

   Stop all I/O and unmount any file systems on this volume before
   proceeding.

   IMPORTANT: If you see system error messages related to this
   deleted volume, you may need to reboot your host system to
   permanently remove any information about this volume.

   Are you sure you want to continue?
   ```

   ---

3. Type Yes in the text area to delete the volume.
4. Select OK.

End Of Procedure

Deactivating and Disabling the Remote Volume Mirroring Feature

If no mirror relationships exist and the Remote Volume Mirroring feature is no longer required, then deactivating the feature will reestablish normal use of dedicated ports on both disk subsystems and delete both mirror repository volumes.

The Remote Volume Mirroring feature can also be disabled. When the feature is in the Disabled/Active state, previously existing mirrors can still be maintained and managed, however, new mirror relationships cannot be created. When in the Disabled/Deactivated state, no Remote Volume Mirroring feature activity can occur.

Deactivating the Remote Volume Mirroring Feature

To change the Remote Volume Mirroring feature status from Enabled/Activated to Enabled/Deactivated or from Disabled/Activated to Disabled/Deactivated, complete the following procedure.

IMPORTANT This procedure will delete all mirror repository volumes on the current disk subsystem.

---

1. Verify that all mirror relationships have been removed. For more information, refer to "Removing Mirror Relationships" on page 3-13.
2. Select Disk Subsystem >> Remote Volume Mirroring >> Deactivate.
3. Carefully review the information presented in the Confirmation dialog.
4. Select Yes.

End Of Procedure

Disabling the Remote Volume Mirroring Feature

To change the Remote Volume Mirroring feature status from Enabled/Deactivated to Disabled/Deactivated or from Enabled/Activated to Disabled/Activated, complete the following procedure.

1. From the Array Management Window, select Disk Subsystem >> Premium Features >> Disable.
2. Select Remote Volume Mirroring.
3. Select OK.
4. Carefully review the information presented in the Confirmation dialog.
5. Select Yes.

End Of Procedure

Chapter 4

Disaster Recovery

This chapter describes the actions to take to prepare for a disaster and the actions to take if a hardware component or complete site failure should occur.

As businesses require the ability to access critical data round-the-clock with little or no downtime, system administrators are required to ensure that critical data is safeguarded against potential disasters whether natural or man-made.

In preparing for a potential disaster, system administrators need to develop a disaster recovery plan that describes the procedures devised to prevent and prepare for disasters, and proposed actions for responding to and recovering from disasters if they occur.

Planning for Disaster Recovery

This section provides information on the steps that should be undertaken in preparation for a possible disaster or catastrophic failure. Preparation steps discussed include backing up critical data prior to and during Remote Volume Mirroring, using host clustering software for failover protection, and preparing the secondary disk subsystem that will participate in the Remote Volume Mirror.

The Remote Volume Mirroring checklist should be completed to ensure that your primary and secondary disk subsystems are prepared correctly.

Backing Up Critical Data

Backing up critical data regularly is vital insurance against disasters or catastrophic failure. Backups should be performed regardless of whether the Remote Volume Mirroring feature is in use.

A backup of all critical data on both the primary and secondary disk subsystems participating in Remote Volume Mirroring should be performed prior to creating a Remote Volume Mirror. Periodic backups of the primary disk subsystem should be carried out after Remote Volume Mirrors are in use.

Backups to tape or disk can be made while I/O continues using the Snapshot Volume premium feature, which captures a point-in-time image of a volume. For more information on using snapshot volumes, refer to “Snapshot Volumes” on page 1-13 or the Array Management Window online help.

Preparing the Secondary Disk Subsystem

When preparing for a potential disaster, ensure the secondary disk subsystem, to which the data is being mirrored, is structured in the same manner as the primary disk subsystem.

Prior to creating a Remote Volume Mirror, you will need to prepare your secondary disk subsystem to ensure that storage partitions are defined and ready to function if secondary disk subsystem volumes are promoted to primary roles.

Defining SANshare Storage Partitioning

The SANshare Storage Partitioning premium feature allows you to define which hosts have access to which volumes on the disk subsystem and at what logical unit number. When configuring your secondary disk subsystem, replicate the storage partitions that were previously defined on the primary disk subsystem. This will ensure that after a role reversal is carried out, hosts will be able to access their required data.

For more information on SANshare Storage Partitioning, refer to “Using Other Premium Features and Remote Volume Mirroring” on page 1-12, or refer to the Array Management Window online help.

Ensuring Failover Protection Using Host Clustering Software

Host failover clustering is a process in which the operating system and application software work together to provide continuous availability in the event of an application failure, hardware failure, or operating-system error. Software products that support remote failover may refer to global or geographic cluster management.

The Remote Volume Mirroring feature can be used in conjunction with remote host failover to provide complete redundancy of host systems and disk subsystems. If a disaster occurs at the primary disk subsystem, hosts at the secondary disk subsystem will take over processing and initiate a role change to the secondary disk subsystem.

Remote failover is not a requirement for a disaster recovery plan. Depending on the requirements for how quickly operations must be functioning at Optimal status again, mirroring the disk subsystems and depending on manual startup of the remote hosts may be acceptable.

For more information on failover protection, refer to your *BladeStore Storage Manager Planning Guide*.

Disaster Preparation Checklist

The following checklist should be completed in preparation for disaster recovery. Complete the steps listed to ensure access to mirrored data is possible in the event of a disaster or catastrophic failure.

