IBM System Storage SAN Volume Controller

# Host Attachment User's Guide

*Version 4.2.1*

SC26-7905-02

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**Note:**
Before using this information and the product it supports, read the information in **Notices**.

This edition applies to the IBM System Storage SAN Volume Controller, release 4.2.1, and to all subsequent releases and modifications until otherwise indicated in new editions. This edition replaces SC26-7905-01.

# Contents

# Figures

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# About this guide

This guide provides information that is required when you are attaching the IBM System Storage SAN Volume Controller to an open-systems host with fibre-channel adapters.

Each chapter describes how to attach a SAN Volume Controller to a specific open-systems host with fibre-channel adapters.

## Who should use this guide

This guide is intended for system administrators or others who install and use the SAN Volume Controller.

Before using the SAN Volume Controller, you should have an understanding of storage area networks (SANs), the storage requirements of your enterprise, and the capabilities of your storage units.

## Summary of changes

This document contains terminology, maintenance, and editorial changes.

Technical changes or additions to the text and illustrations for the latest release are indicated by a vertical line to the left of the change.

The topics in the summary of changes describe new functions that have been added to this release and to the previous release.

### Summary of changes for SC26-7905-02 SAN Volume Controller Host Attachment User's Guide

The following list includes changes to this guide since the previous edition (SC26-7905-01).

#### New information

There was no new information added to this document.

#### Changed information

This section lists the updates that were made in this document.

The following information has been updated:

- "Setting the Sun SPARC host parameters for use with MPxIO" on page 85
- "Configuring the Data ONTAP software for IBM N Series, NetApp V-Series or gFiler NAS servers" on page 71
- "Configuring the HP 9000 and HP Integrity servers operating system" on page 6
- "AIX environments for IBM System p hosts" on page 23

#### Removed information

There was no information removed from this document.

# Summary of changes for SC26-7905-01 SAN Volume Controller Host Attachment Guide

The following list includes changes to this guide since the previous edition (SC26-7905-00).

## New information

This edition includes the following new information:

- The SAN Volume Controller now supports the following servers:
  - HP Integrity
  - SGI Origin
- The SAN Volume Controller now supports the following operating systems:
  - HP-UX 11iV3,
  - RHEL 5.0
- The SAN Volume Controller now supports the following processors:
  - AMD Opteron
  - AMD 64
  - Intel IA32
  - Intel IA32e
  - Intel EM64T
  - Intel Itanium

## Changed information

This section lists the updates that were made in this document.

- There is a new SAN Volume Controller supported model. The SAN Volume Controller is now documented by model number. For example, this publication describes four SAN Volume Controller models types: SAN Volume Controller 2145-4F2, the SAN Volume Controller 2145-8F2, SAN Volume Controller 2145-8F4, and the new SAN Volume Controller 2145-8G4.

  **Note:** Text that refers to the SAN Volume Controller refers to a generic SAN Volume Controller but can also be refer to all SAN Volume Controller models. When the SAN Volume Controller is referred to as the SAN Volume Controller 2145-4F2, the SAN Volume Controller 2145-8F2, SAN Volume Controller 2145-8F4, or the SAN Volume Controller 2145-8G4, only that specific SAN Volume Controller is designated.
- The *IBM System Storage SAN Volume Controller Configuration Guide* is now titled *IBM System Storage SAN Volume Controller: Software Installation and Configuration Guide*.
- The *IBM System Storage SAN Volume Controller Installation Guide* is now titled *IBM System Storage SAN Volume Controller: Hardware Installation Guide*.
- The *IBM System Storage Master Console for SAN Volume Controller: Installation and User's Guide* and the *IBM System Storage Master Console for SAN Volume Controller* Information Center are no longer updated and distributed. Instead, all pertinent information from those information units has been incorporated into other SAN Volume Controller publications.

## Removed information

There was no information removed from this document.

## Emphasis

Different typefaces are used in this guide to show emphasis.

The following typefaces are used to show emphasis:

| | |
|---|---|
| **Boldface** | Text in **boldface** represents menu items and command names. |
| *Italics* | Text in *italics* is used to emphasize a word. In command syntax, it is used for variables for which you supply actual values, such as a default directory or the name of a cluster. |
| `Monospace` | Text in `monospace` identifies the data or commands that you type, samples of command output, examples of program code or messages from the system, or names of command flags, parameters, arguments, and name-value pairs. |

## SAN Volume Controller library and related publications

A list of other publications that are related to this product are provided to you for your reference.

The tables in this section list and describe the following publications:

- The publications that make up the library for the IBM System Storage SAN Volume Controller
- Other IBM publications that relate to the SAN Volume Controller

### SAN Volume Controller library

The following table lists and describes the publications that make up the SAN Volume Controller library. Unless otherwise noted, these publications are available in Adobe portable document format (PDF) from the following Web site:

http://www.ibm.com/storage/support/2145

| Title | Description | Order number |
|---|---|---|
| *IBM System Storage SAN Volume Controller: CIM Agent Developer's Reference* | This reference guide describes the objects and classes in a Common Information Model (CIM) environment. | SC26-7904 |
| *IBM System Storage SAN Volume Controller: Command-Line Interface User's Guide* | This guide describes the commands that you can use from the SAN Volume Controller command-line interface (CLI). | SC26-7903 |
| *IBM System Storage SAN Volume Controller: Software Installation and Configuration Guide* | This guide provides guidelines for configuring your SAN Volume Controller. | SC23-6628 |

| Title | Description | Order number |
| --- | --- | --- |
| *IBM System Storage SAN Volume Controller: Host Attachment Guide* | This guide provides guidelines for attaching the SAN Volume Controller to your host system. | SC26-7905 |
| *IBM System Storage SAN Volume Controller: Hardware Installation Guide* | This guide includes the instructions that the IBM service representative uses to install the SAN Volume Controller. | GC27-2132 |
| *IBM System Storage SAN Volume Controller: Planning Guide* | This guide introduces the SAN Volume Controller and lists the features you can order. It also provides guidelines for planning the installation and configuration of the SAN Volume Controller. | GA32-0551 |
| *IBM System Storage SAN Volume Controller: Service Guide* | This guide includes the instructions that the IBM service representative uses to service the SAN Volume Controller. | GC26-7901 |
| *IBM Systems Safety Notices* | This guide contains translated caution and danger statements. Each caution and danger statement in the SAN Volume Controller documentation has a number that you can use to locate the corresponding statement in your language in the *IBM Systems Safety Notices* document. | G229-9054 |

## Other IBM publications

The following table lists and describes other IBM publications that contain additional information that is related to the SAN Volume Controller.

You can download IBM eServer xSeries, IBM xSeries, and IBM System x publications from the following Web site:

http://www-304.ibm.com/jct01004c/systems/support/

| Title | Description | Order number |
|---|---|---|
| *IBM System Storage Multipath Subsystem Device Driver: User's Guide* | This guide describes the IBM System Storage Multipath Subsystem Device Driver Version 1.6 for TotalStorage Products and how to use it with the SAN Volume Controller. This publication is referred to as the *IBM System Storage Multipath Subsystem Device Driver: User's Guide*. | GC27-2122 |
| *IBM TotalStorage DS4300 Fibre Channel Storage Subsystem Installation, User's, and Maintenance Guide* | This guide describes how to install and configure the IBM TotalStorage DS4300 Fibre-Channel Storage Subsystem. | GC26-7722 |
| *IBM eServer xSeries 306m (Types 8849 and 8491) Installation Guide* | This guide describes how to install the IBM eServer xSeries 306m, which is the hardware delivered for some versions of the hardware master console. | MIGR-61615 |
| *IBM xSeries 306m (Types 8849 and 8491) User's Guide* | This guide describes how to use the IBM eServer xSeries 306m, which is the hardware delivered for some versions of the hardware master console. | MIGR-61901 |
| *IBM xSeries 306m (Types 8849 and 8491) Problem Determination and Service Guide* | This guide can help you troubleshoot and resolve problems with the IBM eServer xSeries 306m, which is the hardware delivered for some versions of the hardware master console. | MIGR-62594 |
| *IBM eServer xSeries 306 (Type 8836) Installation Guide* | This guide describes how to install the IBM eServer xSeries 306, which is the hardware delivered for some versions of the hardware master console. | MIGR-55080 |
| *IBM eServer xSeries 306 (Type 8836) User's Guide* | This guide describes how to use the IBM eServer xSeries 306, which is the hardware delivered for some versions of the hardware master console. | MIGR-55079 |
| *IBM eServer xSeries 306 (Types 1878, 8489 and 8836) Hardware Maintenance Manual and Troubleshooting Guide* | This guide can help you troubleshoot problems and maintain the IBM eServer xSeries 306, which is the hardware delivered for some versions of the hardware master console. | MIGR-54820 |

| Title | Description | Order number |
| --- | --- | --- |
| *IBM eServer xSeries 305 (Type 8673) Installation Guide* | This guide describes how to install the IBM eServer xSeries 305, which is the hardware delivered for some versions of the hardware master console. | MIGR-44200 |
| *IBM eServer xSeries 305 (Type 8673) User's Guide* | This guide describes how to use the IBM eServer xSeries 305, which is the hardware delivered for some versions of the hardware master console. | MIGR-44199 |
| *IBM eServer xSeries 305 (Type 8673) Hardware Maintenance Manual and Troubleshooting Guide* | This guide can help you troubleshoot problems and maintain the IBM eServer xSeries 305, which is the hardware delivered for some versions of the hardware master console. | MIGR-44094 |
| *IBM TotalStorage 3534 Model F08 SAN Fibre Channel Switch User's Guide* | This guide introduces the IBM TotalStorage SAN Switch 3534 Model F08. | GC26-7454 |
| *IBM System x3250 (Types 4364 and 4365) Installation Guide* | This guide describes how to install the IBM System x3250, which is the hardware delivered for some versions of the hardware master console. | MIGR-5069761 |
| *IBM System x3250 (Types 4364 and 4365) User's Guide* | This guide describes how to use the IBM System x3250, which is the hardware delivered for some versions of the hardware master console. | MIGR-66373 |
| *IBM System x3250 (Types 4364 and 4365) Problem Determination and Service Guide* | This guide can help you troubleshoot and resolve problems with the IBM System x3250, which is the hardware delivered for some versions of the hardware master console. | MIGR-66374 |
| *IBM TotalStorage SAN Switch 2109 Model F16 User's Guide* | This guide introduces the IBM TotalStorage SAN Switch 2109 Model F16. | GC26-7439 |
| *IBM TotalStorage SAN Switch 2109 Model F32 User's Guide* | This guide introduces the IBM TotalStorage SAN Switch 2109 Model F32. It also describes the features of the switch and tells you where to find more information about those features. | GC26-7517 |

| Title | Description | Order number |
|---|---|---|
| *IBM System Storage Productivity Center Introduction and Planning Guide* | This guide introduces the IBM System Storage Productivity Center hardware and software. | SC23-8824 |
| *IBM System Storage Productivity Center Hardware Installation and Configuration Guide* | This guide describes how to install and configure the IBM System Storage Productivity Center hardware. | SC23-8822 |
| *IBM System Storage Productivity Center Software Installation and User's Guide* | This guide describes how to install and use the IBM System Storage Productivity Center software. | SC23-8823 |

Some related publications are available from the following SAN Volume Controller support Web site:

http://www.ibm.com/storage/support/2145

## Related Web sites

The following Web sites provide information about the SAN Volume Controller or related products or technologies.

| Type of information | Web site |
|---|---|
| SAN Volume Controller support | http://www.ibm.com/storage/support/2145 |
| Technical support for IBM storage products | http://www.ibm.com/storage/support/ |

## How to order IBM publications

The IBM publications center is a worldwide central repository for IBM product publications and marketing material.

The IBM publications center offers customized search functions to help you find the publications that you need. Some publications are available for you to view or download free of charge. You can also order publications. The publications center displays prices in your local currency. You can access the IBM publications center through the following Web site:

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

## How to send your comments

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- e-mail

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  starpubs@us.ibm.com

Be sure to include the name and order number of the book and, if applicable, the specific location of the text you are commenting on, such as a page number or table number.

- Mail

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  International Business Machines Corporation
  RCF Processing Department
  Department 61C
  9032 South Rita Road
  Tucson, Arizona 85775-4401
  U.S.A.

# Chapter 1. Host attachment overview for the IBM System Storage SAN Volume Controller

The IBM System Storage SAN Volume Controller supports IBM and non-IBM storage systems hosts so that you can consolidate storage capacity and workloads for open-systems hosts into a single storage pool. The storage pool can then be managed from a central point on the SAN (storage area network).

By allowing you to attach hosts from different vendors, the SAN Volume Controller offers you the following advantages:

- Makes your storage easier to manage
- Increases utilization of your data
- Allows you to apply advanced Copy Services functions across storage systems from many different vendors

## Open-systems hosts

You can attach the SAN Volume Controller to open-systems hosts that use the small computer system interface-fibre channel protocol (SCSI-FCP). You can also attach the SAN Volume Controller to iSCSI (small computer system interface over internet protocol) hosts that are attached to a Cisco fabric.

The SAN Volume Controller supports connection to the Cisco MDS 9000 SAN-OS Software Release 2.1 for the Cisco MDS 9000 Family platform with the attached iSCSI hosts (in single path mode only). See the following Web site for the latest support information:

http://www.ibm.com/storage/support/2145

**Note: Guidelines for zoning iSCSI hosts and the SAN Volume Controller:**

In a conventional fibre-channel SAN, there are a number of SAN paths between a particular SAN Volume Controller I/O group and the server HBA ports that use the VDisks that are supplied by that I/O group. A multipathing device driver resolves these multiple paths into a single logical device on which the server can perform I/O. The multipathing device driver also provides failover and path recovery functions for SAN fabric paths that change or fail.

The present iSCSI solution, however, only supports a single path between the iSCSI host network information center (NIC) and the SAN Volume Controller VDisk. There is no multipathing driver in the iSCSI host. Therefore, there is no recovery from errors and it is not possible to concurrently upgrade the SAN Volume Controller software while maintaining connectivity with an iSCSI host system. It is, thus, inappropriate for the SAN Volume Controller to present the VDisk to multiple ports in the fibre-channel SAN. To prevent this, you must select a single SAN Volume Controller port in each SAN Volume Controller I/O group that is to be associated with each iSCSI host. Zoning is then applied in the Cisco MDS switch so that each iSCSI host can only see one SAN Volume Controller port in each SAN Volume Controller I/O group. If multiple iSCSI hosts are in use, the hosts should be evenly spread across the ports in each SAN Volume

Controller I/O group. Issue the `svctask mkvdiskhostmap` command to ensure that each SAN Volume Controller VDisk is mapped to a single NIC in the server.

Hosts are attached to the SAN Volume Controller through a switched fibre-channel fabric. Each SAN Volume Controller node has four ports, and each port is identified by a worldwide port name (WWPN).

The SAN Volume Controller does not limit the number of fibre-channel ports or host bus adapters (HBAs) that each connected host or host partition can have. Your connected hosts are limited only by the number of ports or HBAs that are supported by the multipathing device driver on the host (or host partition).

The following IBM Web site provides current interoperability information about current support information, including maximum configuration details, technical flashes, hints and tips, host systems, operating system levels, HBAs, cables, fabrics that IBM supports, and documentation about the SAN Volume Controller:

http://www.ibm.com/storage/support/2145

## LUNs

The SAN Volume Controller supports a maximum of 1024 LUNs per I/O group, with a maximum of 512 configured to any one host.

**Note:** Not all hosts support 512 LUNs.

Each virtual disk that is created on the SAN Volume Controller can be mapped to multiple HBA fibre-channel ports in a given host. There can also be multiple paths across the SAN. For these reasons, each host must run multipathing software, such as the subsystem device driver (SDD). The multipathing software manages the many paths that are available to the virtual disk and presents a single storage device to the operating system. The SAN Volume Controller supports a variety of multipathing software. The specific multipathing software that is supported by the SAN Volume Controller depends on the host operating system with which it is being used.

- The number of paths through the network from the SAN Volume Controller nodes to a host must not exceed 8. Configurations in which this number is exceeded are unsupported.
  - Each SAN Volume Controller node has four ports and each I/O group has two SAN Volume Controller nodes. Therefore, without any zoning, the number of paths to a VDisk is 8 × the number of host ports.
  - This rule exists to limit the number of paths that must be resolved by the multipathing device driver.

If you want to restrict the number of paths to a host, zone the switches so that each HBA port is zoned with one SAN Volume Controller port for each node in the cluster. If a host has multiple HBA ports, zone each port to a different set of SAN Volume Controller ports to maximize performance and redundancy.

## Copy Services support

You can use the FlashCopy®, Metro Mirror, or Global Mirror Copy Services functions for SAN Volume Controller across the host storage systems to help further simplify operations.

The following requirements and restrictions apply to FlashCopy, Metro Mirror, and Global Mirror functions:

- If you require concurrent read/write access to both the source and target volumes, be sure that the source volume resides on a different host system than the target volume. A copy operation from a source volume to a target volume that is on the same host system creates a target volume with the same identification as the source volume. The host system sees two identical volumes.
- When the copy operation creates the same identification for the target volume as for the source volume, you cannot distinguish one from the other. Therefore, you might not be able to access the original data.
- The target volume and the source volume can be on the same host system for a Metro Mirror, Global Mirror, or FlashCopy operation only under the following conditions:
  - For the AIX® operating system, when the host is using a logical volume manager (LVM) with **recreatevg** command.
  - For HP, when the host is using LVM with the **vfchigid -f** command.
  - For the AIX and Sun operating systems, when the host is *not* using an LVM.
  - For host systems that run the VERITAS Volume Manager, the SAN Volume Controller sets a bit in the inquiry data that enables the VERITAS Volume Manager to distinguish between the source and target virtual disks (VDisks) for those mapping states where the source and target VDisks might be identical copies.
  - For any host system, when the host system can distinguish between a source and a target volume that has the same identification.

# Chapter 2. Attaching to HP 9000 and HP Integrity servers

This information provides the requirements and instructions for attaching the SAN Volume Controller to HP 9000 and HP Integrity servers.

## Attachment requirements for HP 9000 and HP Integrity servers

You must be aware of the requirements for attaching the SAN Volume Controller to HP 9000 and HP Integrity servers.

You must meet the following requirements before you can attach the SAN Volume Controller to your host system:

- Check the LUN limitations for your host system. Ensure that there are enough Fibre Channel adapters that are installed in the server to manage the total LUNs that you want to attach.

  **Note:** If you want to use more than eight LUNs per SCSI target, you must set the type attribute to `hpux` when you create the host object. You can use the SAN Volume Controller command-line interface or the SAN Volume Controller Console to set this attribute.
- Ensure that you have the documentation for your HP system and the *IBM System Storage SAN Volume Controller: Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  http://www.ibm.com/storage/support/2145
- Ensure that you have installed the correct operating systems and version levels on your host. See the supported software levels for the SAN Volume Controller at the following Web site for details about the release level for your operating system:

  http://www.ibm.com/storage/support/2145

### Environments for HP 9000 and HP Integrity servers

Ensure that your HP 9000 and HP Integrity servers use a supported operating system and level.

The following Web page provides current interoperability information about supported operating system levels:

http://www.ibm.com/storage/support/2145

### HBAs for HP hosts

Ensure that your HP hosts use the correct host bus adapters (HBAs).

The following IBM Web site provides current interoperability information about supported HBAs and platform levels:

http://www.ibm.com/storage/support/2145

### Drivers and firmware for HP hosts

Be sure that you use the correct host bus adapter device driver and firmware levels for your HP hosts.

The following IBM Web site provides current interoperability information about supported device driver and firmware levels:

http://www.ibm.com/storage/support/2145

## Installing HBA drivers for HP 9000 and HP Integrity servers

After you install the host bus adapter (HBA), you must download and configure the appropriate HBA driver.

Perform the following tasks to install the HBA driver:

1. Obtain the appropriate HBA driver using the following steps:
   a. Go to the supported hardware list on the following Web page. Find the sections for the HP operating system and then the HBA that is installed on your host machine.

      http://www.ibm.com/storage/support/2145

      The specific versions of the driver is indicated on the hardware list.
   b. Note the version number of the driver.
   c. Obtain the driver from Hewlett-Packard.
2. Install the driver according to the documentation that is provided with the driver.

After installing the adapters and drivers, you can verify their status using the `fcmsutil /dev/td`*x* command, where *x* is the number of the adapter, which normally begins with 0.

After storage has been configured and mapped to the host, you can discover the disks by running `ioscan -f -n`. The disks are discovered as IBM® 2145 disks, and the number of discovered devices depends on the number of adapters and zoned paths to the SAN Volume Controller.

After discovering the disks, run `insf -e` to build the device nodes in the `/dev/dsk` and `/dev/rdsk` directories. When this is done, you can build your host disk devices using the subsystem device driver (SDD). For more information, see *IBM System Storage Multipath Subsystem Device Driver: User's Guide*.

**Note:** If you use a Cisco MDS 9000 Family switch with the HP-UX 11i operating system, you must ensure that you enable the Cisco persistent FC (fibre channel) ID feature. See your Cisco manual for more information.

## Configuring the HP 9000 and HP Integrity servers operating system

You must configure the operating system before you can use these servers with the SAN Volume Controller.

Before you configure the host operating system, the following tasks must be completed:

- The IBM service representative must have installed the SAN Volume Controller.
- You must have installed the appropriate host bus adapter (HBA) and driver on your host system.

After the prerequisite tasks are complete, use the following general steps to configure your host system:

1. Zone the host system to the SAN Volume Controller on the Fibre Channel SAN.
2. Install the appropriate multipathing driver for your host system to enable the management of multiple paths to SAN Volume Controller virtual disks (VDisks).

   **Notes:**

   a. The subsystem device driver (SDD) only supports the HP-UX 11iv1 and HP-UX 11iv2 operating systems in a clustering environment. The subsystem device driver (SDD) does not support the HP-UX 11.0 operating systems in a clustering environment.
   b. SDD does not support an HP-UX 32-bit mode operating environment.
   c. To have failover protection on an open system, SDD requires a minimum of two fibre-channel adapters. The maximum number of supported fibre-channel adapters is four, on a total of four fibre-channel ports.
3. Create the host system on the SAN Volume Controller using the worldwide port names (WWPNs). Map the VDisks to the host as required.
4. Create volumes/disks on your host using instructions in your host system publications.

## Multipath support for HP 9000 and HP Integrity servers

The SAN Volume Controller supports multipathing for HP 9000 and HP Integrity servers.

Multipathing support is available using either of the following software:

- Subsystem device driver (SDD)
- HP PVLinks (physical volume links)

### SDD dynamic pathing on HP 9000 and HP Integrity servers

HP 9000 and HP Integrity servers support subsystem device driver (SDD) dynamic pathing when you add more paths to a virtual disk (VDisk) or when you present a new VDisk to a host.

For HP 9000 and HP Integrity servers, SDD is aware of the preferred paths that are set by SAN Volume Controller for each VDisk. During failover processing, SDD tries the first preferred path, then the next known preferred path, and so on, until it has tried all preferred paths. If SDD cannot find an available path using the preferred paths, it tries nonpreferred paths. If all paths are unavailable, the VDisk goes offline. SDD performs load balancing across the preferred paths where appropriate.

### PVLinks dynamic pathing on HP 9000 and HP Integrity servers

HP 9000 and HP Integrity servers support HP PVLinks (physical volume links) dynamic pathing when you add more paths to a virtual disk (VDisk) or when you present a new VDisk to a host.

Unlike the subsystem device driver (SDD), PVLinks does *not* balance I/O loads and is unaware of the preferred paths that are set by the SAN Volume Controller for each VDisk. Therefore SDD is strongly recommended, unless you are using a clustering environment or if you are using a VDisk as your boot disk.

During failover processing, PVLinks uses a simple algorithm: it tries the first path, then the next known path, and so on, until it has tried all paths. If all paths are unavailable, the VDisk goes offline.

If you use PVLinks, keep the following configuration considerations in mind:

- When you create a volume group, be sure to perform the following actions:
  - Specify the primary path that you want the host to use when it accesses the physical volume that is presented by the SAN Volume Controller. This is the only path that can access the physical volume. (The preferred path to the VDisk that is set by the SAN Volume Controller is ignored.)
  - Ensure that the primary links to the physical volumes (and, thus, the load) are balanced over the host bus adapters (HBAs), the Fibre Channel switches, SAN Volume Controller nodes, and any other devices.
- When you add alternate paths to the physical volume and extend a volume group, add the new paths in the preferred order that you want the host to use if the primary path becomes unavailable. To avoid unnecessary node failover due to HBA, Fibre Channel link, or Fibre Channel switch failure, ensure that the first alternate path that you add is from the same SAN Volume Controller node as the primary path.

### Multipathing configuration maximums for HP 9000 and HP Integrity servers

Ensure that you are aware of the configuration maximums for the subsystem device driver (SDD) on HP 9000 and HP Integrity servers.

The following table provides the maximum virtual disks (VDisks) and paths per VDisk for SDD:

| Object | SDD maximum | Description |
|---|---|---|
| VDisk (HDisk) | 512 | The maximum number of VDisks that can be supported by the SDD (per host object). |
| Paths per VDisk | 4 | The maximum number of paths to each VDisk. |

### Coexistence of SDD and PVLinks on HP 9000 and HP Integrity servers

If you want to use PVLinks (physical volume links) for multipathing a VDisk while the subsystem device driver (SDD) is installed, you must ensure that SDD does not configure a vpath for that VDisk.

To do this, add the serial number of any VDisks that you want SDD to ignore in the /etc/vpathmanualexcl.cfg file.

**Note:** If you are using the SAN boot function, SDD automatically ignores the boot VDisk.

## Clustering support for HP 9000 and HP Integrity servers

The SAN Volume Controller provides clustering support for HP 9000 and HP Integrity servers.

See the following Web site for supported cluster software and other information:

http://www.ibm.com/storage/support/2145

**Restriction:** HP-UX does not currently support the use of high availability monitors to monitor disks that are presented by the SAN Volume Controller.

## SAN boot support for HP 9000 and HP Integrity servers

The SAN Volume Controller provides san boot support for HP 9000 and HP Integrity servers.

For the HP-UX operating system, use HP PVLinks (physical volume links) as the multipathing software on the boot device. PVLinks or the subsystem device driver (SDD) provides the multipathing support for the other devices that are attached to the system.

The following Web site provides information about known restrictions for SAN boot support:

http://www.ibm.com/storage/support/2145

### Migrating existing SAN boot images

If you have an HP host and existing SAN boot images that are controlled by storage controllers, you can migrate these images to image-mode virtual disks (VDisks) that are controlled by the SAN Volume Controller.

Perform the following steps to migrate your existing SAN boot images:

1. Shut down the host.
2. Perform the following configuration changes on the storage controller:
   a. Remove all the image-to-host mappings from the storage controller.
   b. Map the existing SAN boot image and any other disks being migrated to SAN Volume Controller control.
3. Zone one port of each host bus adapter (HBA) to one of the SAN Volume Controller ports that is associated with the I/O group for the target image-mode VDisk.
4. Perform the following configuration changes on the SAN Volume Controller:
   a. Create an image-mode VDisk for the managed disk (MDisk) that contains the SAN boot image. Use the MDisk unique identifier to specify the correct MDisk.
   b. Create a host object and assign it to the HBA port that you zoned to SAN Volume Controller port in step 3.
   c. Map the image mode VDisk to the host. For example, you might map the boot disk to the host with SCSI LUN ID 0.
   d. Map the swap disk to the host, if required. For example, you might map the swap disk to the host with SCSI LUN ID 1.
5. Change the boot address of the host by using the following steps:
   a. Restart the host and open the BIOS utility of the host during the booting process.
   b. Set the primary boot path to the hardware path of the LUN mapped from the SAN Volume Controller.
6. Boot the host in single-path mode
7. Uninstall any multipathing driver that is unsupported for the HP host using the SAN Volume Controller.
8. Install subsystem device driver (SDD) if required.

9. If you installed SDD, restart the host in single-path mode to ensure that the SDD was properly installed.
10. Zone each HBA port to one port on each SAN Volume Controller node.
11. Add additional HBA ports to the host object that you created in step 4b on page 9.
12. Configure the HBA settings on the host by using the following steps:
    a. Restart the host and open the BIOS utility of the host during the booting process.
    b. Set the alternate boot path to the hardware path of the boot disk using the HBA and SAN Volume Controller node that is not used by the primary boot path.
    c. Exit the BIOS utility and finish booting the host.
13. Map any further VDisks to host as required.

### Configuring physical volume timeout

Physical volumes (PV) can be multipathed with the subsystem device driver (SDD) or HP PVLinks.

You must set the PV timeout as follows:

- Physical volumes that are multipathed with SDD must have a PV timeout of 90 seconds.
- Physical volumes that are multipathed with PVLinks must have a PV timeout of 60 seconds. (The timeout default set by PVLinks is 4 minutes.)

## Known issues and limitations

There are several known issues and limitations for attaching the SAN Volume Controller to HP 9000 and HP Integrity servers.

The following Web site provides the most current information about known restrictions:

http://www.ibm.com/storage/support/2145

### Adapter shown as offline

If the host bus adapters (HBAs) on HP 9000 and HP Integrity servers go offline, this does not necessarily indicate that an error has occurred.

For example, the HBA can log out from the SAN Volume Controller if there is no file open to the SAN Volume Controller through the HBA.

Typically, Fibre Channel HBAs are logged in and are online only when they are actively working. If no volume group is assigned to the HBA or if the volume group is not in use, the HBA logs out and is shown as offline. This behavior is normal.

### Setting domain IDs

For HP 9000 and HP Integrity servers, you might want to set the domain IDs prior to building the multiswitch fabric and prior to rezoning.

Consider the following reasons:

- When two active switches are joined, they determine if the domain ID is already in use as before. If there is a conflict, it cannot be changed in an active switch. A conflict causes an active switch to fail.
- The domain ID identifies switch ports when you implement zoning using the domain and switch port number. If domain IDs are negotiated at every fabric start up, there is no guarantee that switch IDs can persist from one session to the next. If the switch ID changes, any zoning definitions become invalid.
- If the domain ID is changed after a SAN is set up, the host can have difficulty logging back into the switch, and you might have to reconfigure the host configuration or detect devices on the switch again.

## Attaching to clusters

When you attach the HP 9000 or HP Integrity server to a cluster that presents virtual disks (VDisks) from more than one I/O group, you must implement a specific configuration to immediately view any new disk mappings without having to restart the host.

Each I/O group must present a VDisk on logical unit number (LUN) 0 to avoid having to restart the host when new LUNs are presented.

## Starting ServiceGuard packages with degraded VDisks

If you use ServiceGuard and PV links in an HP 9000 or HP Integrity clustering environment, the package startup time can take from 20 to 60 minutes when you use the `vgchange -a e` *`VolumeGroupName`* command to start a package that contains a degraded virtual disk (VDisk).

To avoid a lengthy startup time, you can perform the following actions:

- Do not start packages on an HP 9000 or HP Integrity cluster while upgrading the SAN Volume Controller cluster.
- Configure your HP 9000 or HP Integrity cluster so that each node is running a package that contains a VDisk from each I/O group. This allows any automatic failover and failback to complete within a reasonable time.

**Note:** The lengthy startup time does not occur under the following circumstances:

- If the host already has an active volume group containing a degraded VDisk from the same I/O group.
- If the host started while the VDisk was degraded.

## Using a VDisk as a cluster lock disk

ServiceGuard does not provide a way to specify alternate links to a cluster lock disk.

When you use a virtual disk (VDisk) as your lock disk in an HP 9000 or HP Integrity clustering environment, the nodes in this cluster cannot access the lock disk when *both* of the following situations apply:

- The path that is defined for the FIRST_CLUSTER_LOCK_PV variable is unavailable.
- A 50-50 split in the quorum occurs.

To resolve this issue and to maintain redundancy, specify a different path to the lock disk for each node in your HP 9000 or HP Integrity cluster using the FIRST_CLUSTER_LOCK_PV variable in the cluster configuration ASCII file. For

example, if you are configuring a two-node cluster, set the path of FIRST_CLUSTER_LOCK_PV on server A to the first SAN Volume Controller node (through one Fibre Channel switch) and set the FIRST_CLUSTER_LOCK_PV for server B to the second SAN Volume Controller node (through another Fibre Channel switch).

**Note:** To determine that the paths to the lock disk are different on different servers, you must inspect the hardware path.

# Chapter 3. Attaching to an HP AlphaServer host

This information explains the requirements and other information for attaching the SAN Volume Controller to an HP AlphaServer host.

## Attachment requirements for HP AlphaServer hosts

You must be aware of the requirements for attaching the SAN Volume Controller to an HP AlphaServer host.

You must meet the following requirements before you can attach the SAN Volume Controller to your HP AlphaServer host system:

- HP AlphaServer running the Tru64 UNIX® operating system has a limit of 255 LUNs per target.
- Ensure that you have the documentation for your HP AlphaServer Tru64 UNIX system and the *IBM System Storage SAN Volume Controller: Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  http://www.ibm.com/storage/support/2145
- Ensure that you have installed the correct operating systems and version levels on your host. See the supported software levels for the SAN Volume Controller at the following Web site for details about the release level for your operating system:

  http://www.ibm.com/storage/support/2145

### Environments for HP AlphaServer hosts

Ensure that your HP AlphaServer hosts use a supported operating system and level.

The SAN Volume Controller supports HP AlphaServer hosts that run on the Tru64 UNIX and OpenVMS operating system.

The following IBM Web site provides current interoperability information about supported HP AlphaServer operating system levels:

http://www.ibm.com/storage/support/2145

### HBAs for HP hosts

Ensure that your HP hosts use the correct host bus adapters (HBAs).

The following IBM Web site provides current interoperability information about supported HBAs and platform levels:

http://www.ibm.com/storage/support/2145

### Drivers and firmware for HP hosts

Be sure that you use the correct host bus adapter device driver and firmware levels for your HP hosts.

The following IBM Web site provides current interoperability information about supported device driver and firmware levels:

http://www.ibm.com/storage/support/2145

## Installing adapter drivers for HP AlphaServer hosts

After you install the host bus adapter (HBA) in your HP AlphaServer host, you must download and configure the appropriate HBA driver.

Perform the following tasks to install the HBA driver:

1. Obtain the appropriate HBA driver using the following steps:
   a. Go to the supported hardware list on the following Web site and find the sections for the HP Tru64 operating system and the HBA that is installed on your host machine:

      http://www.ibm.com/storage/support/2145

      The specific version of the driver is indicated on the hardware list.
   b. Note the version number for the driver.
   c. Obtain the driver from Hewlett-Packard.
2. Install the driver according to the documentation provided with the driver.
3. On the AlphaServer console, if required by the host, issue the following command:

   `set mode diag`

   You can then issue the `wwidmgr –show` *`adapter`* command to confirm that each adapter was properly installed.
4. Update the adapter firmware, if it is required.

The following output provides an example of what you see when you type the **wwidmgr** commands. You must have the worldwide port name (WWPN) to configure the storage unit host attachment. If you use KGPSA adapters, you can determine the WWPN by replacing the “2” in the WWNN with a “1”. The WWPN of KGPSA-CA in this example is 1000-0000-c922-69bf. The WWPNs are required to configure SAN Volume Controller host attachments.

```
P00>>>set mode diag
Console is in diagnostic mode
P00>>>wwidmgr -show adapter
polling kgpsa0 (KGPSA-CA) slot 5, bus 0 PCI, hose 1
kgpsaa0.0.0.5.1    PGA0        WWN 2000-0000-c922-69bf
polling kgpsa1 (KGPSA-CA) slot 3, bus 0 PCI, hose 0
kgpsab0.0.0.3.0    PGB0        WWN 2000-0000-c923-db1a
item  adapter                  WWN           Cur. Topo  Next Topo
[ 0] kgpsab0.0.0.3.0   2000-0000-c923-db1a   FABRIC     FABRIC
[ 1] kgpsaa0.0.0.5.1   2000-0000-c922-69 bf  FABRIC     FABRIC
[9999] All of the above.
P00>>>wwidmgr -set adapter -item 9999 -topo fabric
polling kgpsa0 (KGPSA-CA) slot 5, bus 0 PCI, hose 1
kgpsaa0.0.0.5.1    PGA0        WWN 2000-0000-c922-69bf
polling kgpsa1 (KGPSA-CA) slot 3, bus 0 PCI, hose 0
kgpsab0.0.0.3.0    PGB0        WWN 2000-0000-c923-db1a
P00>>>wwidmgr -show wwid
[0] UDID:-1 WWID:01000010:6005-0768-0185-0033-7000-0000-0000-0000 (ev:wwid0)
[1] UDID:-1 WWID:01000010:6005-0768-0185-0033-7000-0000-0000-0223 (ev:none)
[2] UDID:-1 WWID:01000010:6005-0768-0185-0033-7000-0000-0000-1143 (ev:none)
[3] UDID:-1 WWID:01000010:6005-0768-0185-0033-7000-0000-0000-0225 (ev:none)
[4] UDID:-1 WWID:01000010:6005-0768-0185-0033-7000-0000-0000-0001 (ev:none)
[5] UDID:-1 WWID:01000010:6005-0768-0185-0033-7000-0000-0000-022b (ev:none)
 [6] UDID:-1 WWID:01000010:6005-0768-0185-0033-7000-0000-0000-0227 (ev:none)
```

After the Tru64 operating system is started from the chosen disk (ex. dkd100), log into the system and verify that the disks are available and online by issuing the following command:

```
boot dkd100
```

## Configuring the Tru64 UNIX host operating system

You must configure the operating system before you can use Tru64 UNIX hosts with the SAN Volume Controller.