	Task Description	Validation Activity
1	Ensure that all critical data has been backed up on both the primary and secondary disk subsystems.	❑ Completed.
2	Ensure that SANshare Storage Partitioning is in place on the secondary disk subsystem. This will reduce any lag time when promoting a secondary volume to the primary volume role. For more information on setting up SANshare Storage Partitioning, refer to the Array Management Window online help.	❑ Completed.
3	If possible, ensure that your host clustering software is configured to allow host failover between the primary disk subsystem and secondary disk subsystem participating in Remote Volume Mirroring. For more information, refer to your host clustering software documentation.	❑ Completed.

Recovering from Switch Failures

The Campus Configuration is the only configuration where each switch is a single point of failure. In all other configurations, 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 Volume Mirroring feature, but for all host to disk subsystem I/O as well.

If a switch fails in the Campus Configuration, the system administrator should decide whether or not to do a complete site failover. This decision should 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, one of the following temporary scenarios will need to occur until the switch can be replaced.

- **Direct connection between hosts and disk subsystems** – This will bypass the switch and allow normal I/O to continue. All mirror relationships will be suspended until a normal configuration is resumed. Since the disk subsystems have a finite number of host connections, all hosts may not be able to access the disk subsystem. For information on how to directly connect hosts and disk subsystems, refer to the *Control Module and Blade Module User Guide*.
- **Entire Site Failover** – The switch at the primary site has failed, however, the switch at the secondary site is still functional, which allows all hosts to access the switch and disk subsystems. Mirror relationships will be suspended until the primary disk subsystem is recovered. If a complete site failover is needed to continue normal operations, refer to “Entire Site Failover Procedure.”

Recovering from Storage System Failures

This section provides procedures for recovering storage systems where one of the following situations has occurred:

- The primary disk subsystem is damaged or destroyed
- Entire primary site is damaged or destroyed

Both situations require a complete site failover from the primary site to the secondary site so that business operations can continue. For a secondary site failure, no site failover is necessary. If the primary volume is not damaged, then a full synchronization will occur when the site is recovered. If the primary disk subsystem is damaged, follow the procedure in "Rebuilding a Damaged Site" on page 4-6.

IMPORTANT The procedures in this section should be completed in the order presented to ensure that the affected site or disk subsystem is recovered successfully.

Entire Site Failover Procedure

Entire site failover is necessary when an event occurs that inhibits normal operation to the primary site for an extended period of time.

1. Manually reverse the role of the secondary volume of the mirror relationship to the primary role. For more information, refer to "Reversing the Roles of Primary and Secondary Volumes" on page 4-8.
2. Have all hosts at the secondary site been properly configured for host failover?
   - **Yes** – Go to step 4.
   - **No** – Go to step 3.
3. Reinstall host cluster software and reconfigure settings as needed. For more information about installing and configuring host cluster software, refer to the documentation provided with the software.
4. Has SANshare Storage Partitioning been pre-configured so that proper hosts can access appropriate volumes?
   - **Yes** – Go to step 6 on page 4-6.
   - **No** – Go to step 5.
5. Configure the storage partitioning so that host to volume access is identical to the primary site configuration. For more information about setting up storage partitioning, refer to "Using Other Premium Features and Remote Volume Mirroring" on page 1-12.

6 Resume normal operation with the secondary site acting as a new, fully-functioning primary site.

The entire site failover is complete. The primary site must now be reconfigured and the Remote Volume Mirroring environment must be re-created. The next step will depend on the resulting status of the disk subsystem from the disaster.

7 Is the disk subsystem and all the contained data recovered and fully operational?

- **Yes** – Go to "Re-creating a Mirror Relationship."
- **No** – Go to "Rebuilding a Damaged Site."

Rebuilding a Damaged Site

If a disaster occurs to the primary or secondary site that renders the disk subsystem or all data on the disk subsystem irreparable, then the site needs to be rebuilt with new equipment.

Complete the following procedure to rebuild a damaged site:

1 Obtain new disk subsystems and any hosts and equipment needed to properly use the Remote Volume Mirroring feature. It is recommended that the new equipment have equal or greater hardware and software specifications than the damaged equipment.

2 Depending on the configuration, complete the switch zoning and hardware installation procedure as presented in Chapter 2, "Hardware and Software Installation" for this site only.

3 Create a volume to replace the mirrored volume damaged on the original disk subsystem. The new volume should be identical to the specifications of the previously damaged volume.

4 Ensure SANshare Storage Partitioning is properly defined so that it may take over normal operation from the secondary site. For more information on setting up storage partitioning, refer to "Using Other Premium Features and Remote Volume Mirroring" on page 1-12.

5 Ensure the host cluster software is properly configured so that the hosts can take over I/O from the secondary site hosts. For more information about installing and configuring host cluster software, refer to the documentation provided with the software.

6 The Damaged site is now ready to support mirror relationships. Go to "Re-creating a Mirror Relationship."

Re-creating a Mirror Relationship

After the damaged site is back online and properly configured, mirror relationships can be resumed by completing the following procedure.

1. From the undamaged site, remove all mirror relationships that existed prior to the disaster.
2. From the undamaged site, create a mirror relationship using the volume on the recovered primary site as the secondary volume. For more information, refer to "Creating Mirror Relationships" on page 3-7.
3. Ensure SANshare Storage Partitioning is properly defined on the recovered primary site so that it may take over normal operation from the secondary site. For more information on setting up storage partitioning, refer to "Using Other Premium Features and Remote Volume Mirroring" on page 1-12.