Before you configure the host operating system, the following tasks must be completed:

- The IBM service representative must have installed the SAN Volume Controller.
- You must have installed the appropriate host bus adapter (HBA) and driver on your host system.

After the prerequisite tasks are complete, use the following general steps to configure your Tru64 UNIX host system.

1. Zone the host system to the SAN Volume Controller on the fibre-channel SAN.
2. Configure and map the storage to the host.
3. Discover the disks by using the **hwmgr scan scsi** command.

   The disks are discovered as IBM 2145 disks, and the number of discovered devices depends on the number of adapters and zoned paths to the SAN Volume Controller.
4. Optionally, check the status and number of attached disks by using the following commands:
   - **hwmgr view devices**
   - **hwmgr show scsi**
   - **hwmgr show components**

The following is an example of the output that is displayed when you issue the `hwmgr view devices` command:

```
# hwmgr v d
 HWID: Device Name          Mfg      Model            Location
 ------------------------------------------------------------------------------
    4: /dev/dmapi/dmapi
    5: /dev/scp_scsi
    6: /dev/kevm
  104: /dev/disk/dsk0c      COMPAQ   BD03685A24       bus-1-targ-0-lun-0
  105: /dev/disk/dsk1c      COMPAQ   BD036635C5       bus-1-targ-1-lun-0
  106: /dev/disk/cdrom0c    TEAC     CD-W216E         bus-2-targ-0-lun-0
  107: /dev/random
  108: /dev/urandom
  246: /dev/disk/dsk76c     IBM      2145             bus-0-targ-5-lun-0
  247: /dev/disk/dsk77c     IBM      2145             bus-0-targ-5-lun-1
  248: /dev/disk/dsk78c     IBM      2145             bus-0-targ-5-lun-2
  249: /dev/disk/dsk79c     IBM      2145             bus-0-targ-5-lun-3
  250: /dev/disk/dsk80c     IBM      2145             bus-4-targ-4-lun-4
```

The following is an example of the output that is displayed when you issue the `hwmgr show scsi` command:

```
# hwmgr sh s

        SCSI                DEVICE    DEVICE  DRIVER NUM  DEVICE FIRST
 HWID:  DEVICEID HOSTNAME   TYPE      SUBTYPE OWNER  PATH FILE   VALID PATH
-------------------------------------------------------------------------
  104:  0        es47       disk      none    2      1    dsk0   [1/0/0]
  105:  1        es47       disk      none    0      1    dsk1   [1/1/0]
  106:  2        es47       cdrom     none    0      1    cdrom0 [2/0/0]
  246:  77       es47       disk      none    2      8    dsk76  [0/6/0]
  247:  78       es47       disk      none    2      8    dsk77  [4/2/1]
  248:  79       es47       disk      none    2      8    dsk78  [0/6/2]
  249:  80       es47       disk      none    0      8    dsk79  [4/7/3]
  250:  3        es47       disk      none    0      8    dsk80  [4/7/4]
# hwmgr show scsi -full -id 250

        SCSI                DEVICE    DEVICE  DRIVER NUM  DEVICE FIRST
 HWID:  DEVICEID HOSTNAME   TYPE      SUBTYPE OWNER  PATH FILE   VALID PATH
-------------------------------------------------------------------------
  250:  3        es47       disk      none    0      4    dsk80  [4/7/4]

      WWID:01000010:6005-0768-0193-8100-5000-0000-0000-0014

      BUS   TARGET  LUN   PATH STATE
      --------------------------------
      4     7       4     valid
      3     5       4     valid
      0     5       4     valid
      4     2       4     valid
#
```

## Configuring kernel SCSI parameters

You can reduce the time needed to perform jobs that have substantial I/O by changing certain files within your application.

The two procedures described in "Procedure A" and "Procedure B" on page 17 can be performed to shorten the processing time of large I/O directed to one SAN Volume Controller disk array unit. Both procedures must be performed for this operation to be successful.

### Procedure A

Procedure A applies to all versions of Tru64 Unix 4.0f, and later. For more information, see the Tru64 Unix man files for `ddr.dbase` and `ddr_config` information.

Perform the following steps to set up the Tru64 Unix device parameter database so that it is aware of the features that are specific to the SAN Volume Controller:

1. Quiesce the storage.
2. Place the host system in single-user mode and as *root*.
3. Edit /etc/ddr.dbase by including the following lines as an entry in the DISKS subsection:

```
SCSIDEVICE
    #
    # Values for the IBM 2145
    #
    Type = disk
    Name = "IBM" "2145"
    #
    PARAMETERS:
        TypeSubClass        = hard_disk, raid
        BadBlockRecovery    = disabled
        DynamicGeometry     = true
        LongTimeoutRetry    = enabled
        PwrMgmt_Capable     = false
        TagQueueDepth       = 20
        ReadyTimeSeconds    = 180
        CMD_WriteVerify     = supported
        InquiryLength       = 255
        RequestSenseLength  = 255
```

4. Compile the ddr.dbase file by issuing the following command:

   `ddr_config –c`
5. Confirm the values by issuing the following command:

   `ddr_config –s disk "IBM" "2145"`

## Procedure B

"Procedure B" requires a kernel rebuild.

Perform the following steps to set a kernel SCSI parameter:

1. Quiesce the storage.
2. Place the host system in single-user mode and as *root*.
3. Edit the /sys/data/cam_data.c file by changing the non- read/write command time-out values in the changeable disk driver time-out section.

   Change from `u_long cdisk_to_def = 10; /* 10 seconds */` to `u_long cdisk_to_def = 60; /* 60 seconds */`
4. Compile the cam_data.c file by issuing the following command:

   `deconfig –c "hostname"`

   where *hostname* is the name of the system kernel which can be found in the /sys/conf/ directory.

   The following output displays an example of what you would see when issuing the `–c "hostname"` command:

```
#doconfig -c "ES47"
*** KERNEL CONFIGURATION AND BUILD PROCEDURE ***

Saving /sys/conf/ES47 as /sys/conf/ES47.bck

Do you want to edit the configuration file? (y/n) [n]: y

Using ed to edit the configuration file.  Press return when ready,
or type 'quit' to skip the editing session: quit


*** PERFORMING KERNEL BUILD ***
Working....Wed Mar 22 17:36:19 PST 2006

The new kernel is /sys/ES47/vmunix
#
```

## Configuring AdvFS parameters

You must change the Tru64 5.1B Unix AdvfsIORetryControl parameter to prevent Tru64 UNIX advanced file system (AdvFS) from losing access to SAN Volume Controller disks.

As a result of temporary path loss, the AdvFS may lose access to the SAN Volume Controller disks. Therefore, the AdvfsIORetryControl parameter must be changed from its default value of 0. See Figure 1.

```
# sysconfig -q advfs AdvfsIORetryControl
advfs:
AdvfsIORetryControl = 0
# sysconfig -r advfs AdvfsIORetryControl=2
# sysconfig -q advfs AdvfsIORetryControl
advfs:
AdvfsIORetryControl = 2
```

*Figure 1. Setting the AdvfsIORetryControl parameter*

To prevent the AdvfsIORetryControl parameter from resetting after a reboot, enter the parameters in Figure 2.

```
# sysconfig -q advfs AdvfsIORetryControl > /tmp/advfs.out
# vi /tmp/advfs.out
advfs:
AdvfsIORetryControl=2

# sysconfigdb -af /tmp/advfs.out advfs

-> New entry in the /etc/sysconfigtab


# sysconfig -d advfs
advfs:
AdvfsIORetryControl = 2
```

*Figure 2. Example entries to maintain the AdvfsIORetryControl parameter*

## Configuring the OpenVMS operating system

You must configure the OpenVMS operating system before you can use the xxx hosts with the SAN Volume Controller.

### Configuring HBAs

To discover available VDisks, you must issue the `init` command at the Alpha Server Console level. See Figure 3.

```
P00>>>init               (there will be various informational output)


P00>>>wwidmgr –show wwid

[1] UDID: 1 WWID:01000010:6005-0768-0183-000e-7800-0000-0000-0001 (ev:none)
                                  *
                                  *
                                  *
[16] UDID:16 WWID:01000010:6005-0768-0183-000e-7800-0000-0000-0016 (ev:none)
[17] UDID:17 WWID:01000010:6005-0768-0183-000e-7800-0000-0000-0017 (ev:none)
```

*Figure 3. Configuring the OpenVMS HBAs*

After you reboot the OpenVMS, log on and verify that the disks are available and are online. See Figure 4.

```
P00>>>boot dkd200

$ sho dev f

Device                  Device           Error
 Name                   Status           Count
FTA0:                   Offline              0

Device                  Device           Error
 Name                   Status           Count
FGA0:                   Online               0
FGB0:                   Online               0
FGC0:                   Online               3
$ sho dev/fu FGC0:
Device FGC0:, device type KGPSA Fibre Channel, is online, shareable, error
    logging is enabled.

    Error count                    3    Operations completed                0
    Owner process                 ""    Owner UIC                      [SYSTEM]
    Owner process ID        00000000    Dev Prot              S:RWPL,O:RWPL,G,W
    Reference count                0    Default buffer size                 0
    Current preferred CPU Id       1    Fastpath                            1
    Current Interrupt CPU Id       1
    FC Port Name 1000-0000-C930-9156    FC Node Name        2000-0000-C930-9156

$
```

*Figure 4. Example output from the boot process*

## Discovering and assigning VDisks with OpenVMS

OpenVMS cannot recognize VDisks without issuing a UDID value.

Although many other operating systems using AlphaServer platforms do not use UDID, for OpenVMS, UDID must be issued after MDisk and related group/host information is set up. See Figure 5.

```
IBM_2145:svc_190:admin>svctask mkvdisk -mdiskgrp 0 -size 2 -unit gb -iogrp io_grp0 -mdisk mdisk0 -udid 10 -name ovms_10

IBM_2145:svc_190:admin> svctask mkvdiskhostmap -host gs160a ovms_10
```

*Figure 5. Example output for assigning VDisks*

When you use the procedure outlined in Figure 5, you can then use the same procedure for the rest of the new disks. See Figure 6.

```
IBM_2145:svc_190:admin>svcinfo lsvdisk -delim :
id:name:IO_group_id:IO_group_name:status:mdisk_grp_id:mdisk_grp_name:capacity:type:FC_id:FC_name:RC_id:RC_name:vdisk_UID
0:ovms_0:0:io_grp_0:online:0:ds6000:2.0GB:striped:::::60050768019381005000000000000000
1:ovms_1:0:io_grp_0:online:0:ds6000:2.0GB:striped:::::60050768019381005000000000000001
2:ovms_2:0:io_grp_0:online:0:ds6000:2.0GB:striped:::::60050768019381005000000000000002
3:ovms_3:0:io_grp_0:online:0:ds6000:2.0GB:striped:::::60050768019381005000000000000003
4:ovms_4:0:io_grp_0:online:0:ds6000:3.0GB:striped:::::60050768019381005000000000000004
5:ovms_5:0:io_grp_0:online:0:ds6000:3.0GB:striped:::::60050768019381005000000000000005
6:ovms_6:0:io_grp_0:online:0:ds6000:2.0GB:striped:::::60050768019381005000000000000006
7:ovms_7:0:io_grp_0:online:0:ds6000:2.0GB:striped:::::60050768019381005000000000000007
```

*Figure 6. Example output*

Use the SYSMAN utility to discover new disks on the OpenVMS host. See Figure 7 on page 20.

```
SYSMAN> IO SCSI_PATH_VERIFY
SYSMAN> IO AUTOCONFIGURE
SYSMAN> exit
$ sho dev d

Device                  Device           Error    Volume         Free  Trans Mnt
 Name                   Status           Count     Label        Blocks Count Cnt
GS160A$DKA0:            Online               0
$1$DGA10:     (GS160A)  Online               0
$1$DGA11:     (GS160A)  Online               1
$1$DGA12:     (GS160A)  Online               1
$1$DGA13:     (GS160A)  Online               1
$1$DGA14:     (GS160A)  Online               0
$1$DGA15:     (GS160A)  Online               0
$1$DGA16:     (GS160A)  Online               0
$1$DGA17:     (GS160A)  Online               0
$1$DGA10001:  (GS160A)  Online               0
$1$DKD100:    (GS160A)  Online               0
$1$DKD300:    (GS160A)  Mounted              0  GS160A_SYS    25643715   341   1
$1$DKD500:    (GS160A)  Online               0
$1$DQA0:      (GS160A)  Online               0
$1$DQA1:      (GS160A)  Offline              1
$ init $1$dga16: dga16
$ init $1$dga17: dga17
$ mou $1$dga16 dga16
%MOUNT-I-MOUNTED, DGA16 mounted on _$1$DGA16: (GS160A)
$ mou $1$dga17 dga17
%MOUNT-I-MOUNTED, DGA17 mounted on _$1$DGA17: (GS160A)
$ init $1$dga10: dga10
$ init $1$dga11: dga11
$ mou $1$dga11 dga11
%MOUNT-I-MOUNTED, DGA11 mounted on _$1$DGA11: (GS160A)
$ sho dev d

Device                  Device           Error    Volume         Free  Trans Mnt
 Name                   Status           Count     Label        Blocks Count Cnt
GS160A$DKA0:            Online               0
$1$DGA10:     (GS160A)  Online               0
$1$DGA11:     (GS160A)  Mounted alloc       12  DGA11          4193950     1   1
$1$DGA12:     (GS160A)  Online              57
$1$DGA13:     (GS160A)  Online              57
$1$DGA14:     (GS160A)  Online              56
$1$DGA15:     (GS160A)  Online              57
$1$DGA16:     (GS160A)  Mounted alloc       12  DGA16          4193950     1   1
$1$DGA17:     (GS160A)  Mounted alloc       20  DGA17          4193950     1   1
$1$DGA10001:  (GS160A)  Online               0
$1$DKD100:    (GS160A)  Online               0
$1$DKD300:    (GS160A)  Mounted              0  GS160A_SYS    25642572   341   1
$1$DKD500:    (GS160A)  Online               0
$1$DQA0:      (GS160A)  Online               0
$1$DQA1:      (GS160A)  Offline              1
```

*Figure 7. Example output*

# Multipath support for HP AlphaServer hosts

SAN Volume Controller supports the multipathing and load-balancing functions that are embedded into the Tru64 device driver.

## Multipathing configuration maximums for HP AlphaServer hosts

When you configure your HP AlphaServer hosts to support multipathing, keep in mind the multipathing configuration maximums.

Table 1 on page 21 provides the maximum virtual disks (VDisks) and paths per VDisk for multipathing.

*Table 1. Configuration maximums for multipathing on HP AlphaServer hosts*

| Object | Maximum for multipathing support | Description |
|---|---|---|
| VDisk | 255 | The maximum number of VDisks per I/O group that can be supported for multipathing. Because HP AlphaServer hosts have a limit of 255 LUNs per target, there is a limit of 255 VDisks per I/O group. |
| Paths per VDisk | 8 | The maximum number of paths to each VDisk. The maximum paths per VDisk is limited by the path-failover time. |

## Clustering support for HP AlphaServer hosts

The SAN Volume Controller provides clustering support for HP AlphaServer hosts.

Table 2 provides information about the supported cluster software and other information for clustering on an HP AlphaServer host.

*Table 2. Clustering support for HP AlphaServer hosts*

| Operating system | Cluster software | Number of hosts in cluster |
|---|---|---|
| Tru64 UNIX | TruCluster Server | 2 |

**Note:** SAN Volume Controller disks can be used as quorum and member boot disks for the installation and configuration of the TruCluster Server software.

## SAN boot support for HP AlphaServer hosts

SAN boot for HP AlphaServer hosts is supported by the SAN Volume Controller.

SAN boot is supported on HP AlphaServer hosts by using TruCluster Server software as the multipathing software on the boot device.

The following IBM Web site provides information about any known restrictions for SAN boot support:

http://www.ibm.com/storage/support/2145

### Migrating existing SAN boot images

If you have an HP AlphaServer host and existing SAN boot images that are controlled by storage controllers, you can migrate these images to image-mode virtual disks (VDisks) that are controlled by the SAN Volume Controller.

Perform the following steps to migrate your existing SAN boot images:

1. Shut down the host.
2. Perform the following configuration changes on the storage controller:
   a. Remove all the image-to-host mappings from the storage controller.
   b. Map the existing SAN boot image and any other disks being migrated to SAN Volume Controller control.

3. Zone one port of each host bus adapter (HBA) to one of the SAN Volume Controller ports that is associated with the I/O group for the target image-mode VDisk.
4. Perform the following configuration changes on the SAN Volume Controller:
   a. Create an image-mode VDisk for the managed disk (MDisk) that contains the SAN boot image. Use the MDisk unique identifier to specify the correct MDisk.
   b. Create a host object and assign it to the HBA port that you zoned to SAN Volume Controller port in step 3.
   c. Map the image mode VDisk to the host. For example, you might map the boot disk to the host with SCSI LUN ID 0.
   d. Map the swap disk to the host, if required. For example, you might map the swap disk to the host with SCSI LUN ID 1.
5. Change the host's boot address by using the following steps:
   a. Use the **init** command to re-initialize the system and use the **wwidmgr** utility before booting the operating system.
   b. Set the primary boot path to the hardware path of the LUN mapped from the SAN Volume Controller.
6. Zone each HBA port to one port on each SAN Volume Controller node.
7. Add additional HBA ports to the host object that you created in step 4b.
8. Map any further VDisks to host as required.

## Copy Services support for HP AlphaServer hosts

If you use the Tru64 UNIX advanced file system (AdvFS) option, you can map a FlashCopy target to the same machine as a FlashCopy source.

To use the same domain name, you must create a symbolic link to the new disk. Use the **ln -s /dev/disk/dskNc** command to create a symbolic link in the /etc/fdmns/*domain_name* directory, where *domain_name* is the name of the target directory in which to place the link. Refer to your Tru64 UNIX operating system documentation for additional information.

# Chapter 4. Attaching to an IBM System p5, eServer pSeries, or RS/6000 AIX host

This information explains the requirements and other information for attaching the SAN Volume Controller to an IBM AIX host.

The SAN Volume Controller supports any of the following AIX hosts:

- IBM System p5™
- IBM eServer™ p5
- IBM eServer i5
- IBM eServer pSeries®
- IBM eServer iSeries™
- IBM eServer BladeCenter® JS20
- IBM RS/6000®

In this section, these hosts are referred to as IBM System p hosts, which includes IBM System i partitions and IBM BladeCenter JS20 blades running the AIX operating system.

## Attachment requirements for IBM System p hosts

This section provides an overview of the requirements for attaching the SAN Volume Controller to IBM System p hosts running the AIX operating system.

Before you attach an IBM System p host, ensure that you meet the following prerequisites:

- You have installed the correct operating systems and version levels on your host, including any updates and APARS (Authorized Program Analysis Reports) for the operating system.
- You have the documentation for your host system and the *IBM System Storage SAN Volume Controller: Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  http://www.ibm.com/storage/support/2145

### AIX environments for IBM System p hosts

Ensure that each IBM System p host uses a supported operating system and level.

The SAN Volume Controller supports IBM System p hosts that run the operating systems listed on Table 3.

*Table 3. Supported IBM System p host operating systems*

| Operating systems | Level |
|---|---|
| AIX | AIX 4 |
| | AIX 5L 5 |
| | AIX 6 |

The following IBM Web site provides current interoperability information about supported operating system levels for IBM System p hosts:

http://www.ibm.com/storage/support/2145

### HBAs for IBM System p hosts

Ensure that your IBM System p AIX hosts use the correct host bus adapters (HBAs).

The following IBM Web site provides current interoperability information about supported HBAs:

http://www.ibm.com/storage/support/2145

### Drivers and firmware for IBM System p hosts

Ensure that you use the correct host bus adapter device driver and firmware levels for your IBM System p AIX hosts.

The following Web site provides current interoperability information about device driver and firmware levels:

http://www.ibm.com/storage/support/2145

## Installing the host attachment script on IBM System p hosts

To attach an IBM System p AIX host, you must install the AIX host attachment script.

Perform the following steps to install the host attachment scripts:

1. Access the following Web site:

   http://www.ibm.com/servers/storage/support/software/sdd/downloading.html
2. Select **Host Attachment Scripts for AIX**.
3. Select either **Host Attachment Script for SDDPCM** or **Host Attachment Scripts for SDD** from the options, depending on your multipath device driver.
4. Download the AIX host attachment script for your multipath device driver.
5. Follow the instructions that are provided on the Web site or any readme files to install the script.

## Configuring the AIX operating system

You must configure the AIX operating system before you can use IBM System p hosts with the SAN Volume Controller.

Before you configure the AIX host operating systems, the following tasks must be completed:

- The IBM service representative must have installed the SAN Volume Controller.
- You must have installed the appropriate host bus adapters.

After the prerequisite tasks are complete, use the following general steps to configure your AIX host system.

1. Zone the host system to the SAN Volume Controller on the fibre-channel SAN.
2. Install the appropriate multipathing driver for your host system to enable the management of multiple paths to SAN Volume Controller virtual disks (VDisks).

**Note:** The subsystem device driver (SDD) and the subsystem device driver path control module (SDDPCM) for the AIX operating system support System p AIX host systems in a clustering environment. To have failover protection on an open system, these multipath drivers require a minimum of two fibre-channel adapters. The maximum number of fibre-channel ports that are supported in a single host (or logical partition) is four. This can be four single-port adapters or two dual-port adapters or a combination, as long as the maximum number of ports that are attached to the SAN Volume Controller does not exceed four.

3. Create the host system on the SAN Volume Controller, using the worldwide port names (WWPNs). Map the VDisks to the host as required.
4. Create volumes/disks on your host using instructions in your host system publications.

## Configuring for fast fail and dynamic tracking

For hosts systems that run an AIX 5.2 or later operating system, you can achieve the best results by using the fast fail and dynamic tracking attributes.

Before configuring your host system to use these attributes, ensure that the host is running the AIX operating system version 5.2 or later.

Perform the following steps to configure your host system to use the fast fail and dynamic tracking attributes:

1. Issue the following command to set the Fibre Channel SCSI I/O Controller Protocol Device event error recovery policy to fast_fail for each fibre-channel adapter:

   ```
   chdev -l fscsi0 -a fc_err_recov=fast_fail
   ```

   The previous example command was for adapter fscsi0.
2. Issue the following command to enable dynamic tracking for each fibre-channel device:

   ```
   chdev -l fscsi0 -a dyntrk=yes
   ```

   The previous example command was for adapter fscsi0.

## Multipath support for IBM System p hosts

You must install multipathing software on all IBM System p AIX hosts that are attached to the SAN Volume Controller.

On IBM System p hosts, the subsystem device driver (SDD) or the subsystem device driver path control module (SDDPCM) provide multipathing support.

### Configuring SAN Volume Controller devices with multiple paths per LUN

The SAN Volume Controller supports multiple LUNs on a IBM System p AIX host.

The SAN Volume Controller supports multiple path configurations for a LUN. This means that you can have multiple hdisks (logical hard disks) available on the host for each physical LUN.

To configure multiple paths for all LUNs, add all of the adapters and fibre-channel cables and run the **cfgmgr** command. You might need to run **cfgmgr** multiple times. See the *IBM System Storage Multipath Subsystem Device Driver: User's Guide* for details about using the **cfgmgr** command.

**Note:** In addition to the **cfgmgr** command, you might also find that the subsystem device driver (SDD) **addpaths** and **datapath query device** commands are helpful when configuring multiple paths.

### Multipathing configuration maximums for IBM System p hosts

When you configure, keep in mind the maximum configuration for IBM System p AIX hosts.

Table 4 provides the maximum virtual disks (VDisks) and paths per VDisk for the subsystem device driver (SDD) and the subsystem device driver path control module (SDDPCM).

*Table 4. Configuration maximums for SDD and SDDPCM on IBM System p AIX hosts*

| Object | SDD maximum | SDDPCM maximum | Description |
|---|---|---|---|
| VDisk (HDisk) | 512 | N/A | The maximum number of VDisks that can be supported by the SDD (per host object). The maximum number of VDisks is enforced by the SAN Volume Controller. |
| Paths per VDisk | 8 | N/A | The maximum number of paths to each VDisk. The number of paths directly corresponds with the resulting path-failover time. Although the maximum number of supported paths is eight, do not use more than two paths per adapter port. |

## Clustering support for IBM System p hosts

The SAN Volume Controller provides clustering support for IBM System p AIX hosts.

The following IBM Web site provides current interoperability information about supported cluster software:

http://www.ibm.com/storage/support/2145

## SAN boot support for IBM System p hosts

If your IBM System p hosts use AIX operating system version 5.2 or later, the SAN Volume Controller allows you to SAN boot the operating system over Fibre Channel from a SAN Volume Controller VDisk.

You must use the subsystem device driver path control module (SDDPCM) multipath driver to use SAN boot. Create an appropriately sized installation VDisk and map it to the host. Proceed with the installation per the AIX installation instructions and, when you are prompted, select the previously defined VDisk as the target installation disk.

## Dynamically increasing virtual disk size

If your IBM System p AIX hosts use AIX 5.2 or a later AIX operating system version, the SAN Volume Controller supports the ability to dynamically increase virtual disk (VDisk) size.

The `chvg` command options provide the ability to grow the size of a physical volume that the Logical Volume Manager (LVM) uses, without interruptions to the use or availability of the system. Refer to the AIX publication *System Management Guide: Operating System and Devices* for more information.

## Virtual input/output for IBM System p hosts

The SAN Volume Controller provides both single and dual Virtual input/output (VIO) server configurations on IBM System p hosts that support VIO.

You can present the SAN Volume Controller VDisks to the VIO server host bus adapters (HBAs) using the same method as a standard AIX installation. For single VIO server configurations, VDisks can be split up into logical volumes by the VIO server and mapped to the VIO clients. For dual VIO server configurations, VDisks cannot be split into logical volumes, and must instead be mapped intact through both servers to the VIO clients.

The following Web site provides the most current information about multipath requirements and restrictions for the supported VIO configurations:

http://www.ibm.com/storage/support/2145

# Known issues and limitations

There are known issues and limitations with the SAN Volume Controller and an IBM System p AIX host.

The AIX host imposes the following size limitations on disk volume sizes:

**1 TB** On 32-bit AIX platforms (4.3.3, 5.1, 5.2, or 5.3)

**2 TB** On 64-bit AIX 5.1 platforms (1 TB for anything reliant on *bootinfo*)

**2 ZB** On 64-bit AIX 5.2 platforms (2 TB when using LVM bad block relocation)

The following IBM support Web site provides for the most current information about known restrictions:

http://www.ibm.com/storage/support/2145

On a heavily loaded system, you might see the following symptoms, which can indicate that the host is low on direct memory access (DMA) resources:

- You might see errors that indicate that the host bus adapter (HBA) was unable to activate an I/O request on the first attempt.
- You might see lower-than-expected performance with no errors being logged.

To reduce the incidence of these messages, you can increase the resources by modifying the maximum transfer size attribute for the adapter as follows:

1. Type the following command to view the current setting:

   ```
   lsattr -El HBA -a max_xfer_size
   ```

where *HBA* is the name of the adapter logging the error. For this example, the HBA is fcs0.

2. Type the following command to increase the size of the setting:

   ```
   chdev -l fcs0 -P -a max_xfer_size=0x1000000
   ```

   **Note:** To view the range of allowable values for the attribute, type: `lsattr -Rl fcs0 -a max_xfer_size`

3. Restart the host to put these changes into effect.

## Sample AIX error log

This information provides an example of an AIX error log.

The errors that are shown in the following sample error log indicate that the HBA was unable to open an I/O request on the first attempt because the DMA resources were too low.

```
LABEL:  FCS_ERR6
IDENTIFIER: D0EAC662

Date/Time:       Wed Dec  4 16:41:48 MST
Sequence Number: 1949119
Machine Id:      0021DF9A4C00
Node Id:         lode1
Class:           H
Type:            TEMP
Resource Name:   fcs0
Resource Class:  adapter
Resource Type:   df1000f9
Location:        3V-08
VPD:
        Part Number.................03N2452
        EC Level....................D
        Serial Number...............1809102EC
        Manufacturer................0018
        FRU Number..................09P0102
        Network Address.............10000000C92BB50F
        ROS Level and ID............02C03891
        Device Specific.(Z0)........1002606D
        Device Specific.(Z1)........00000000
        Device Specific.(Z2)........00000000
        Device Specific.(Z3)........02000909
        Device Specific.(Z4)........FF401050
        Device Specific.(Z5)........02C03891
        Device Specific.(Z6)........06433891
        Device Specific.(Z7)........07433891
        Device Specific.(Z8)........20000000C92BB50F
        Device Specific.(Z9)........CS3.82A1
        Device Specific.(ZA)........C1D3.82A1
        Device Specific.(ZB)........C2D3.82A1

Description
MICROCODE PROGRAM ERROR

Probable Causes
ADAPTER MICROCODE

Failure Causes
ADAPTER MICROCODE

 Recommended Actions
 IF PROBLEM PERSISTS THEN DO THE FOLLOWING
 CONTACT APPROPRIATE SERVICE REPRESENTATIVE
```

```
Detail Data
SENSE DATA
0000 0000 0000 0029 0002 0039 0000 0000 0061 1613 0090 D5FD 0000 C98B 0000 012C
0000 0000 0000 0003 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0608 0000 0000 0010 0000 0000 0000 0000 0000 2710 0000 07D0 0000 076C
0000 0064 0000 000F 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000
```

# Chapter 5. Attaching to IBM pSeries and JS20 hosts running the Linux operating system

This information provides an overview for attaching the SAN Volume Controller to supported POWER™ technology-based hosts running the Linux® operating system.

The following POWER technology-based hosts are supported by the SAN Volume Controller:

- IBM eServer pSeries
- IBM eServer BladeCenter JS20
- IBM System p5

## Attachment requirements for pSeries and JS20 hosts

This section provides an overview of the requirements for attaching the SAN Volume Controller to a pSeries or JS20 host running the Linux operating system.

The following list provides the requirements for attaching the SAN Volume Controller to your pSeries and JS20 hosts running the Linux operating system:

- Check the LUN limitations for your host system.
- Ensure that you have the documentation for your host system and the *IBM System Storage SAN Volume Controller: Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  http://www.ibm.com/storage/support/2145
- Ensure that you have installed the correct operating systems and are running a supported kernel of Linux.
- When you attach the SAN Volume Controller to a BladeCenter platform, refer to the BladeCenter documentation for SAN configuration details.

### Linux distributions for pSeries and JS20 hosts

Ensure that each pSeries or JS20 host uses a supported Linux distribution.

The following IBM Web site provides current interoperability information about supported software levels:

http://www.ibm.com/storage/support/2145

### HBAs for pSeries and JS20 hosts running the Linux operating system

Ensure that your pSeries and JS20 hosts running the Linux operating system use the correct Linux host bus adapters (HBAs) and host software.

The following IBM Web site provides current interoperability information about supported HBAs and platform levels:

http://www.ibm.com/storage/support/2145

### Drivers and firmware for pSeries and JS20 hosts running the Linux operating system

Be sure that you use the correct host bus adapter device driver and firmware levels for your pSeries and JS20 hosts running the Linux operating system.

The following IBM Web site provides current interoperability information about supported device driver and firmware levels:

http://www.ibm.com/storage/support/2145

## Installing the HBA on a host running the Linux operating system

The first step for attaching a host that runs the Linux operating system is to install the host bus adapter (HBA).

Before you install the HBA, ensure that the adapter is supported by the SAN Volume Controller. The following IBM Web site provides current interoperability information about supported HBAs:

http://www.ibm.com/storage/support/2145

Use the manufacturer's instructions to install the HBA and driver.

## Installing a QLogic HBA driver

If your Linux on pSeries or JS20 host contains a QLogic host bus adapter (HBA), you must download and install the appropriate QLogic driver for the adapter.

1. Download the appropriate QLogic driver and associated files using the following steps:
   a. Use the supported hardware list on the following Web page to find the specific operating system and the QLogic HBA that is installed on your host machine.

      http://www.ibm.com/storage/support/2145

      The specific versions of the QLogic driver and the associated firmware version are indicated on the hardware list.
   b. Ensure that your QLogic HBA is running the correct firmware version. If you need to update the firmware to the version listed on the hardware list, click on the link for the firmware version to download and install the correct version.
   c. Click the link in the **HBA Driver** column.
   d. Download the driver file for the driver to a local disk.
   e. Decompress the downloaded file.
2. Install the QLogic HBA driver using the instructions in the downloaded file.
3. Restart the host.

## Installing an Emulex HBA driver

If your Linux on pSeries host contains an Emulex host bus adapter (HBA), you must download and install the appropriate QLogic driver for the adapter.

1. Download the appropriate Emulex driver and associated files using the following steps:

a. Go to the supported hardware list on the following Web site and find the specific operating system and then the Emulex HBA that is installed on your host machine.

   http://www.ibm.com/storage/support/2145

   The specific versions of the Emulex driver and the associated firmware version are indicated on the hardware list.

b. Ensure that your Emulex HBA is running the correct firmware version. If you need to update the firmware to the version listed on the hardware list, click on the link for the firmware version to download and install the correct version.

c. Click the link in the **HBA Driver** column.

d. Download the driver file for the driver to a local disk.

e. Decompress the downloaded file.

2. Install the Emulex HBA driver using the instructions in the downloaded file.
3. Restart the host.

## Configuring the Linux operating system

You must configure the operating system before you can use hosts running the Linux operating system with the SAN Volume Controller.

Before you configure the host operating systems, the following tasks must be completed:

- The IBM service representative must have installed the SAN Volume Controller.
- You must have installed the appropriate host bus adapters.

After the prerequisite tasks are complete, use the following general steps to configure your host system:

1. Zone the host system to the SAN Volume Controller on the fibre-channel SAN. See the *IBM System Storage SAN Volume Controller: Software Installation and Configuration Guide* for additional information about zoning.
2. Install the appropriate multipathing driver for your host system to enable the management of multiple paths to SAN Volume Controller virtual disks (VDisks). Refer to the *IBM System Storage Multipath Subsystem Device Driver: User's Guide* for installation instructions.
3. Create the host system on the SAN Volume Controller, using the worldwide port names (WWPNs). Map the VDisks to the host, as required. See the *IBM System Storage SAN Volume Controller: Software Installation and Configuration Guide* or *IBM System Storage SAN Volume Controller: Command-Line Interface User's Guide* for additional information about creating hosts and mapping.
4. Either create volumes or disks on your host using a logical volume manager (LVM) or partition and create file systems on the disks. Refer to your host system publications or see the *IBM System Storage Multipath Subsystem Device Driver: User's Guide* for more information.

### Multipath support for pSeries and JS20 hosts

You must install multipathing software on all pSeries and JS20 hosts that are attached to the SAN Volume Controller.

On pSeries and JS20 hosts that run the Linux operating system, the following software provides multipathing support:

- Subsystem device driver (SDD)

### SDD dynamic pathing on hosts running the Linux operating system

Hosts that run the Linux operating system do not support subsystem device driver (SDD) dynamic pathing. If you use a QLogic or Emulex device driver, you must reload the device driver to pick up the new paths.

On the Linux operating system, SDD is aware of the preferred paths that are set by SAN Volume Controller for each VDisk. When failing over paths, SDD tries the first preferred path, then the next known preferred path, and so on until it has tried all preferred paths. If SDD cannot find an available path using the preferred paths, it begins trying non-preferred paths. If all paths are unavailable, the VDisk goes offline.

SDD on the Linux operating system does not perform load balancing across the preferred paths.

### Multipathing configuration maximums for pSeries and JS20 hosts

When you configure, keep in mind the maximum configuration for the subsystem device driver (SDD) on pSeries and JS20 hosts running the Linux operating system.

Table 5 provides the maximum virtual disks (VDisks) and paths per VDisk for SDD on hosts running the Linux operating system.