4. Ensure the host cluster software is properly configured so that the hosts at the recovered primary site can take over I/O from the secondary site hosts. For more information about installing and configuring host cluster software, refer to the documentation provided with the software.
5. Perform a role reversal so that the recovered primary site now possesses the active primary volume, and the secondary volume now exists on the secondary site. For more information, refer to "Reversing the Roles of Primary and Secondary Volumes" on page 4-8.

   The Remote Volume Mirroring configuration is now ready.

End Of Procedure

Reversing the Roles of Primary and Secondary Volumes

A role reversal is the act of promoting the secondary volume to be the primary volume within the mirrored volume pair, and demoting the primary volume to be the secondary volume.

A role reversal may be performed using one of the following methods:

- **Changing a secondary mirrored volume to a primary volume** – This option promotes the selected secondary volume to become the primary volume of the mirrored pair and would be used when a catastrophic failure has occurred. For step-by-step instructions, refer to "Changing a Secondary Volume to a Primary Volume."
- **Changing a primary mirrored volume to a secondary volume** – This option demotes the selected primary volume to become the secondary volume of the mirrored pair and would be used during normal operating conditions. For step-by-step instructions, refer to "Changing a Primary Volume to a Secondary Volume."

Role reversals may also be performed using the *set* command in the Script Editor or the command line interface. For more information, refer to the Enterprise Management Window online help.

Changing a Secondary Volume to a Primary Volume

A secondary volume is typically promoted to a primary volume role when a catastrophic failure has occurred to the disk subsystem that contains the primary volume, and the secondary volume needs to be promoted so that hosts can access data and business operations can continue.

This option is not available unless the Remote Volume Mirroring premium feature has been activated.

IMPORTANT When the secondary volume becomes a primary volume, any hosts that are mapped to the volume through a volume-to-LUN mapping will now be able to read or write to the volume.

If a communication problem between the secondary and primary sites prevents the demotion of the remote primary volume, an error message is displayed. However, you are given the opportunity to proceed with the promotion of the secondary volume, even though this will lead to a dual-primary condition.

To promote a secondary volume to a primary role:

1. Select the secondary volume in the Logical View, then select Volume >> Remote Mirroring >> Change >> Role to Primary.

   The Change to Primary dialog is displayed.

2. Select Yes. The secondary volume is promoted to be the primary volume role in the Remote Volume Mirror.

After the controller owner of the primary volume can be contacted, the primary volume is automatically demoted back to be the secondary role in the mirror relationship.

Changing a Primary Volume to a Secondary Volume

Changing a primary volume to a secondary role is used for role reversals during normal operating conditions. You can also use this option during a Recovery Guru procedure when a dual-primary condition occurs.

This option is not available unless the Remote Volume Mirroring premium feature has been activated.

IMPORTANT Any hosts that are accessing the primary volume through a volume-to-LUN mapping will no longer be able to read or write to the volume. When the primary volume becomes a secondary volume, only remote writes initiated by the primary controller will be written to the volume.

If a communication problem between the primary and secondary sites prevents the promotion of the secondary volume, an error message is displayed. However, you are given the opportunity to proceed with the demotion of the primary volume, even though this will lead to a dual-secondary condition.

If the selected primary volume has associated snapshot volumes, demoting this volume to a secondary role will cause the associated snapshot volumes to fail.

To demote a primary volume to a secondary role:

1. Select the primary volume in the Logical View, then select Volume >> Remote Mirroring >> Change >> Role to Secondary.

   The Change to Secondary dialog is displayed.

2. Select Yes. The primary volume is demoted to be the secondary volume in the Remote Volume Mirror.

Once the controller owner of the secondary volume can be contacted, the secondary volume is automatically promoted back to the primary volume in the mirror relationship.

Chapter 5

Troubleshooting

This chapter provides information about troubleshooting some of the more commonly encountered problems when using the Remote Volume Mirroring feature.

Troubleshooting topics include general Remote Volume Mirroring problems, inappropriate Fibre Channel fabric configurations, problems with disk subsystem components involved in Remote Volume Mirroring, and basic switch troubleshooting. Also provided is a list of the critical events that may 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 technical support.

General Troubleshooting

This section describes some of the typical problems that may be encountered when using the Remote Volume Mirroring premium feature. The information is presented in order from the time the feature is enabled and activated, to problems that may be encountered completing typical tasks when using the Remote Volume Mirroring Feature.

Information about the probable cause and recommended resolution for each problem is provided. If your problem is not addressed in this section, refer to the remaining sections in this chapter before contacting technical support.

The Remote Volume Mirroring menu options in the Array Management Window are greyed out and unavailable.	
Cause:	The Remote Volume Mirroring premium feature is not enabled or activated.
Resolution:	**1** Enable the Remote Volume Mirroring premium feature. A feature key file is required to enable premium features. If one has not been supplied, contact your storage supplier. **2** Activate the Remote Volume Mirroring feature. For step-by-step instructions on enabling and activating the Remote Volume Mirroring feature, refer to "Enabling and Activating the Remote Volume Mirroring Feature" on page 3-2 or the Array Management Window online help.

The Remote Volume Mirroring icon in the premium feature status area is greyed out with a red line.	
Cause:	The Remote Volume Mirroring premium feature is not enabled or activated.