*Table 5. Configuration maximums for SDD on pSeries and JS20 hosts running the Linux operating system*

| Object | Maximum | Description |
|---|---|---|
| VDisks | 256 | The maximum number of VDisks that can be supported by Linux (per host object). |
| Paths per VDisk | 4 | The maximum number of paths to each VDisk. |

## Clustering support on hosts running the Linux operating system

The SAN Volume Controller does not provide clustering support on hosts that run the Linux operating system.

## SAN boot support on pSeries and JS20 hosts

The SAN Volume Controller provides SAN boot support for pSeries and JS20 hosts that run the Linux operating system.

The following Web site provides information about known restrictions for SAN boot support:

http://www.ibm.com/storage/support/2145

## Defining the number of disks for pSeries and JS20 hosts

When you define the number of disks on pSeries and JS20 hosts running the Linux operating system, you are allocating space for configured disks. On the Linux operating system, disks are represented as device files.

There are 256 minor numbers that are available for each of the eight major numbers that can be used to define Linux device files.

Use the following formula to define the maximum number of device files for the host system:

*(Number of major numbers) x (Number of minor numbers) / (Number of partitions) = Number of devices*

For example, 8 x 256 / 16 = 128.

## Setting queue depth with QLogic HBAs

The queue depth is the number of I/O operations that can be run in parallel on a device.

Configure your host running the Linux operating system using the formula specified in the *IBM System Storage SAN Volume Controller: Software Installation and Configuration Guide*.

Perform the following steps to set the maximum queue depth:

1. Add the following line to the /etc/modules.conf file:

   **For the 2.4 kernel (SUSE Linux Enterprise Server 8 or Red Hat Enterprise Linux 3):**

   ```
   options qla2300 ql2xmaxqdepth=new_queue_depth
   ```

   **For the 2.6 kernel (SUSE Linux Enterprise Server 9 or Red Hat Enterprise Linux 4):**

   ```
   options qla2xxx ql2xmaxqdepth=new_queue_depth
   ```

2. Rebuild the RAM disk that is associated with the kernel being used by using one of the following commands:
   - If you are running on an SUSE Linux Enterprise Server operating system, run the `mk_initrd` command.
   - If you are running on a Red Hat operating system, run the `mkinitrd` command and then restart.

## Setting queue depth for Emulex HBAs

Configure your host running the Linux operating system to allow a maximum queue depth of four.

Perform the following steps to set the maximum queue depth:

1. Add the following line to the /etc/modules.conf file:

   ```
   options lpfc lpfc_lun_queue_depth=new_queue_depth
   ```

   where `new_queue_depth` is a number calculated using the formula specified in Chapter 1 of the *IBM System Storage SAN Volume Controller: Software Installation and Configuration Guide*.

2. Restart the machine.

## SAN Volume Controller storage configuration for pSeries and JS20 hosts

Each attached SAN Volume Controller LUN has a special device file in the Linux directory /dev.

There is a maximum of 128 fibre-channel disks that are based on the major numbers that are available. The entries for all 128 devices are added by the operating system automatically.

The range of devices are detailed below:

**Device range without a subsystem device driver (SDD)**
/dev/sda (LUN 0) to /dev/sddx (LUN 127)

**Device range with an SDD**
/dev/vpatha, vpathb...vpathp (LUN 0) to /dev/vpathaa, vpathab... vpathzp (LUN 127)

Figure 8 and Figure 9 show examples of the range for the devices.

```
# ls –l /dev/sda
brw-rw---- 1 root disk 8, 0 Aug 24 2005 /dev/sda
```

*Figure 8. Example of range of devices for a host running the Linux operating system when not using the SDD*

```
# ls –l /dev/vpatha
brw-rw---- 1 root disk 8, 0 Aug 24 2005 /dev/vpatha
```

*Figure 9. Example of range of devices for a host running the Linux operating system when using the SDD*

## Partitioning the SAN Volume Controller disk

Use this information when you set up SAN Volume Controller disk partitions.

Before you create a file system, partition the disk by using the fdisk utility. You have to specify the special device file of the disk you want to partition when you run fdisk. Figure 10 shows an example of the different options for the fdisk utility.

**Note:** If you are using the subsystem device driver (SDD), your path in the example is /dev/vpathb instead of /dev/sdb.

```
# fdisk /dev/sdb

Command  (m for help): m
Command  action
a     toggle a bootable flag
b     edit bsd disklabel
c     toggle the dos compatibility flag
d     delete a partition
l     list known partition types
m     print this menu
n     add a new partition
o     create a new empty DOS partition table
p     print the partition table
q     quit without saving changes
s     create a new empty Sun disklabel
t     change a partitions system id
u     change display/entry units
v     verify the partition table
w     write table to disk and exit
x     extra functionality (experts only)
```

*Figure 10. Example of different options for the fdisk utility*

Figure 11 on page 37 shows an example of a primary partition on the disk /dev/sdb.

**Note:** If you are using the SDD, your path in the example is /dev/vpathb instead of /dev/sdb.

```
Command (m for help): n

Command  action
e     extended
p     primary partition (1-4)
p
Partition number (1-4): 1
First cylinder (1-953, default 1): Enter
Using default value 1
Last cylinder or +size or +sizeM or +sizeK (1-953, default 953): Enter
Using default value 953

Command (m for help): p

Disk /dev/sdb: 64 heads, 32 sectors, 953 cylinders
Units = cylinders of 2048 * 512 bytes

 Device Boot  Start  End   Blocks  Id  System
 /dev/sdb1     1 953   975856  83  Linux
```

*Figure 11. Example of a primary partition on the disk /dev/sdb*

## Assigning the system ID to the partition

Use this information when you assign a system ID to the partition.

Perform the following steps to assign the system ID to the SAN Volume Controller partition on the host running the Linux operating system:

1. Assign the system partition ID.
2. Write the information to the partition table on the disk.
3. Exit the fdisk program.

Figure 12 shows the assignment of the Linux system ID to the partition (hex code 83).

```
Command  (m for help): t
Partition number (1-4): 1

Hex code (type L to list codes): 83

Command  (m for help): w
The partition table has been altered!

Calling ioctl() to re-read partition table.
SCSI device sdb: hdwr sector= 512 bytes. Sectors= 1953152 [953 MB] [1.0 GB]
 sdb: sdb1
SCSI device sdb: hdwr sector= 512 bytes. Sectors= 1953152 [953 MB] [1.0 GB]
 sdb: sdb1

WARNING: If you have created or modified any DOS 6.x partitions, please see the
fdisk manual page for additional information.
Syncing disks.
[root@yahoo /data]#
```

*Figure 12. Example of assigning a Linux system ID to the partition*

## Creating file systems on the SAN Volume Controller

Use this information when you are ready to create and use file systems on the SAN Volume Controller.

After you partition the disk, the next step is to create a file system. Figure 13 shows an example of how to use the **mke2fs** command to create an EXT2 Linux file system (which is nonjournaled).

```
[root@yahoo /data]# mke2fs /dev/vpathb1
mke2fs 1.18, 11-Nov-1999 for EXT2 FS 0.5b, 95/08/09
Filesystem label=
OS type: Linux
Block size=4096 (log=2)
Fragment size=4096 (log=2)
122112 inodes, 243964 blocks
12198 blocks (5.00%) reserved for the super user
First data block=0
8 block groups
32768 blocks per group, 32768 fragments per group
15264 inodes per group
Superblock backups stored on blocks:
32768, 98304, 163840, 229376

Writing inode tables: done
Writing superblocks and filesystem accounting information: done
[root@yahoo /data]#
```

*Figure 13. Example of creating a file with the mke2fs command*

Figure 14 shows an example of how to create the EXT2 Linux file system (which is nonjournaled) by using the **mkfs** command.

```
[root@yahoo /data]# mkfs -t ext2 /dev/vpathb1
mke2fs 1.18, 11-Nov-1999 for EXT2 FS 0.5b, 95/08/09
Filesystem label=
OS type: Linux
Block size=4096 (log=2)
Fragment size=4096 (log=2)
122112 inodes, 243964 blocks
12198 blocks (5.00%) reserved for the super user
First data block=0
8 block groups
32768 blocks per group, 32768 fragments per group
15264 inodes per group
Superblock backups stored on blocks:
32768, 98304, 163840, 229376
Writing inode tables: done
Writing superblocks and filesystem accounting information: done
[root@yahoo /data]#
```

*Figure 14. Example of creating a file with the mkfs command*

# Chapter 6. Attaching to IBM System z9 or eServer zSeries hosts running the Linux operating system

This information provides an overview for attaching the SAN Volume Controller to supported IBM System z9™ and IBM eServer zSeries® hosts running the Linux operating system.

## Attachment requirements for System z9 and zSeries hosts running Linux operating systems

This section provides an overview of the requirements for attaching the SAN Volume Controller to a System z9 or zSeries host running the Linux operating system.

The following list provides the requirements for attaching the SAN Volume Controller to your System z9 or zSeries host system running the Linux operating system:

- Check the LUN limitations for your host system.
- Ensure that you have the documentation for your host system and the *IBM System Storage SAN Volume Controller: Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  http://www.ibm.com/storage/support/2145
- Ensure that you have installed the correct operating systems and are running a supported Linux kernel.

### Linux distributions for System z9 and zSeries hosts

Ensure that each System z9 and zSeries host uses a supported Linux distribution.

Table 6 provides information about the supported distributions.

*Table 6. Linux distributions for System z9 and zSeries hosts*

| Host server | Linux distribution |
|---|---|
| zSeries server | SUSE Linux Enterprise Server |
| System z9 server | SUSE Linux Enterprise Server |
| zSeries server | Red Hat Enterprise Linux AS |
| System z9 server | Red Hat Enterprise Linux AS |

The following IBM Web site provides current interoperability information about supported software levels, including distribution levels:

http://www.ibm.com/storage/support/2145

### HBAs for System z9 and zSeries hosts running Linux operating systems

Ensure that your System z9 and zSeries hosts running the Linux operating system use the correct Linux host bus adapters (HBAs) and host software.

Table 7 lists the supported HBAs for System z9 and zSeries hosts running the Linux operating system.

*Table 7. HBAs for System z9 and zSeries hosts running the Linux operating system*

| Host | Operating system | Supported HBAs (Note 1) |
|---|---|---|
| zSeries server | SUSE Linux Enterprise Server<br>Red Hat Enterprise Linux AS | FICON® |
| | | FICON Express |
| | | FICON Express2 |
| System z9 | SUSE Linux Enterprise Server<br>Red Hat Enterprise Linux AS | FICON |
| | | FICON Express |
| | | FICON Express2 |
| System z9 Enterprise Class (z9™ EC) | SUSE Linux Enterprise Server<br>Red Hat Enterprise Linux AS | FICON |
| | | |
| | | FICON Express |
| | | FICON Express2 |
| | | FICON Express4 |
| **Note:** The System z9 EC System z9, and zSeries HBAs must be ordered as an additional feature for a host system. They are either factory-installed on the host system or installed in an existing system by a n IBM service representative. | | |

The following Web site provides current interoperability information about supported HBA and platform levels:

http://www.ibm.com/storage/support/2145

## Drivers and firmware for System z9 and zSeries hosts

Be sure that you use the correct host bus adapter device driver and firmware levels for your System z9 and zSeries hosts running the Linux operating system.

The following IBM Web site provides current interoperability information about supported device driver and firmware levels:

http://www.ibm.com/storage/support/2145

# Installing and configuring the HBA on System z9 and zSeries hosts

The host bus adapters (HBAs) for a System z9 or zSeries host must be ordered as features and they are either factory-installed when you order a new system or installed into an existing system by an IBM service representative.

Perform the following steps to check the installation of the HBA and to configure the HBA to work with the SAN Volume Controller:

1. Ensure that FICON, FICON Express, or FICON Express2 features are installed on your System z9 or zSeries system.
2. Configure the HBA to run in FCP mode.

See the following IBM Web site for additional information about FCP connectivity:

http://www.ibm.com/systems/z/connectivity/

## Configuring the Linux operating system for System z9 and zSeries hosts

You must configure the Linux operating system before you can use System z9 and zSeries hosts with the SAN Volume Controller.

Before you configure the host operating systems, the following tasks must be completed:

- An IBM service representative must have installed the SAN Volume Controller.
- You must have installed the appropriate host bus adapters.

After the prerequisite tasks are complete, use the following general steps to configure your System z9 and zSeries hosts running the Linux operating system:

1. Zone the host system to the SAN Volume Controller on the fibre-channel SAN. See the *IBM System Storage SAN Volume Controller: Software Installation and Configuration Guide* for additional information about zoning.
2. Create the host system on the SAN Volume Controller, using the worldwide port names (WWPNs). Map the VDisks to the host, as required. See the *IBM System Storage SAN Volume Controller: Software Installation and Configuration Guide* or *IBM System Storage SAN Volume Controller: Command-Line Interface User's Guide* for additional information about creating hosts and mapping.
3. Configure your Linux system for FCP attachment. Refer to the *Linux on zSeries Device Drivers and Installation Commands for the Linux Kernel 2.4 - June 2003 stream* publication (dated March 23, 2005) and *Device Drivers,Features and Commands for the Linux Kernel 2.6 - April 2004 stream* publication (dated March 23, 2006) for additional information.
4. Either create volumes or disks on your host using the logical volume manager and create file systems on the disks. Refer to your host system publications.

## Multipath support for System z9 and zSeries hosts

You must install multipathing software on all System z9 and zSeries hosts that are attached to the SAN Volume Controller.

On System z9 and zSeries hosts running the Linux operating system, the following software provides multipathing support:

**Linux Kernel 2.4**
The logical volume manager.

**Linux Kernel 2.6**
The mp-tools package.

See the documentation at the following Web site for more information about using the logical volume manager or the multipathing tools package with System z9 and zSeries hosts that run Linux kernel 2.4 or Linux kernel 2.6:

http://www.ibm.com/developerworks/linux/linux390/

### Multipathing configuration maximums for LVM and mp-tools

When you configure, keep in mind the maximum configuration for the logical volume manager (specifically, LVM1) for the Linux operating system.

### Logical volume manager

Table 8 provides the maximum number of physical volumes, logical volumes, and paths for LVM1.

*Table 8. Configuration maximums for LVM1*

| Object | Maximum | Description |
|---|---|---|
| Number of volume groups | 99 | The number of volume groups that can be defined per host |
| Physical volumes per volume group | 256 | The maximum number of physical volumes that can be assigned to one volume group |
| Paths per physical volume | 16 | The maximum number of paths to each PV |
| Logical volumes | 256 | The total number of logical volumes supported by LVM1 (because of the 256 minor number limit of the kernel) |

### Multipath-tools

The number of paths per physical volume is limited to eight paths with Kernel 2.6.

## Clustering support on hosts running the Linux operating system

The SAN Volume Controller does not provide clustering support on hosts that run the Linux operating system.

## SAN boot support on System z9 and zSeries hosts

On a SCSI LUN, you can perform an initial program load (IPL) process, but be aware that the boot can fail.

IPL processes on SCSI LUNs can fail because there is no multipath support during the boot process. Refer to the *How to use FC-attached SCSI devices with Linux on System z - April 2004 stream* publication for more information about using IPL processes with System z9 and zSeries hosts

## Defining the number of disks on System z9 and zSeries hosts

When you define the number of disks on System z9 and zSeries hosts running the Linux operating system, you are allocating space for configured disks.

On the Linux operating system, disks are represented as device files. The maximum number of devices depends on your Linux configuration.

## SAN Volume Controller storage configuration for System z9 and zSeries hosts

Each attached SAN Volume Controller LUN has a special device file in the Linux directory /dev.

The maximum number of devices depends on your Linux configuration. Refer to the *Linux on zSeries Device Drivers and Installation Commands for the Linux Kernel 2.4 - June 2003 stream* publication (dated March 23, 2005) and *Device Drivers, Features*

*and Commands for the Linux Kernel 2.6 - April 2004 stream* publication (dated March 23, 2006) for additional information about multipathing support.

## Known issues and limitations for System z9 and zSeries hosts

There are some restrictions for System z9 and zSeries hosts running the Linux operating system.

The following Web site provides currently known restrictions for the latest Linux for System z9 and zSeries streams:

http://www.ibm.com/developerworks/linux/linux390/

From that Web site, click **June 2003 stream** to find the known restrictions for the Linux kernel 2.4, or click **October 2005 stream** to find known restrictions for the Linux kernel 2.6.

### Interoperability restrictions with Red Hat Enterprise Linux 4 update 4 for IBM System z

There are interoperation restrictions for SAN Volume Controller software level 4.1.0 and Red Hat Enterprise Linux 4 Update 4 for IBM System z™.

Additional restrictions might be imposed on hardware, such as switches and storage, that are attached to SAN Volume Controller.

**Installation restrictions:**

To install Red Hat Enterprise Linux 4 Update 4 onto a SAN Volume Controller FCP device, you must have at least one DASD device connected to the system via ESCON® or FICON; otherwise, the installation fails.

**IPL restrictions:**

DM-MP multipathing is not available on either the root or boot devices.

For more information about DM-MP multipath usage, see http://www.redhat.com/docs/manuals/csgfs/browse/rh-cs-en/ap-rhcs-dm-multipath-usagetxt.html. System re-IPL (`shutdown -r`) is supported on zVM guests only; not in LPAR mode.

**Multipath configuration:**

Red Hat Enterprise Linux 4 Update 4 does not include a default multipath configuration for the SAN Volume Controller.

You must update the device part of your multipath.conf with the following:

```
device {
              vendor                  "IBM "
              product                 "2145            "
              path_grouping_policy    group_by_prio
              prio_callout            "/sbin/mpath_prio_alua /dev/%n"
              features                "1 queue_if_no_path"
              path_checker            tur
       }
```

**Fabric maintenance:**

You must apply a workaround on the host before you can begin fabric maintenance.

Apply the following workaround on the Red Hat Enterprise Linux 4 Update 4 zlinux host before starting fabric maintenance, including the SAN Volume Controller software upload:

```
$>vi /bin/bug23366.sh
          #!/bin/bash
          for f in `grep offline /sys/bus/scsi/drivers/sd/*/state | sed 's/^\(.*state\):.*$/\1/g'`;
          do echo running > $f;
          done
$>crontab -e
          */2 * * * * /bin/bug23366
```

# Chapter 7. Attaching to a host running the Linux operating system

This information provides an overview for attaching the SAN Volume Controller to a host running the Linux operating system on Intel IA32, IA32e, EM64T, or Xeon processors and AMD 64 or Opteron processors.

## Attachment requirements for hosts running the Linux operating system

This section provides an overview of the requirements for attaching the SAN Volume Controller to a host running the Linux operating system on Intel IA32, IA32e, EM64T, or Xeon processors and AMD 64 or Opteron processors.

The following list provides the requirements for attaching the SAN Volume Controller to your host running the Linux operating system:

- Check the LUN limitations for your host system.
- Ensure that you have the documentation for your host system and the *IBM System Storage SAN Volume Controller: Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  http://www.ibm.com/storage/support/2145
- Ensure that you have installed the correct operating systems and are running a supported kernel of Linux.
- When attaching the SAN Volume Controller to a BladeCenter platform, refer to the Bladecenter documentation for SAN configuration details.

### Linux distributions for hosts

Ensure that each host uses a supported Linux distributions.

The SAN Volume Controller supports hosts that run the following Linux distributions:

- Red Hat Enterprise Linux AS
- SUSE Linux Enterprise Server

The following IBM Web site provides current interoperability information about supported software levels:

http://www.ibm.com/storage/support/2145

### HBAs for hosts running the Linux operating system

Ensure that your hosts running the Linux operating system use the correct host bus adapters (HBAs) and host software.

The following IBM Web site provides current interoperability information about HBA and platform levels:

http://www.ibm.com/storage/support/2145

### Drivers and firmware for hosts running the Linux operating system

Ensure that you use the correct host bus adapter device driver and firmware levels for your hosts.

The following Web site provides current interoperability information about supported device driver and firmware levels:

http://www.ibm.com/storage/support/2145

## Installing the HBA on a host running the Linux operating system

The first step for attaching a host that runs the Linux operating system is to install the host bus adapter (HBA).

Before you install the HBA, ensure that the adapter is supported by the SAN Volume Controller. The following IBM Web site provides current interoperability information about supported HBAs:

http://www.ibm.com/storage/support/2145

Use the manufacturer's instructions to install the HBA and driver.

## Configuring the Linux operating system

You must configure the operating system before you can use hosts running the Linux operating system with the SAN Volume Controller.

Before you configure the host operating systems, the following tasks must be completed:

- The IBM service representative must have installed the SAN Volume Controller.
- You must have installed the appropriate host bus adapters.

After the prerequisite tasks are complete, use the following general steps to configure your host system:

1. Zone the host system to the SAN Volume Controller on the fibre-channel SAN. See the *IBM System Storage SAN Volume Controller: Software Installation and Configuration Guide* for additional information about zoning.
2. Install the appropriate multipathing driver for your host system to enable the management of multiple paths to SAN Volume Controller virtual disks (VDisks). Refer to the *IBM System Storage Multipath Subsystem Device Driver: User's Guide* for installation instructions.
3. Create the host system on the SAN Volume Controller, using the worldwide port names (WWPNs). Map the VDisks to the host, as required. See the *IBM System Storage SAN Volume Controller: Software Installation and Configuration Guide* or *IBM System Storage SAN Volume Controller: Command-Line Interface User's Guide* for additional information about creating hosts and mapping.
4. Either create volumes or disks on your host using a logical volume manager (LVM) or partition and create file systems on the disks. Refer to your host system publications or see the *IBM System Storage Multipath Subsystem Device Driver: User's Guide* for more information.

## Multipath support for hosts running the Linux operating system

You must install multipathing software on all hosts that are attached to the SAN Volume Controller.

The following software provides multipathing support for hosts that run the Linux operating system:

- Subsystem device driver (SDD)

### SDD dynamic pathing on hosts running the Linux operating system

Hosts that run the Linux operating system do not support subsystem device driver (SDD) dynamic pathing. If you use a QLogic or Emulex device driver, you must reload the device driver to pick up the new paths.

On the Linux operating system, SDD is aware of the preferred paths that are set by SAN Volume Controller for each VDisk. When failing over paths, SDD tries the first preferred path, then the next known preferred path, and so on until it has tried all preferred paths. If SDD cannot find an available path using the preferred paths, it begins trying non-preferred paths. If all paths are unavailable, the VDisk goes offline.

SDD on the Linux operating system does not perform load balancing across the preferred paths.

### Multipathing configuration maximums for hosts running the Linux operating system

When you configure, keep in mind the maximum configuration for the subsystem device driver (SDD) on Intel-based hosts that run the Linux operating system.

Table 9 provides the maximum virtual disks (VDisks) and paths per VDisk for SDD on the Linux operating system.

*Table 9. Configuration maximums for hosts running the Linux operating system*

| Object | Maximum | Description |
|---|---|---|
| VDisks | 512 (for 2.6 kernel operating systems)<br><br>256 (for 2.4 kernel operating systems | The maximum number of VDisks that can be supported by the Linux operating system (per host per cluster). |
| Paths per VDisk | 4 | The maximum number of paths to each VDisk. |

## Clustering support on hosts running the Linux operating system

The SAN Volume Controller does not provide clustering support on hosts that run the Linux operating system.

## SAN boot support on hosts running the Linux operating system

The SAN Volume Controller provides SAN boot support for hosts that run the Linux operating system.

The following Web site provides information about known restrictions for SAN boot support:

http://www.ibm.com/storage/support/2145

## Defining the number of disks on hosts running the Linux operating system

When you define the number of disks on hosts running the Linux operating system, you are allocating space for configured disks. On the Linux operating system, disks are represented as device files.

For 2.4 Linux kernels, there are 256 minor numbers that are available for each of the eight major numbers that can be used to define Linux device files. Use the following formula to define the maximum number of device files for the host system:

*(Number of major numbers) x (Number of minor numbers) / (Number of partitions) = Number of devices*

For example, if you have 16 partitions on a 2.4 kernel, you would have 128 devices (8 x 256 / 16 = 128).

For 2.6 Linux kernels, there are significantly more minor device numbers that are available. Because SAN Volume Controller limits you to 512 VDisks per host, you have more device numbers than can be used.

## Setting queue depth with QLogic HBAs

The queue depth is the number of I/O operations that can be run in parallel on a device.

Configure your host running the Linux operating system using the formula specified in the *IBM System Storage SAN Volume Controller: Software Installation and Configuration Guide*.

Perform the following steps to set the maximum queue depth:

1. Add the following line to the /etc/modules.conf file:

   **For the 2.4 kernel (SUSE Linux Enterprise Server 8 or Red Hat Enterprise Linux 3):**

   ```
   options qla2300 ql2xmaxqdepth=new_queue_depth
   ```

   **For the 2.6 kernel (SUSE Linux Enterprise Server 9 or Red Hat Enterprise Linux 4):**

   ```
   options qla2xxx ql2xmaxqdepth=new_queue_depth
   ```

2. Rebuild the RAM disk that is associated with the kernel being used by using one of the following commands:
   - If you are running on an SUSE Linux Enterprise Server operating system, run the `mk_initrd` command.
   - If you are running on a Red Hat operating system, run the `mkinitrd` command and then restart.

## SAN Volume Controller storage configuration for hosts running the Linux operating system

Each of the attached SAN Volume Controller LUNs has a special device file in the Linux directory /dev.

Hosts that use 2.4 kernel Linux operating systems have a maximum of 128 fibre-channel disks that are based on the major numbers that are available. The entries for all 128 devices are added by the operating system automatically.

Hosts that use 2.6 kernel Linux operating systems can have as many fibre-channel disks as the number allowed by the SAN Volume Controller. The following Web site provides the most current information about maximum configuration for the SAN Volume Controller:

http://www.ibm.com/storage/support/2145

The range of devices for each type of kernel is detailed below:

**Device range without a subsystem device driver (SDD)**
/dev/sda to /dev/sddx

**Device range with an SDD**

- 2.4 kernel operating systems have the following range:
  - /dev/vpatha, vpathb...vpathp
  - /dev/vpathaa, vpathab...vpathap
  - /dev/vpathba, vpathbb...vpathbp...
  - /dev/vpathza, vpathzb...vpathzp
  - /dev/vpathaaa, vpathaab...vpathaap...
- 2.6 kernel operating systems have the following range:
  - /dev/vpatha, vpathb...vpathz
  - /dev/vpathaa, vpathab...vpathaz
  - /dev/vpathba, vpathbb...vpathbz...
  - /dev/vpathza, vpathzb...vpathzz
  - /dev/vpathaaa, vpathaab...vpathaaz...

Figure 15 and Figure 16 show examples of the range for the devices.

```
# ls –l /dev/sda
brw-rw---- 1 root disk 8, 0 Aug 24 2005 /dev/sda
```

*Figure 15. Example of range of devices for a host running the Linux operating system when not using the SDD*

```
# ls –l /dev/vpatha
brw-rw---- 1 root disk 8, 0 Aug 24 2005 /dev/vpatha
```

*Figure 16. Example of range of devices for a host running the Linux operating system when using the SDD*

### Partitioning the SAN Volume Controller disk

Use this information when you set up SAN Volume Controller disk partitions.

Before you create a file system, partition the disk by using the fdisk utility. You have to specify the special device file of the disk you want to partition when you run fdisk. Figure 17 shows an example of the different options for the fdisk utility.

**Note:** If you are using the subsystem device driver (SDD), your path in the example is /dev/vpathb instead of /dev/sdb.

```
# fdisk /dev/sdb

Command  (m for help): m
Command  action
a     toggle a bootable flag
b     edit bsd disklabel
c     toggle the dos compatibility flag
d     delete a partition
l     list known partition types
m     print this menu
n     add a new partition
o     create a new empty DOS partition table
p     print the partition table
q     quit without saving changes
s     create a new empty Sun disklabel
t     change a partitions system id
u     change display/entry units
v     verify the partition table
w     write table to disk and exit
x     extra functionality (experts only)
```

*Figure 17. Example of different options for the fdisk utility*

Figure 18 shows an example of a primary partition on the disk /dev/sdb.

**Note:** If you are using the SDD, your path in the example is /dev/vpathb instead of /dev/sdb.

```
Command (m for help): n

Command  action
e     extended
p     primary partition (1-4)
p
Partition number (1-4): 1
First cylinder (1-953, default 1): Enter
Using default value 1
Last cylinder or +size or +sizeM or +sizeK (1-953, default 953): Enter
Using default value 953

Command (m for help): p

Disk /dev/sdb: 64 heads, 32 sectors, 953 cylinders
Units = cylinders of 2048 * 512 bytes

 Device Boot  Start  End   Blocks  Id  System
 /dev/sdb1     1 953   975856  83  Linux
```

*Figure 18. Example of a primary partition on the disk /dev/sdb*

## Assigning the system ID to the partition

Use this information when you assign a system ID to the partition.

Perform the following steps to assign the system ID to the SAN Volume Controller partition on the host running the Linux operating system:

1. Assign the system partition ID.

2. Write the information to the partition table on the disk.
3. Exit the fdisk program.

Figure 19 shows the assignment of the Linux system ID to the partition (hex code 83).

```
Command  (m for help): t
Partition number (1-4): 1

Hex code (type L to list codes): 83

Command  (m for help): w
The partition table has been altered!

Calling ioctl() to re-read partition table.
SCSI device sdb: hdwr sector= 512 bytes. Sectors= 1953152 [953 MB] [1.0 GB]
 sdb: sdb1
SCSI device sdb: hdwr sector= 512 bytes. Sectors= 1953152 [953 MB] [1.0 GB]
 sdb: sdb1

WARNING: If you have created or modified any DOS 6.x partitions, please see the
fdisk manual page for additional information.
Syncing disks.
[root@yahoo /data]#
```

*Figure 19. Example of assigning a Linux system ID to the partition*

## Creating file systems on the SAN Volume Controller

Use this information when you are ready to create and use file systems on the SAN Volume Controller.

After you partition the disk, the next step is to create a file system. Figure 20 shows an example of how to use the **mke2fs** command to create an EXT2 Linux file system (which is nonjournaled).

```
[root@yahoo /data]# mke2fs /dev/vpathb1
mke2fs 1.18, 11-Nov-1999 for EXT2 FS 0.5b, 95/08/09
Filesystem label=
OS type: Linux
Block size=4096 (log=2)
Fragment size=4096 (log=2)
122112 inodes, 243964 blocks
12198 blocks (5.00%) reserved for the super user
First data block=0
8 block groups
32768 blocks per group, 32768 fragments per group
15264 inodes per group
Superblock backups stored on blocks:
32768, 98304, 163840, 229376

Writing inode tables: done
Writing superblocks and filesystem accounting information: done
[root@yahoo /data]#
```

*Figure 20. Example of creating a file with the mke2fs command*

Figure 21 on page 52 shows an example of how to create the EXT2 Linux file system (which is nonjournaled) by using the **mkfs** command.

```
[root@yahoo /data]# mkfs -t ext2 /dev/vpathb1
mke2fs 1.18, 11-Nov-1999 for EXT2 FS 0.5b, 95/08/09
Filesystem label=
OS type: Linux
Block size=4096 (log=2)
Fragment size=4096 (log=2)
122112 inodes, 243964 blocks
12198 blocks (5.00%) reserved for the super user
First data block=0
8 block groups
32768 blocks per group, 32768 fragments per group
15264 inodes per group
Superblock backups stored on blocks:
32768, 98304, 163840, 229376
Writing inode tables: done
Writing superblocks and filesystem accounting information: done
[root@yahoo /data]#
```

*Figure 21. Example of creating a file with the mkfs command*

# Known issues and limitations

There are known issues and limitations of attaching the SAN Volume Controller to an Intel® host running the Linux operating system.

The following IBM Web site provides the most current information about known restrictions:

http://www.ibm.com/storage/support/2145

## LUN set offline

On Intel-based hosts running the Linux operating system, in response to errors, the kernel might permanently disable a LUN and log a message that states both **device set offline** and the specific device.

The kernel typically sets a LUN offline to avoid a possible miscompare mechanism. The message is logged in the syslog, which is usually found in the /var/log/messages directory.

If you receive this message, try one of the following actions:

- Remove the module.
- Restart the host.

If you decide to remove the module or need additional details for setting the LUN online, see the *IBM System Storage Multipath Subsystem Device Driver: User's Guide*.

## Maximum file system size limits VDisk size

For certain Linux kernels, the maximum file system is less than the LUN maximum size supported by the SAN Volume Controller.

For 2.4 Linux kernels, the maximum file system size is 512 bytes less than 1 terabyte (TB). For these kernels, this means that your virtual disks are limited to 1 099 511 627 264 bytes of capacity.

# Chapter 8. Attaching to a host running the Microsoft Windows 2000 Server or Windows Server 2003 operating system

This information explains the requirements and other information for attaching the SAN Volume Controller to a host running the Windows® 2000 Server and Windows Server 2003 operating systems.

See the following Web site for a list of the supported operating systems: http://www.ibm.com/storage/support/2145.

The following Web site provides current interoperability information for operating systems: http://www.ibm.com/storage/support/2145.

## Attachment requirements for hosts running Windows 2000 Server and Windows Server 2003 operating systems

This section provides an overview of the requirements for attaching the SAN Volume Controller to a host running Windows 2000 Server and Windows Server 2003 operating systems.

The following list provides the requirements for attaching the SAN Volume Controller to your host:

- For the Windows Server 2003 x64 Edition operating system, you must install the Microsoft® Hotfix KB908980 (available from Microsoft support) before using it with the SAN Volume Controller. If you do not install the fix prior to operation, preferred pathing is not available.
- Check the LUN limitations for your host system. Ensure that there are enough fibre-channel adapters installed in the server to handle the total LUNs that you want to attach.
- Ensure that you have the documentation for your Windows operating system and the *IBM System Storage SAN Volume Controller: Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  http://www.ibm.com/storage/support/2145
- Ensure that you have installed the supported hardware and software on your host, including the following:
  - Operating system service packs and patches
  - Host Bus Adapters (HBAs)
  - HBA device drivers
  - Multipathing drivers
  - Clustering software

  The following Web site provides current interoperability information about HBA and platform levels:

  http://www.ibm.com/storage/support/2145

## Drivers and firmware for hosts running Windows 2000 Server and Windows Server 2003 operating systems

Ensure that you use the correct host bus adapter device driver and firmware levels for your hosts.

The following Web site provides current interoperability information about supported device driver and firmware levels:

http://www.ibm.com/storage/support/2145

## Installing the HBA driver for hosts running the Windows 2000 or 2003 operating system

After you install the host bus adapter (HBA) into the host machine, you must download and install the appropriate HBA driver.

Follow manufacturer's instructions to upgrade the BIOS levels for each type of HBA.

## Configuring the QLogic HBA for hosts running Windows 2000 Server and Windows Server 2003 operating systems

After you have installed the QLogic HBA and the device driver, you must configure the HBA.

To configure the QLogic host bus adapter (HBA), perform the following steps:

1. Restart the server.
2. When you see the QLogic banner, press the **Ctrl - Q** keys to open the FAST!UTIL menu panel.
3. From the Select Host Adapter menu, select the Adapter Type **QLA2***xxx*.
4. From the Fast!UTIL Options menu, select **Configuration Settings**.
5. From the Configuration Settings menu, click **Host Adapter Settings**.
6. From the Host Adapter Settings menu, select the following values:
   a. Host Adapter BIOS: **Disabled**
   b. Frame size: **2048**
   c. Loop Reset Delay: **5 (minimum)**
   d. Adapter Hard Loop ID: **Disabled**
   e. Hard Loop ID: **0**
   f. Spinup Delay: **Disabled**
   g. Connection Options: **1 - point to point only**
   h. Fibre Channel Tape Support: **Disabled**
   i. Data Rate: **2**
7. Press the **Esc** key to return to the Configuration Settings menu.
8. From the Configuration Settings menu, select **Advanced Adapter Settings**.
9. From the Advanced Adapter Settings menu, set the following parameters:
   a. Execution throttle: **100**
   b. Luns per Target: **0**
   c. Enable LIP Reset: **No**

d. Enable LIP Full Login: **Yes**
e. Enable Target Reset: **Yes**

**Note:** If you are using subsystem device driver (SDD) 1.6 or higher, set Enable Target Reset to **No**.

f. Login Retry Count: **30**
g. Port Down Retry Count: **30**
h. Link Down Timeout: **0**
i. Extended error logging: **Disabled (might be enabled for debugging)**
j. RIO Operation Mode: **0**
k. Interrupt Delay Timer: **0**

10. Press Esc to return to the Configuration Settings menu.
11. Press Esc.
12. From the Configuration settings modified window select **Save changes**.
13. From the Fast!UTIL Options menu, select **Select Host Adapter** and repeat steps 3 on page 54 to 12 if more than one QLogic adapter was installed.
14. Restart the server.
15. Ensure that the following registry key includes the required parameters:

| Key | Required parameters |
|---|---|
| **HKEY_LOCAL_MACHINE** → **SYSTEM** → **CurrentControlSet** → **Services** → *ql2xxx* → **Parameters** → **Device** → **DriverParameters** | `Buschange=0;FixupInquiry=1`<br><br>**Note:** If you are using qlogic driver version 9.1.2.11 or higher, Buschage cannot be set to zero. Refer to the documentation for your device driver for more information. |

16. Restart the system.

## Configuring the Emulex HBA for hosts running Windows 2000 Server and Windows Server 2003 operating systems

After you install the Emulex host bus adapter (HBA) and the driver, you must configure the HBA.