Resolution:	**1** Enable the Remote Volume Mirroring premium feature. A feature key file is required to enable premium features. If one has not been supplied, contact your storage supplier. **2** Activate the Remote Volume Mirroring feature. For step-by-step instructions on enabling and activating the Remote Volume Mirroring feature, refer to "Enabling and Activating the Remote Volume Mirroring Feature" on page 3-2 or the Array Management Window online help.

When creating a Remote Volume Mirror, an error message listing the code INVALID_MIRROR_CANDIDATE_VOL is received.	
Cause:	The secondary volume candidate was participating in a mirror relationship with a different volume on this disk subsystem. The mirror relationship was successfully removed from the other disk subsystem. However, a communication error prevented the successful removal of the mirror relationship on this disk subsystem. A volume on this disk subsystem still has a mirror relationship with the secondary volume candidate.
Resolution:	**1** Select the View >> Disk Subsystem Profile option, then select the Volumes tab and the Mirrors tab. **2** Locate the volume that is still participating in the mirror relationship with the secondary volume candidate and remove the mirror relationship. For step-by-step instructions, refer to "Removing Mirror Relationships" on page 3-13 or the Array Management Window online help. **3** Re-create the intended Remote Volume Mirror using the original candidate volumes. For step-by-step instructions, refer to "Creating a Mirror Relationship Using the Create Remote Volume Mirror Wizard" on page 3-8 or the Array Management Window online help.

The primary volume is showing a Synchronization in Progress status.	
Cause:	A full synchronization, between the primary and secondary volumes participating in a mirror relationship, is in progress. All data on the primary volume is being copied in its entirety to its associated secondary volume.
Resolution:	Wait for the full synchronization to complete. After it has finished copying data from the primary volume to the secondary volume, the mirrored volume pair transitions to a Synchronized status. For more information on monitoring the status of a Remote Volume Mirror, refer to the Array Management Window online help.

Both the primary and secondary volumes are displayed as being the primary volume.	
Cause:	A disaster or catastrophic failure has occurred on the disk subsystem containing the primary volume, and the secondary volume has been promoted to the primary volume role. The primary disk subsystem is now operational, but unreachable because of a link failure. A forced promotion of the secondary volume has resulted in both the primary and secondary volumes viewing themselves in the primary volume role.
Resolution:	**1** From the Array Management Window of the primary site, select the primary volume. **2** Select Volume >> Remote Volume Mirroring >> Remove Mirror Relationship. **Note** The mirror relationship for the secondary volume will not be removed if there is a connection problem between the disk subsystems. If the mirror relationship still exists at the secondary site, repeat steps 1 and 2 for the secondary volume from the secondary site Array Management Window. **3** Recreate the mirror relationship by completing "Creating a Mirror Relationship Using the Create Remote Volume Mirror Wizard" in Chapter 3.

Both the primary and secondary volumes are displayed as being the secondary volume.	
Cause:	In response to a dual primary volume condition, a role reversal was carried out and the primary volume was demoted to the secondary volume role. The secondary disk subsystem is operational, but unreachable because of a link failure. The forced demotion of the primary volume has resulted in both the primary and secondary volumes viewing themselves in the secondary volume role.
Resolution:	**1** From the Array Management Window of the primary site, select the local secondary volume. **2** Select Volume >> Remote Volume Mirroring >> Remove Mirror Relationship. **Note** The mirror relationship for the secondary site will not be removed if there is a connection problem between the disk subsystems. If the mirror relationship still exists at the secondary site, repeat steps 1 and two for the secondary volume from the secondary site Array Management Window. **3** Recreate the mirror relationship by completing "Creating a Mirror Relationship Using the Create Remote Volume Mirror Wizard" in Chapter 3.

The primary volume/secondary volume is displayed as being a Missing Volume.	
Cause:	A physical hard drive on which a Remote Volume Mirror depends (primary volume, secondary volume) has been removed, and the volume is now displayed under the Missing Volumes node in the Logical View of the Array Management Window.
Resolution:	● If missing volumes are detected because drives have been accidentally removed, or are detected as missing because of a loss of power to the blade modules, recovery of these volumes is possible by: **1** Re-inserting the drives back into the blade module. **2** Ensuring that the blade module's power supplies are properly connected to an operating power source and have an Optimal status. For more information, refer to Recovery Guru or contact technical support. ● If the missing volume is no longer required, it may be deleted. **Important** Deleting a missing volume is a permanent action. Any associated volumes or volume-to-LUN mappings will also be deleted. For more information, refer to the Recovery Guru or the Array Management Window online help.

The mirror relationship was removed successfully from the primary side, but not from the secondary side.	
Cause:	When removing a mirror relationship, a link failure occurred between the primary and secondary disk subsystems, and an error message was displayed. The Array Management Window for the primary disk subsystem indicates that the mirror relationship has been removed successfully, however, the Array Management Window for the secondary disk subsystem indicates that the mirror relationship still exists.
Resolution:	Open the Array Management Window for the secondary disk subsystem and remove the mirror relationship. For step-by-step instructions, refer to"Removing Mirror Relationships" on page 3-13 or the Array Management Window online help.

The mirror relationship was removed successfully from the secondary side, but not from the primary side.	
Cause:	When removing a mirror relationship, a link failure occurred between the primary and secondary disk subsystems. The Array Management Window for the secondary disk subsystem indicates that the mirror relationship has been removed successfully, however, the Array Management Window for the primary disk subsystem indicates that the mirror relationship still exists, with the primary volume showing an Unresponsive status.
Resolution:	Open the Array Management Window for the primary disk subsystem and remove the mirror relationship. For step-by-step instructions, refer to"Removing Mirror Relationships" on page 3-13 or the Array Management Window online help.