For the Emulex HBA StorPort driver, accept the default settings and set topology to 1 (1=F_Port Fabric). For the Emulex HBA FC Port driver, use the default settings and change the parameters given in Table 10.

**Note:** The parameters shown in parentheses correspond to the parameters in HBAnywhere.

*Table 10. Recommended configuration file parameters for the Emulex HBA*

| Parameters | Recommended Settings |
|---|---|
| Query name server for all N-ports (BrokenRSCN) | Enabled |
| LUN mapping (MapLuns) | Enabled (1) |
| Automatic LUN mapping (MapLuns) | Enabled (1) |
| Allow multiple paths to SCSI targets (MultipleSCSIClaims) | Enabled |

*Table 10. Recommended configuration file parameters for the Emulex HBA (continued)*

| Parameters | Recommended Settings |
|---|---|
| Scan in device ID order (ScanDeviceIDOrder) | Disabled |
| Translate queue full to busy (TranslateQueueFull) | Enabled |
| Retry timer (RetryTimer) | 2000 milliseconds |
| Maximum number of LUNs (MaximumLun) | Equal to or greater than the number of the SAN Volume Controller LUNs that are available to the HBA |

## Configuring the Windows 2000 Server and Windows Server 2003 operating systems

You must configure the Windows 2000 Server and Windows Server 2003 operating system before you can use the hosts with the SAN Volume Controller.

Before you configure the host operating systems, the following tasks must be completed:

- The IBM service representative must have installed the SAN Volume Controller.
- You must have installed the appropriate host bus adapter and driver on your host system.

After the prerequisite tasks are complete, use the following general steps to configure your operating system:

1. Zone the host system to the SAN Volume Controller on the Fibre Channel SAN.
2. Install the appropriate multipathing driver for your host system to enable the management of multiple paths to SAN Volume Controller virtual disks (VDisks).
3. Create the host system on the SAN Volume Controller, using the worldwide port names (WWPNs). Map the VDisks to the host as required.
4. Create volumes/disks on your host using instructions in your host system publications.

### Multipath support for host running the Windows 2000 Server and Windows Server 2003 operating systems

You must install a multipathing software on all attached hosts that run the Windows 2000 Server and Windows Server 2003 operating systems.

The following Web site provides current interoperability information:

http://www.ibm.com/storage/support/2145

#### Multipathing configuration maximums

When you configure, keep in mind the maximum configurations for hosts.

The following table provides the configuration maximums for hosts running the Windows 2000 Server and Windows Server 2003 operating systems:

| Object | Maximum | Description |
|---|---|---|
| VDisk | 512 (See Note 1.) | The maximum number of VDisks that can be supported by the SAN Volume Controller for a host running a Windows operating system (per host object). |
| Paths per VDisk (See Note 2.) | 8 | The maximum number of paths to each VDisk. The recommended number of paths is 4. |

**Notes:**

1. You can assign a maximum of 26 individual drive letters to a host running a Windows operating system. However, both Windows 2000 and Windows 2003 support submounting drives as directories within other drives.
2. SDD and SDDDSM for Windows actually support 16 paths per VDisk, but the SAN Volume Controller supports only a maximum of eight paths to support a reasonable path-failover time.

## SDD dynamic pathing on hosts running Windows 2000 Server and Windows Server 2003 operating systems

The subsystem device driver (SDD) for Windows supports dynamic pathing for hosts that run some versions of the Windows 2000 Server and Windows Server 2003 operating systems.

**Restriction:**

1. SDD is not supported on all operating systems. See the following Web site for the latest support information:

   http://www.ibm.com/storage/support/2145
2. When you use SDD for multipathing, you must use the FC Port driver for Emulex HBAs and SCSI Miniport driver for Qlogic HBAs.
3. The SDD driver can coexist on a host running the Windows 2000 Server operating system with the IBM DS4000 (FAStT) Redundant Dual Active Controller (RDAC) driver. Coexistence is not supported on hosts that run the Windows Server 2003 operating system. For supported levels of DS4000 RDAC, see the supported hardware list at the following Web site:

   http://www.ibm.com/storage/support/2145

SDD supports dynamic pathing when you add more paths to an existing VDisk and when you present a new VDisk to the host. No user intervention is required, other than is normal for a new device discovery under the Windows operating system.

SDD uses a load-balancing policy and tries to equalize the load across all preferred paths. If preferred paths are available, SDD uses the path that has the least I/O at the time. If SDD finds no available preferred paths, it tries to balance the load across all the paths it does find and uses the least active non-preferred path.

## MPIO/SDDDSM dynamic pathing

You can use the Microsoft Multipath I/O (MPIO) driver for dynamic pathing when you also use the IBM subsystem device driver device specific module (SDDDSM).

**Restriction:**

1. SDDSM is not supported on all operating systems. See the following Web site for the latest support information:

   http://www.ibm.com/storage/support/2145
2. When you use SDDDSM for multipathing, you must use the Storport Miniport driver for Emulex HBAs and the STOR Miniport driver for Qlogic HBAs.

MPIO supports dynamic pathing when you add more paths to an existing VDisk and when you present a new VDisk to the host. No user intervention is required, other than is normal for a new device discovery under a Windows operating system.

SDDDSM uses a load-balancing policy that tries to equalize the load across all preferred paths. If preferred paths are available, SDDDSM uses the path that has the least I/O at the time. If SDDDSM finds no available preferred paths, it tries to balance the load across all the paths it does find and uses the least active non-preferred path.

Path probing and reclamation is provided by MPIO and SDDDSM. For SDDDSM, the interval is set to 60 seconds. You can change this by modifying the following Windows system registry key: HKLM\SYSTEM\CurrentControlSet\Services\mpio\Parameters\PathVerificationPeriod

## Configuring hosts running Windows 2000 Server and Windows Server 2003 operating systems for SAN Boot

If you want to use the SAN Volume Controller as a boot device for a host running either the Windows 2000 Server or Windows Server 2003 operating system, you must configure the system correctly.

SAN boot is not supported on all operating systems. See the following Web site for the latest support information:

http://www.ibm.com/storage/support/2145

Use the following steps to configure the operating system:

1. Configure the SAN Volume Controller so that only the boot virtual disk (VDisk) is mapped to the host.
2. Configure the Fibre Channel SAN so that the host can see only one SAN Volume Controller node port. This means that there is only one path from the host to its boot disk.
3. Configure and enable the HBA BIOS.
4. Install the operating system, using the normal procedure, selecting the VDisk as the partition on which to install.
5. After the operating system and the subsystem device driver (SDD), the subsystem device driver device specific module (SDDDSM), or Microsoft Multipath I/O driver is installed, zoning should be modified to allow multiple paths.

   **Restriction:** For SDD, there can be no multipathing during the boot sequence, until after SDD is loaded.
6. Set redundant boot devices in the BIOS to allow the host to boot when its original boot path has failed.

## Clustering support for Windows 2000 Server and Windows Server 2003 operating systems

The SAN Volume Controller provides clustering support for Windows 2000 Server and Windows Server 2003 operating systems.

See the following Web site for supported cluster software and other information:

http://www.ibm.com/storage/support/2145

## Migrating existing SAN boot images

If you have a host that runs a Windows 2000 Server or Windows Server 2003 operating system and existing SAN boot images that are controlled by storage controllers, you can migrate these images to image-mode virtual disks (VDisks) that are controlled by the SAN Volume Controller.

Perform the following steps to migrate your existing SAN boot images:

1. If the existing SAN boot images are controlled by an IBM storage controller that uses SDD as the multipathing driver, you must use SDD v1.6 or higher. Run the SDD command `datapath set bootdiskmigrate 2145` to prepare for image migration. See the *IBM System Storage Multipath Subsystem Device Driver: User's Guide* for more information about this command.
2. Shut down the host.
3. Perform the following configuration changes on the storage controller:
   a. Remove all the image-to-host mappings from the storage controller.
   b. Map the existing SAN boot image and any other disks to the SAN Volume Controller.
4. Zone one port of each host bus adapter (HBA) to one of the SAN Volume Controller ports that is associated with the I/O group for the target image-mode VDisk.
5. Perform the following configuration changes on the SAN Volume Controller:
   a. Create an image-mode VDisk for the managed disk (MDisk) that contains the SAN boot image. Use the MDisk unique identifier to specify the correct MDisk.
   b. Create a host object and assign it to the HBA port that you zoned to the SAN Volume Controller port in step 4.
   c. Map the image mode VDisk to the host. For example, you might map the boot disk to the host with SCSI LUN ID 0.
   d. Map the swap disk to the host, if required. For example, you might map the swap disk to the host with SCSI LUN ID 1.
6. Change the boot address of the host by performing the following steps:
   a. Restart the host and open the BIOS utility of the host during the booting process.
   b. Set the BIOS settings on the host to find the boot image at the worldwide port name (WWPN) of the node that is zoned to the HBA port.
7. Boot the host in single-path mode.
8. Uninstall any multipathing driver that is not supported for SAN Volume Controller hosts that run the Windows 2000 Server or Windows Server 2003 operating system.
9. Install a supported multipathing driver.

10. Restart the host in single-path mode to ensure that the supported multipath driver was properly installed.
11. Zone each HBA port to one port on each SAN Volume Controller node.
12. Add additional HBA ports to the host object that you created in step 5b on page 59.
13. Configure the HBA settings on the host by using the following steps:
    a. Restart the host and open the host's BIOS utility during the booting process.
    b. Ensure that all HBA ports are boot-enabled and can see both nodes in the I/O group that contains the SAN boot image. Configure the HBA ports for redundant paths.
    c. Exit the BIOS utility and finish booting the host.
14. Map any additional VDisks to the host as required.

## Known issues and limitations for hosts running Windows 2000 Server and Windows Server 2003 operating systems

There are known issues and limitations when attaching to a host that runs Windows 2000 Server and Windows Server 2003 operating systems.

The following Web site provides the most current information about known restrictions for hosts and details about using the SAN boot feature with Microsoft clusters:

http://www.ibm.com/storage/support/2145

### Using the SAN boot feature with Microsoft clusters

Microsoft SAN Boot Clusters (MSCS) have the following Microsoft restrictions:

- On a host running a Windows 2000 operating system, server clusters require that the boot disk be on a different storage bus than the cluster server disks.
- On a host running a Windows 2003 operating system, it is required that the boot disk be on a different storage bus to the clustered disks.

The following Web site provides additional details about using the SAN boot feature with Microsoft clusters:

http://www.ibm.com/storage/support/2145

# Chapter 9. Attaching to a host running the Microsoft Windows NT operating system

These are requirements for attaching the SAN Volume Controller to a host running the Windows NT® operating system.

## Attachment requirements for hosts running the Windows NT operating system

This section provides an overview of the requirements for attaching the SAN Volume Controller to a host running the Windows NT operating system.

The following list provides the requirements for attaching the SAN Volume Controller to your host running the Windows NT operating system:

- Check the LUN limitations for your host system. Ensure that there are enough fibre-channel adapters installed in the server to handle the total LUNs that you want to attach.
- Ensure that you have the documentation for your Windows NT operating system and the *IBM System Storage SAN Volume Controller: Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  http://www.ibm.com/storage/support/2145
- Ensure that you have installed the supported hardware and software on your host, including the following:
  - Operating system service packs and patches
  - Host Bus Adapters (HBAs)
  - HBA device drivers
  - Multipathing drivers
  - Clustering software

  The following IBM Web site provides current interoperability information about HBA and platform levels:

  http://www.ibm.com/storage/support/2145

## Configuring the QLogic HBA for hosts running the Windows NT operating system

After you have installed the QLogic host bus adapter (HBA) and the device driver, you must configure the HBA.

To configure the QLogic HBA for a host that runs the Windows NT operating system, use the following steps:

1. Restart the server.
2. When you see the QLogic banner, press Ctrl+Q to get to the FAST!UTIL menu panel.
3. From the Select Host Adapter menu, select the Adapter Type QLA23*xx*.
4. From the Fast!UTIL Options menu, select **Configuration Settings**.
5. From the Configuration Settings menu, click **Host Adapter Settings**.

6. From the Host Adapter Settings menu, set the parameters and values as follows:
   a. Host Adapter BIOS: **Disabled**
   b. Frame size: **2048**
   c. Loop Reset Delay: **5 (minimum)**
   d. Adapter Hard Loop ID: **Disabled**
   e. Hard Loop ID: **0**
   f. Spinup Delay: **Disabled**
   g. Connection Options: **1 - point to point only**
   h. Fibre Channel Tape Support: **Disabled**
   i. Data Rate: **2**
7. Press Esc to return to the Configuration Settings menu.
8. From the Configuration Settings menu, select **Advanced Adapter Settings**.
9. From the Advanced Adapter Settings menu, set the following parameters:
   a. Execution throttle: **100**
   b. Luns per Target: **0**
   c. Enable LIP Reset: **No**
   d. Enable LIP Full Login: **Yes**
   e. Enable Target Reset: **Yes**
   f. Login Retry Count: **30**
   g. Port Down Retry Count: **30**
   h. Link Down Timeout: **0**
   i. Extended error logging: **Disabled (might be enabled for debugging)**
   j. RIO Operation Mode: **0**
   k. Interrupt Delay Timer: **0**
10. Press Esc to return to the Configuration Settings menu.
11. Press Esc.
12. From the Configuration settings modified window select **Save changes**.
13. From the Fast!UTIL Options menu, select **Select Host Adapter** and repeat steps 3 on page 61 to 12, if more than one QLogic adapter has been installed.
14. Restart the server.
15. Ensure that the following registry key includes the required parameters.

| Key | Required parameters |
|---|---|
| **HKEY_LOCAL_MACHINE** → **SYSTEM** → **CurrentControlSet** → **Services** → *ql2xxx* → **Parameters** → **Device** → **DriverParameters** | `Buschange=0;FixupInquiry=1` |

16. Restart the system.

## Configuring the Windows NT operating system

You must configure the operating system before you can use hosts running the Windows NT operating system.

Before you configure the host operating systems, the following tasks must be completed:

- The IBM service representative must have installed the SAN Volume Controller.

- You must have installed the appropriate host bus adapters.

After the prerequisite tasks are complete, use the following general steps to configure your Windows NT operating system.

1. Zone the host system to the SAN Volume Controller on the fibre-channel SAN.
2. Install the appropriate multipathing driver for your host system to enable the management of multiple paths to SAN Volume Controller virtual disks (VDisks).
3. Create the host system on the SAN Volume Controller, using the worldwide port names (WWPNs). Map the VDisks to the host as required.
4. Create volumes/disks on your host using instructions in your host system publications.

## Multipath support for hosts running the Windows NT operating system

You must install a multipathing software on all hosts running the Windows NT operating system that are attached to the SAN Volume Controller.

For hosts that run the Windows NT operating system, you must use the following driver for multipathing support:

- Subsystem device driver (SDD)

### SDD dynamic pathing on hosts running the Windows NT operating system

The subsystem device driver (SDD) for Windows supports dynamic pathing for hosts that run the Windows NT operating system.

SDD supports dynamic pathing when you add more paths to an existing VDisk and when you present a new VDisk to the host. No user intervention is required, other than is normal for a new device discovery under Windows operating systems.

Preferred paths are also supported with SDD for Windows. When you use clustering, SDD is aware of the preferred paths that the SAN Volume Controller sets for each VDisk. In this case, SDD uses its reserve policy to reserve a single path to the device and uses a preferred path if one is available. If you do not use clustering, SDD uses its load-balancing policy that tries to equalize the load across all preferred paths. If preferred paths are available, SDD uses the path that has the least I/O at the time. If SDD finds no available preferred paths, it tries to balance the load across all the paths it does find and uses the least active non-preferred path.

When you configure, keep in mind the SDD for Windows maximum configuration, which is provided in Table 11.

*Table 11. Configuration maximums for SDD for Windows*

| Object | SDD maximum | Description |
|---|---|---|
| VDisk | 512 (See Note 1.) | The maximum number of VDisks that can be supported by the SAN Volume Controller for a host that runs a Microsoft Windows operating system (per host object). |

*Table 11. Configuration maximums for SDD for Windows (continued)*

| Object | SDD maximum | Description |
|---|---|---|
| Paths per VDisk (See Note 2.) | 8 | The maximum number of paths to each VDisk. |
| **Notes®:**<br>1. You can assign a maximum of 26 individual drive letters to a host that runs the Windows NT operating system.<br>2. SDD for Windows supports 16 paths per VDisk, but SAN Volume Controller supports only a maximum of eight paths to ensure a reasonable path-failover time. | | |

## Clustering support for hosts running the Windows NT operating system

The SAN Volume Controller does not provide clustering support for hosts that run the Windows NT operating system.

## SAN boot support for hosts running the Windows NT operating system

The SAN Volume Controller does not provide SAN boot support for hosts that run the Windows NT operating system.

## Configuration for availability and recovery

This information provides a quick explanation of the configuration for availability and recovery.

The host adapter uses the time-out parameter to bind its recovery actions and responses to the disk subsystem. The value exists in different places in the system configuration. You can retrieve and use it in different ways depending on the type of host adapter that is installed.

## Setting the TimeOutValue registry

The Windows NT HBA uses the time-out parameter to bind its recovery actions and responses to the disk subsystem.

This information provides the steps required for setting the TimeOutValue registry on a host running the Windows NT operating system.

1. From the **Run** menu or command prompt, type:
   ```
   Regedit32.exe
   ```
2. Navigate to the following registry key:
   ```
   HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Disk
   ```
3. Look for the value called `TimeOutValue`. If the value called `TimeOutValue` does not exist, go to step 3a. If the `TimeOutValue` exists, go to step 4 on page 65.
   a. Click **Edit → Add Value...**
   b. For ValueName, type: `TimeOutValue`.
   c. For data type, type: `REG-DWORD`.
   d. Click **OK**.
   e. For Value data, type: `3c`.
   f. For Base, click **Hex**.
   g. Click **OK**.