The primary volume is showing an Unsynchronized status.	
Cause:	The Remote Volume Mirror is in an Unsynchronized status because the data mirrored between the primary volume and secondary volume is no longer identical. Typical causes for this status include link errors, a failed primary volume or secondary volume, or a dual primary or dual secondary error condition. While the Remote Volume Mirror is in an Unsynchronized status, no mirroring activity will take place.
Resolution:	Once the controller owner of the primary volume can communicate with the controller owner of the secondary volume and the volume is online and optimal, a full synchronization will automatically take place. When a full synchronization begins, the Remote Volume Mirror transitions to a Synchronization in Progress status. For information on monitoring the status of a Remote Volume Mirror, refer to the Array Management Window online help.

Error message indicates that the Remote Volume Mirroring premium feature is out of compliance.	
Cause	The Remote Volume Mirroring premium feature is out of compliance. This normally occurs if a volume group with volumes participating in Remote Volume Mirroring, has been moved into the primary disk subsystem and one of the following conditions now exists: ● The Remote Volume Mirroring premium feature is not enabled on the selected disk subsystem. ● The Remote Volume Mirroring feature is enabled, but the current number of Remote Volume Mirrors created on the primary disk subsystem exceeds the number of mirror relationships allowed for this disk subsystem.
Resolution	● If the Remote Volume Mirroring feature is not enabled for the primary disk subsystem: **1** Obtain a feature key for this feature from your storage supplier. **2** Enable the Remote Volume Mirroring premium feature. For step-by-step instructions, refer to Chapter 3, "Using the Remote Volume Mirroring Premium Feature" or the Array Management Window online help. ● If the Remote Volume Mirroring feature is enabled, but the current number of mirror relationships on the disk subsystem exceeds the number of mirror relationships allowed for the disk subsystem, reduce the number of mirror relationships to equal or less than the number of mirror relationships allowed. There can be up to 8 defined mirrors on an 9176 disk subsystem and up to 32 defined mirrors on an D178 or D280 disk subsystem. For step-by step instructions, refer to "Removing Mirror Relationships" on page 3-13 or the Array Management Window online help.

The remote volume candidate is unresponsive and cannot be updated.	
Cause	The primary disk subsystem is unable to notify the secondary disk subsystem that its world wide name (WWN) has changed. This may be the result of a controller in the primary disk subsystem being swapped or removed. disk subsystem recovery procedures that result in configurations being reset could also cause a change to the WWN. The first write to the primary volume will cause the mirrored volume pair to transition into an Unsynchronized status.
Resolution	**1** Remove all the existing mirror relationships from the primary disk subsystem. For step-by-step instructions, refer to "Removing Mirror Relationships" on page 3-13 or the Array Management Window online help. **2** Re-establish the required mirror relationships. For step-by step instructions, refer to "Creating a Mirror Relationship Using the Create Remote Volume Mirror Wizard" on page 3-8 or the Array Management Window online help.

Inappropriate Fibre Channel Fabric Configurations

This section describes Fibre Channel fabric configuration problems that may be encountered after you have configured your disk subsystems and have activated and enabled the Remote Volume Mirroring feature.

Information about the probable cause and recommended resolution for each problem is provided. If your problem is not addressed in this section, refer to the remaining sections in this chapter before contacting technical support.

The primary volume is unable to contact the Fibre Channel fabric.	
Cause:	Typically, this error occurs because of a failed Fibre Channel fabric or because of cabling between the primary and secondary disk subsystems participating in a Remote Volume Mirror.
Resolution:	• If the Fibre Channel fabric has failed: Repair or replace the failed fabric. • If the Fibre Channel fabric is operational: Check the configurations cabling. The cable should not go through a hub or be connected directly between disk subsystems. Ensure that the cable is attached through a switch. For step-by-step instructions on configuring disk subsystems for Remote Volume Mirroring, refer to Chapter 2, “Hardware and Software Installation.”

The primary volume is unable to communicate with the secondary disk subsystem. The primary disk subsystem can still communicate with the fabric.	
Cause:	Typically, this error occurs when the secondary disk subsystem has lost power or when network problems exist between the secondary disk subsystem and the fabric.
Resolution:	• Secondary disk subsystem has no power: If the secondary disk subsystem has no power and is not operational, restore power to the disk subsystem. For information on powering on disk subsystems, refer to your hardware documentation. • Secondary disk subsystem has power and is operational: Check the network status. Ensure the secondary disk subsystem is visible on the network. Ensure the cables are correctly connected. For step-by-step instructions on configuring disk subsystems for Remote Volume Mirroring, refer to Chapter 2, “Hardware and Software Installation.”

Disk Subsystem Component Failures

This section describes the impact of physical or logical disk subsystem component failures on Remote Volume Mirroring functionality.

Information about the probable cause and recommended resolution for each problem is provided. If your problem is not addressed in this section, refer to the remaining sections in this chapter before contacting technical support.

Following a role reversal, a snapshot volume created for a primary volume indicates that it has failed.	
Cause:	The base volume for the snapshot volume is a primary volume involved in a mirror relationship. A role reversal was performed, demoting the primary volume to secondary volume status, resulting in a snapshot volume on the secondary volume. The base volume for a snapshot volume cannot be a candidate for the secondary volume role in a Remote Volume Mirror, and the snapshot volume is therefore failed.
Resolution:	Perform a role reversal to promote the secondary volume to the primary volume role. After the role reversal is complete, the snapshot volume will return to Optimal status. For step-by-step instructions, refer to"Changing a Secondary Volume to a Primary Volume" on page 4-8 or the Array Management Window online help.

The primary disk subsystem controller indicates that it has failed.	
Cause:	Failure of the owning controller on the primary disk subsystem will typically cause the associated multi-path driver on the attached host system to transfer ownership of the alternate controller on the primary disk subsystem. When this occurs, the alternate controller on the primary disk subsystem will begin forwarding newly-written data to its peer on the secondary disk subsystem. The secondary controller will take ownership of the volume from its (secondary) peer controller. This is a reactive event, which occurs because of the arrival of a write request from the primary disk subsystem to the non-owning controller on the secondary disk subsystem.
Resolution:	Allow the ownership transfer to complete. Operations will continue in a normal fashion, with the alternate (typically the non-preferred) controller on the primary disk subsystem interacting with the alternate controller on the secondary disk subsystem. Failure of the non-owning controller on the primary disk subsystem will have no direct impact on the status of any Remote Volume Mirrors.

The secondary disk subsystem controller indicates that it has failed.	
Cause:	One of the following scenarios has occurred: • Controller A on the secondary disk subsystem has failed, while Controller A is the owner of the primary volume. • Controller B on the secondary disk subsystem has failed while Controller B is the owner of the primary volume. In both scenarios, the mirrored volume pair transitions to the Unsynchronized status.
Resolution:	Restore the failed controller. For detailed recovery procedures, refer to Recovery Guru. Upon restoration of the failed controller, the primary disk subsystem will automatically transition to a Synchronizing status to restore coherency between the volumes.

General Switch Troubleshooting

This section describes some common switch-related problems that may be encountered when using the Remote Volume Mirroring feature. The troubleshooting information provided relates to switches supported for use with this version of the storage management software. For a list of supported switches, refer to Chapter 1, “Remote Volume Mirroring Feature Concepts and Requirements.”

Information about the probable cause and recommended resolution for each problem is provided. If your problem is not addressed in this section, refer to the remaining sections in this chapter before contacting technical support.

Host is unable to detect primary and secondary disk subsystems participating in Remote Volume Mirroring.	
Cause:	When two or more switches are cascaded together and have the same Domain ID, hosts will be unable to locate the target device. Each switch must have a unique Domain ID when attempting to cascade two switches together.
Resolution:	Change the Domain ID of one or more of your switches, ensuring that each one is unique. The Domain ID should be a unique number between 1 and 239, which is used to identify the switch to a Fibre Channel fabric. For more information on setting a Domain ID, refer to your switch user documentation.

Remote Volume Mirroring Critical Events

Critical Major Event Log (MEL) events are generated when an error occurs that can affect data availability or results in a degraded mode of operation. The storage management software responds by alerting the appropriate administrators using e-mail, SNMP trap, or other configured mechanisms.

Because administrative action is required to correct the problem, the disk subsystem will generally enter 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.

The following provides a description of critical MEL events, with a brief explanation of what caused the event to trigger, and the recommended resolution. If your problem is not addressed in this section, refer to the remaining sections in this chapter before contacting technical support.

Mirrored pair becomes unsynchronized.	
Cause:	This event is logged when a Remote Volume Mirror transitions to an Unsynchronized status, from either a Synchronization in Progress or Optimal status.
Resolution:	Refer to the associated Recovery Guru message for specific recovery procedures.

Dual-role conflict detected.	
Cause:	This event is logged when a dual-role conflict is detected, and is typically the result of a role reversal. Since both sides of the mirrored volume pair are in the same primary or secondary volume role, both the primary and secondary disk subsystems will report this MEL event.
Resolution:	Refer to the associated Recovery Guru message for specific recovery procedures.

Communication error with the secondary volume on the secondary, remote disk subsystem.	
Cause:	This event is logged when an interruption in the link that cannot be recovered by the firmware Fibre Channel driver is detected. Error codes and recovery procedures will assist the user in finding the exact cause of the communication problem between disk subsystems participating in a mirror relationship.
Resolution:	Refer to the associated Recovery Guru message for specific recovery procedures.

World wide name (WWN) change notification failed.	
Cause:	This event is logged when a disk subsystem detects during start-up processing that its world wide name (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 disk subsystem that had previously been participating in a mirroring relationship with any volume on the array.
Resolution:	Refer to the associated Recovery Guru message for specific recovery procedures.

Controller Firmware Version 5.20 and Higher Upgrades

The Remote Volume Mirroring feature is designed so that it is not necessary for the primary disk subsystem and the secondary storage to be running exactly the same controller firmware level. All inter-controller operations (including those needed for propagation of newly-written data from the primary volume to the secondary volume) have been 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 disk subsystems without any loss of data.

This section describes the procedure that should be followed for upgrading controller firmware (version 5.20 and higher), to ensure that the Remote Volume Mirroring features works as intended. The preferred sequence for performing firmware upgrades on disk subsystems participating in mirror relationships is detailed below.

IMPORTANT By following this sequence, it is possible to avoid transitions of the mirrored volume pair to an Unsynchronized status, avoiding the need for a full resynchronization afterwards.

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1. Stop I/O to applications that operate on all affected primary volumes temporarily inactive.
2. Download firmware to the secondary disk subsystem.
3. Resume application access to primary volumes. There will be a period of time after this step where the primary disk subsystem is operating with a different firmware level than the secondary disk subsystem, but the inter-controller protocols for data replication will support such interactions.
4. Download firmware to the primary disk subsystem.
5. Resume all I/O operations that were stopped in step 1.

End Of Procedure

It should be noted that some configuration operations, such as establishment of new mirrors and modification of mirror parameters, may not be allowed between disk subsystems that have different firmware levels, and will result in error messages being received. However, the key data availability operations, including promotion from the secondary volume to the primary volume, will be allowed in such circumstances.

Glossary

A

Array Management Window (AMW)

A graphical user interface (GUI) from which a user can manage and configure physical components, such as controllers and drives, logical components, such as volumes and volume groups, recover from errors, and monitor performance in a disk subsystem.

See also Logical View, Mappings View, and Physical View.

B

Base Volume

A volume from which you create a snapshot volume. Beginning with version 8.x of the storage management software, a base volume must be a standard volume in the disk subsystem.

D

Disk Subsystem

A storage entity entirely managed by storage management software. A disk subsystem consists of a collection of both physical components (such as drives, controllers, fans, and power supplies) and logical components (such as volume groups and volumes). A disk subsystem can span multiple physical enclosures.

For example, several blade modules connected to a control module constitutes one disk subsystem. A unit that contains drives and a controller in a single enclosure is also considered one disk subsystem. A rackmount subsystem may contain more than one disk subsystem.

Also known as RAID Module.

Dual Primary Remote Volume Mirror Condition

A Remote Volume Mirror containing two primary volumes, instead of one primary volume and one secondary volume.

This error condition is created when a catastrophic failure has taken place on the disk subsystem that contains the primary volume. The secondary volume was promoted to be the primary volume so that business operations could continue. A forced role reversal was performed because the primary site could not be contacted. The disk subsystem at the original primary site was then restored.

Dual Secondary Remote Volume Mirror Condition

A Remote Volume Mirror containing two secondary volumes, instead of one secondary volume and one primary volume.

This error condition occurs when the Change to Secondary option is used under ordinary conditions to perform a role reversal. An inter-site communication failure interrupted the promotion of the original secondary volume to become the primary volume of the mirrored pair. A decision was made to proceed with the role reversal despite the fact that the original secondary volume could not be promoted. This is an example of a forced role reversal.

Because secondary volumes cannot be accessed by hosts for I/O purposes, the condition must be corrected to promote one of the secondary volumes to be the primary volume of the mirrored pair.

E

Enterprise Management Window (EMW)

A graphical user interface (GUI) from which a user can manage disk subsystems, monitor the health of the disk subsystems, configure e-mail and Simple Network Management Protocol (SNMP) alert notifications, launch an appropriate Array Management Window for a particular disk subsystem, or edit and execute a script to perform batch management tasks.

F

Feature Key File

The disk subsystem controller uses this file to enable an authorized premium feature. The file contains the Feature Enable Identifier of the disk subsystem for which the premium feature is authorized and generates data about the premium feature to be enabled.

Full Synchronization

The copy of all data on the primary volume to the secondary volume. A full synchronization occurs when the Remote Volume Mirror is created. A full synchronization also happens automatically after a link interruption or volume error that caused a Remote Volume Mirror to become unsynchronized is corrected.

The controller owner of the primary volume in the mirrored pair performs this operation in the background, while it is writing host I/O to the primary volume and sending associated remote writes to the secondary volume. You set a synchronization priority to determine how the controller owner of the primary volume will prioritize the full synchronization relative to the I/O activity.

M

Mirror Repository Volume

A special volume in the disk subsystem created as a resource for the controller owner of the primary volume in a Remote Volume Mirror. The controller stores mirroring information on this volume, including information about remote writes that are not yet written to the secondary volume. The controller can use this information to recover when the disk subsystem is powered on and off or when there is a controller reset.

When you activate the Remote Volume Mirroring premium feature on the disk subsystem, you create two mirror repository volumes, one for each controller in the disk subsystem. The mirror repository volume for a controller stores information about *every* Remote Volume Mirror that contains a primary volume owned by this controller. An individual mirror repository volume is not needed for each Remote Volume Mirror.

When you create the mirror repository volumes, you specify placement of the volumes. You can use either existing free capacity or create a volume group for the volumes from unconfigured capacity and specify the RAID level.

Mirror Synchronization in Progress Status

An operational state reported through the graphical user interface (GUI) that shows that a full synchronization is occurring between the primary volume and the secondary volume of a Remote Volume Mirror.

When the full synchronization is completed, the Remote Volume Mirror transitions to a Mirror Synchronized status.

Mirror Synchronized Status

An operational state reported through the graphical user interface (GUI) that shows that an identical copy of the data on the primary volume in a Remote Volume Mirror is present on the secondary volume.

Mirror Unsynchronized Status

An operational state reported through the graphical user interface (GUI) that shows that the data on the primary volume in a Remote Volume Mirror is not currently replicated identically on the secondary volume. Some causes for this status include link errors, a failed primary volume or secondary volume, or a dual primary or dual secondary error condition.

While the Remote Volume Mirror is in an Unsynchronized status, no mirroring activity takes place. When the controller owner of the primary volume can communicate with the controller owner of the secondary volume and the volume is online and optimal, then a full synchronization can take place. When a full synchronization begins, the Remote Volume Mirror transitions to a Mirror Synchronization in Progress status.

Missing Volume

A placeholder node displayed in the Logical View, indicating that the disk subsystem has detected that drives associated with a volume are no longer accessible. Typically, this is the result of removing drives associated with a volume group or when there is a loss of power to one or more blade modules.

Missing volumes are identified by their world wide name and are displayed below the Unconfigured Capacity node or directly below the disk subsystem or root node. They are identified as being standard volumes, base volumes, snapshot volumes, snapshot repository volumes, primary volumes, secondary volumes, or mirror repository volumes.

P

Primary Volume

A volume in a Remote Volume Mirror that accepts host I/O and stores application data. The data on a primary volume is replicated to the secondary volume.

The controller owner of the primary volume initiates remote writes to the secondary volume to keep the data on the two volumes synchronized.

The controller owner of the primary volume initiates a full synchronization after a link interruption or volume error that caused a Remote Volume Mirror to become unsynchronized is corrected.

R

Remote Volume Mirror

A mirrored volume pair that consists of a primary volume at the primary site and a secondary volume at a secondary, remote site. A Remote Volume Mirror is also referred to as a Remote Mirror.

The secondary, remote volume is unavailable to secondary host applications while mirroring is underway. In the event of disaster at the primary site, you can fail over to the secondary site by performing a role reversal to promote the secondary volume to a primary volume. Then the recovery host will be able to access the newly promoted volume and business operations can continue.

Remote Volume Mirroring Premium Feature

This feature allows you to create Remote Volume Mirrors to replicate data from a primary volume to a secondary volume.

Remote Write

Remote writes keep data on the secondary volume synchronized with data on the primary volume.

After the controller owner of a primary volume receives a host I/O write request and writes the data to the primary volume, the controller initiates a remote write to copy data blocks that have changed on the primary volume to the secondary volume.

Role Reversal

The act of promoting the secondary volume to be the primary volume of the mirrored volume pair, and demoting the primary volume to be the secondary volume.

Both options result in the promotion of the secondary volume and the demotion of the primary volume to effect the role reversal.

If communication with the remote disk subsystem is down, you can force a role reversal even when there will be a resulting dual-primary or dual-secondary condition. Use the Recovery Guru to recover from one of those conditions after communication is restored with the remote disk subsystem.

S

Secondary Volume

This volume is used to store replicated data from a primary volume. The controller owner of a secondary volume receives remote writes for the volume from the controller owner of the primary volume. The controller owner of the secondary volume does not accept host read or write requests.

Snapshot Repository Volume

A special volume in the disk subsystem created as a resource for a snapshot volume. A snapshot repository volume contains snapshot data and copy-on-write data for a particular snapshot volume.

A snapshot repository volume is not host-addressable, but you can increase its capacity, rename it, specify the action (either failing it or failing writes to the base volume) when it becomes full, or view its capacity or media scan properties.

Snapshot Volume

A logical point-in-time image of another volume, called a base volume, in the disk subsystem. A snapshot is the logical equivalent of a complete physical copy, but you create it much more quickly than a physical copy and it requires less disk space.

Because a snapshot is a host-addressable volume, you can perform backups using the snapshot while the base volume remains online and user-accessible. In addition, you can write to the snapshot volume to perform application testing or scenario development and analysis.

Standard Volume

A logical structure you create on a disk subsystem for data storage.

Storage Partition

A logical entity consisting of one or more disk subsystem volumes that can be shared among hosts that are part of a host group or accessed by a single host. A Storage Partition is created when you define a collection of hosts (a host group) or a single host and then define a volume-to-logical unit number (LUN) mapping. This mapping allows you to define what host group or host will have access to a particular volume in your disk subsystem.

Synchronization Priority Level

The controller owner of a primary volume performs a full synchronization in the background while processing local I/O writes to the primary volume and associated remote writes to the secondary volume. Because the full synchronization diverts controller processing resources from I/O activity, it can have a performance impact to the host application.

You can choose from five different synchronization priorities for the primary controller owner, ranging from Lowest to Highest, that determines how much of a priority the full synchronization will be relative to host I/O activity and, therefore, how much of a performance impact there will be. The following guidelines roughly approximate the differences between the five priorities. Note that volume size can cause these estimates to vary widely.

- A full synchronization at the Lowest Synchronization Priority Level will take approximately eight times as long as a full synchronization at the Highest Synchronization Priority Level.
- A full synchronization at the Low Synchronization Priority Level will take approximately six times as long as a full synchronization at the Highest Synchronization Priority Level.
- A full synchronization at the Medium Synchronization Priority Level will take approximately three and a half times as long as a full synchronization at the Highest Synchronization Priority Level.
- A full synchronization at the High Synchronization Priority Level will take approximately twice as long as a full synchronization at the Highest Synchronization Priority Level.

You set the Synchronization Priority Level when you create the Remote Volume Mirror, or you can change it later using the Change Synchronization Priority option. Although the primary controller owner performs the full synchronization and uses the synchronization priority, it is set for both the primary and secondary volumes during Remote Volume Mirror creation in case of a role reversal.

U

Usable Capacity

The usable capacity of a volume participating in a mirroring relationship is the minimum of the primary volume and secondary volume actual capacities.

In a given Array Management Window, all primary or secondary volumes present in the same disk subsystem display both actual and usable capacity in the Logical View.

All primary or secondary volumes that are remote (present in a different disk subsystem) display only their actual capacity in the Logical View.

V

Volume

A logical structure you create on a disk subsystem for data storage. A volume is defined over a set of drives called a volume group, and has a defined random array of Independent disks (RAID) level and capacity. The drive boundaries of the volume group are hidden to the host computer.

Also known as Logical Unit Number (LUN).

Volume Group

A set of drives that the controller logically groups together to provide one or more volumes to an application host.

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