4. If the value exists and is less than 0x0000003c (60 decimal), perform the following steps to increase it to 0x3c.
   a. Click **TimeOutValue**.
   b. Click **Edit → DWORD...**.
   c. For Value data, type: 3c.
   d. For Base, click **Hex**.
   e. Click **OK**.
5. Exit the Regedit32 program.
6. Restart your Windows NT server for the changes to take effect.

# Chapter 10. Attaching to a host running a Novell NetWare operating system

This information explains the requirements and other information for attaching the SAN Volume Controller to a host running the Novell NetWare operating system.

## Attachment requirements for hosts running NetWare operating systems

This section provides an overview of the requirements for attaching the SAN Volume Controller to a host that runs a Novell NetWare operating system.

- Ensure that there are enough fibre-channel adapters installed in the server to handle the total LUNs that you want to attach.
- Ensure that you have the documentation for the NetWare operating system and the *IBM System Storage SAN Volume Controller: Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  http://www.ibm.com/storage/support/2145
- Ensure that you have installed the correct operating systems and version levels on your host. Be sure to review the device driver installation documents and configuration utility documents for any additional NetWare patches that you might need.

### NetWare environments

Ensure that each host that runs a Novell NetWare operating system uses a supported level of the operating system.

The following IBM Web site provides current interoperability information about supported operating system levels:

http://www.ibm.com/storage/support/2145

### HBAs for hosts running NetWare operating systems

Ensure that your hosts that run a Novell NetWare operating system use the correct host bus adapters (HBAs).

The SAN Volume Controller supports hosts running the NetWare operating system that use the following HBA type:

- QLogic (on IBM xSeries® platforms)

The following IBM Web site provides current interoperability information about HBA and platform levels:

http://www.ibm.com/storage/support/2145

### Drivers and firmware for hosts running NetWare operating systems

Be sure that you use the correct host bus adapter device driver and firmware levels for your hosts that run a Novell NetWare operating system.

The following IBM Web site provides current interoperability information about device driver and firmware levels:

http://www.ibm.com/storage/support/2145

## Installing an HBA on a host running NetWare operating systems

The first step for attaching a host that runs the NetWare operating system is to install the host bus adapter (HBA).

Before you install the HBA, ensure that it is supported by the SAN Volume Controller. See the supported hardware list at the following IBM Web site if you need to verify that the HBA is supported:

http://www.ibm.com/storage/support/2145

To install the HBA, use the following general steps:

1. Shutdown your host and its attached peripherals, following the manufacturer's recommendations.
2. Install the HBA, using the adapter manufacturer's installation instructions.

## Installing the HBA driver on hosts running NetWare operating systems

Follow the instructions provided by Novell to install the HBA drivers and firmware. Installing these components should be part of the NetWare installation and setup process.

## Configuring the NetWare operating system

You must configure the operating system before you can use hosts that run a Novell NetWare operating system with the SAN Volume Controller.

Before you configure the host operating systems, the following tasks must be completed:

- The IBM service representative must have installed the SAN Volume Controller.
- You must have installed the appropriate host bus adapters.

After the prerequisite tasks are complete, use the following general steps to configure your host system.

1. Define the host system with the worldwide port name identifiers. You will have to locate the list of worldwide port names.
2. Define the fibre-port configuration if it was not done during the installation of the SAN Volume Controller or fibre-channel adapters.
3. Configure the host system for the SAN Volume Controller by using the instructions in your NetWare publications.

### Multipath support for hosts running NetWare operating systems

You must install a multipathing software on all hosts that run a NetWare operating system and are attached to the SAN Volume Controller.

On hosts that run a NetWare operating system, the following software provides multipathing support:

- Novell Storage Services (NSS)

### Configuring multipath support for hosts running NetWare operating systems

You must configure the Novell Storage Services (NSS) for multipath support.

Perform the following steps to configure NSS for multipathing:

1. Find and open the \NWSERVER\STARTUP.NCF file.
2. Enable asynchronous event notification by finding the LOAD SCSIHD.CDM line and adding AEN to the end of the line. The following line provides an example for a line that enables asynchronous event notification:

   ```
   LOAD SCSIHD.CDM AEN
   ```
3. Set multipathing support by adding the following line to the top of the file:

   ```
   SET MULTI-PATH SUPPORT=ON
   ```
4. Configure the host bus adapters (HBAs) by performing the following steps:
   a. Locate a line in the file that loads a fibre-channel HBA (for example `LOAD QL2300.HAM SLOT=101`).
   b. Add the LUNS, MAXLUNS, ALLPATHS, and PORTNAMES parameters, separated by spaces, to the end of the line. Use the following syntax:

      ```
      LOAD adapter_driver_file SLOT=slot_number /LUNS
        /MAXLUNS=max_number_luns /ALLPATHS /PORTNAMES
      ```

      where *adapter_driver_file* is the file name for the HBA driver, *slot_number* is the number of the slot where the HBA is located, and *max_number_luns* is the maximum number of logical unit numbers (LUNs) that are allowed during the LUN scan.

      An example line is provided below:

      ```
      LOAD QL2300.HAM SLOT=101 /LUNS /MAXLUNS=64 /ALLPATHS /PORTNAMES
      ```
   c. Repeat step 4a and step 4b for each line in the file that loads a fibre-channel host bus adapter.
5. Find and open the SYS:\SYSTEM\AUTOEXEC.NCF file.
6. Insert the following line above the line that reads **MOUNT ALL**:

   ```
   SCAN FOR NEW DEVICES
   ```

## Clustering support for hosts running NetWare operating systems

The SAN Volume Controller supports clustering for hosts that run NetWare operating systems.

Table 12 provides information about the cluster software supported for hosts that run a NetWare operating system.

*Table 12. Clustering software supported for hosts running a NetWare operating system*

| Operating system | Cluster software | Vendor |
|---|---|---|
| NetWare | Novell Cluster Services | Novell |

### Configuring clustering support for hosts running NetWare operating systems

You must configure the Novell Storage Services (NSS) for clustering support.

Perform the following steps to configure NSS for clustering:

1. Find and open the SYS\SYSTEM\LDNCS.NCF file.
2. Configure NSS to prevent clustered hosts from entering a failover cascade when a single host fails by using the following steps:
   a. Find the line containing CLSTRLIB.
   b. Add the /HMO=OFF parameter (for example, `CLSTRLIB /HMO=OFF` ).
3. Configure NSS to prevent hosts from entering the recovery state following cluster or IO errors by ensuring that the SET AUTO RESTART AFTER ABEND line is set to 3. For example, the line must look similar to the following line:

   ```
   SET AUTO RESTART AFTER ABEND=3
   ```

   A value of 3 causes the host to immediately restart following a cluster or I/O abend. A value less than 3 will cause the host to enter and remain in the recovery state with its network card disabled.

## SAN boot support for hosts running NetWare operating systems

The SAN Volume Controller provides SAN boot support for NetWare hosts, booted from a single SAN Volume Controller VDisk.

Create an appropriately-sized installation VDisk and map it to the NetWare host. Follow the manufacturer's installation instructions and proceed with the installation of the NetWare operating system. When you are prompted to select an installation target, select the previously-defined SAN Volume Controller VDisk.

# Chapter 11. Attaching to IBM N Series, NetApp V-Series or gFiler NAS servers

This information provides an overview for attaching the SAN Volume Controller to IBM N Series, NetApp V-Series, or gFiler NAS servers.

## Attachment requirements for IBM N Series, NetApp V-Series or gFiler NAS servers

This section provides an overview of the requirements for attaching the SAN Volume Controller to a IBM N Series, NetApp V-Series or gFiler NAS servers.

- Check the LUN limitations for your server. Ensure that there are enough Fibre Channel adapters installed in the server to handle the total LUNs that you want to attach.
- Ensure that you have the documentation for your server and the *IBM System Storage SAN Volume Controller: Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  http://www.ibm.com/storage/support/2145
- Ensure that you have installed the correct operating system level on your server.

## Installing the HBA and driver on IBM N Series, NetApp V-Series or gFiler NAS servers

The servers are supplied with preinstalled host bus adapters (HBAs). If additional HBAs are required, contact your service representative for advice on which model of HBA to install.

The Data ONTAP installation on your server includes the HBA driver, so no special installation steps are necessary for the HBA driver.

## Configuring the Data ONTAP software for IBM N Series, NetApp V-Series or gFiler NAS servers

You must configure the Data ONTAP software before you can use these servers with the SAN Volume Controller.

Use one of the following methods to create an external root volume:

- Create a VDisk on your SAN Volume Controller and map it to your server.
- Partition and zone a back-end storage controller so that your server can directly access a suitable volume to use as its root volume.

Before you configure the Data ONTAP software, the IBM service representative must have installed the SAN Volume Controller.

After the prerequisite task is complete, use the following general steps to configure your Data ONTAP software:

1. Zone the server to the SAN Volume Controller on the fibre-channel SAN. Ensure that exactly two paths exist between the server and each I/O group on the SAN Volume Controller. For redundancy, configure the switch zoning so

that host bus adapter (HBA) port A in the server is zoned with a single connection to SAN Volume Controller node A in an I/O Group, while HBA port B in the server is zoned with a single connection to SAN Volume Controller node B in the same I/O group. When you use a SAN Volume Controller cluster with multiple I/O Groups, each HBA port in the server should be zoned to one SAN Volume Controller node in each I/O Group.

2. Create the host system on the SAN Volume Controller, using the worldwide port names (WWPNs) of the HBAs in the server. For clustered server configurations, create a single host system on the SAN Volume Controller, using the combined WWPNs of the HBAs in all of the servers that participate in the cluster. Map the VDisks to the host system as required.
3. Create aggregates and volumes on your server using the instructions in your host system publications.

## Managing VDisks with IBM N Series, NetApp V-Series or gFiler NAS servers

Before you manage your virtual disks (VDisks) on your server, you must consider some important issues.

The following information is important when managing your VDisks:

- If you use the *–fmtdisk* parameter or the SAN Volume Controller Console to create a formatted VDisk on a SAN Volume Controller that you want to map to the server, wait until the format operation completes before creating the host mapping to associate the VDisk with the server.
- The server does not support shrinkage or expansion of VDisks. Shrinkage is not possible, but to achieve the same effect as expansion, you can perform the following steps:
  1. Create a new VDisk on the SAN Volume Controller.
  2. Map the new VDisk to the server.
  3. Use the server management tools to add the new VDisk to the desired server aggregate.

## Limitations and restrictions when using IBM N Series, NetApp V-Series or gFiler NAS servers

Before you use your server, ensure that you are familiar with the limitations and restrictions.

Review the following limitations and restrictions:

1. You cannot use SAN Volume Controller Copy Services (FlashCopy, Metro Mirror, and Global Mirror) to copy VDisks that are mapped to these servers. This limitation applies only to VDisks that are mapped to these servers and does not restrict the use of Copy Services on other VDisks.
2. The maximum supported VDisk size is 500 GB, which equates to 500x1024x1024x1000 bytes. However, the *minimum* supported VDisk size is 1 GB, which equates to 1024x1024x1024 bytes. The definition for 1 GB used in SAN Volume Controller is 1024x1024x1024 bytes, so mapping a 1GB SAN Volume Controller VDisk to these servers works, but mapping a 500 GB SAN Volume Controller VDisk to these servers fail.
3. VDisks that are mapped to these servers can be moved between I/O Groups on SAN Volume Controller, but you must halt the server before you do this.

4. You cannot map VDisks to these servers as LUN 0. This is the default behavior when creating a host mapping on SAN Volume Controller, and you must override this by using the -scsi switch for the `mkvdiskhostmap` command.
5. You can import pre-existing server LUNs to the SAN Volume Controller in image mode, except for the server's root volume. If the SAN Volume Controller is introduced into an existing server installation, either:
   - The server root file system must be rebuilt using a new VDisk that is presented by the SAN Volume Controller.
   - The server root file system must remain on the original controller and be directly accessed by the server (and masked from the SAN Volume Controller by, for example, LUN Partitioning or switch zoning).
6. The server and SAN Volume Controller might share a back-end storage controller if *both* of the following apply:
   - Appropriate LUN Partitioning is in place on the back-end storage controller
   - The back-end controller is supported by both the server and the SAN Volume Controller

# Chapter 12. Attaching to an SGI Origin host running the SGI IRIX operating system

This information provides the requirements and other information for attaching the SAN Volume Controller to a Silicon Graphics (SGI) Origin host running the SGI IRIX operating system.

## Attachment requirements for SGI Origin hosts

This section provides an overview of the requirements for attaching the SAN Volume Controller to an SGI Origin server running the IRIX operating system.

The requirements for attaching the SAN Volume Controller to your SGI Origin host system running the IRIX operating system are as follows:

- Check the LUN limitations for your host system. Ensure that there are enough fibre-channel adapters installed in the server to handle the total LUNs that you want to attach.
- Ensure that you have the documentation for your host system and the *IBM System Storage SAN Volume Controller: Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  http://www.ibm.com/storage/support/2145
- Ensure that you have installed the correct operating system level and any updates.
- Review device driver installation documents and configuration utility documents for additional patches that you might need.

### Environments for SGI Origin hosts

Ensure that your SGI Origin host uses a supported operating system and version.

The SAN Volume Controller supports SGI Origin hosts that run the IRIX Operating System version 6.5.16 or higher.

The following Web site provides current interoperability information about supported software levels:

http://www.ibm.com/storage/support/2145

### HBAs for SGI Origin hosts

Ensure that your SGI Origin hosts use the correct host bus adapters (HBAs).

The SAN Volume Controller supports SGI Origin hosts running the IRIX operating system that use QLogic HBAs.

The following IBM Web site provides current interoperability information about supported HBAs:

http://www.ibm.com/storage/support/2145

### Drivers and firmware for SGI Origin hosts

Be sure that you use the correct host bus adapter device driver and firmware levels for SGI Origin hosts running on the IRIX operating system.

The IRIX operating system includes the QLogic HBA driver, so no special installation steps are necessary for the QLogic HBA driver. The following IBM Web site provides current interoperability information about device driver and firmware levels:

http://www.ibm.com/storage/support/2145

## Installing the HBA on an SGI Origin host

The first step for attaching the SGI Origin host is to install the host bus adapter (HBA).

Before you install the HBA, ensure that the adapter is supported by the SAN Volume Controller. See the supported hardware list at the following IBM Web site if you need to verify that the HBA is supported:

http://www.ibm.com/storage/support/2145

To install the HBA, use the following general steps:

1. Shut down your host and its attached peripherals, following the manufacturer's recommendations.
2. Install the HBA, using the manufacturer's installation instructions.

## Configuring the QLogic HBA for SGI Origin hosts

After you install the QLogic host bus adapter (HBA) and driver, you must configure the HBA.

### XVM Volume Manager failover capability

The SAN Volume Controller supports version 2 of XVM failover capability for SGI Origin hosts.

The *XVM Volume Manager Administrator's Guide* describes the configuration and administration of XVM logical volumes.

You must create and edit the /etc/failover2.conf file.

To set up the SGI host, complete the following steps:

1. Rescan the HBA ports: `scsiha -rp <device>`.
2. Find the physical paths of volumes within XVM: `show -v *`.
3. Create SGI labels and partitions on the volume: `/usr/bin/fx -x -d <physical path>`.
4. Manually create the /etc/failover2.conf file. For HBA load balancing, use different paths.
5. Either restart the SGI host or initialize failover.
6. Label volumes within XVM: `label -name <labelname> <path>`.
7. Create slices and volumes within XVM: `slice -volname <volname> /phys/<name>`.

8. Create the xfs filesystem on the volumes: `mkfs -t xfs <path>`.
9. Create mount directories.
10. Mount the volumes.
11. Update /etc/fstab.

The following output provides an example of the failover2.conf file:

```
#lun0_svc
 /dev/dsk/5005076801000deb/lun0vol/c4p400000 affinity=0
 /dev/dsk/5005076801000deb/lun0vol/c3p200000 affinity=0
 /dev/dsk/5005076801000df8/lun0vol/c3p100000 affinity=1
 /dev/dsk/5005076801000df8/lun0vol/c4p300000 affinity=1
#lun1_svc
 /dev/dsk/5005076801000deb/lun1vol/c3p100000 affinity=0
 /dev/dsk/5005076801000deb/lun1vol/c4p300000 affinity=0
 /dev/dsk/5005076801000df8/lun1vol/c4p400000 affinity=1
 /dev/dsk/5005076801000df8/lun1vol/c3p200000 affinity=1
```

To display, configure, or change the settings for the XVM physical volumes, complete the following steps:

- Use the XVM hardware inventory command to display the actual status for preferred / alternate paths: `hinv –c disk`
- Use the XVM foconfig command to parse the failover2.conf file on a running system and configure the settings for the preferred or alternate path.
- Use the XVM foswitch command to change the settings for the preferred or alternate path and access a physical volume.

## SAN boot support on SGI Origin hosts

SGI does not support SAN boot for SGI Origin hosts that run the IRIX operating system.

# Chapter 13. Attaching to a Sun SPARC host

This information provides an overview for attaching the SAN Volume Controller to a Sun SPARC host running a Solaris operating system.

## Attachment requirements for Sun SPARC hosts

This section provides an overview of the requirements for attaching the SAN Volume Controller to Sun SPARC hosts.

The requirements for attaching the SAN Volume Controller to your Sun host system are as follows:

- Check the LUN limitations for your host system. Ensure that there are enough fibre-channel adapters installed in the server to handle the total LUNs you want to attach.
- Ensure that you have the documentation for your host system and the *IBM System Storage SAN Volume Controller: Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  http://www.ibm.com/storage/support/2145
- Ensure that you have installed the correct operating system level and any updates.
- Review device driver installation documents and configuration utility documents for additional patches that you might need.

### Environments for Sun SPARC hosts

Ensure that each host uses a supported operating system and version.

The SAN Volume Controller supports Sun SPARC hosts that run the following operating systems:

- Solaris 8, SPARC Platform Edition
- Solaris 9, SPARC Platform Edition
- Solaris 10, SPARC Platform Edition

The following IBM Web site provides current interoperability information about supported software levels:

http://www.ibm.com/storage/support/2145

### HBAs for Sun SPARC hosts

Ensure that your Sun SPARC hosts use the correct host bus adapters (HBAs).

The following IBM Web site provides current interoperability information about HBA levels:

http://www.ibm.com/storage/support/2145

### Drivers and firmware for Sun SPARC hosts

Be sure that you use the correct host bus adapter device driver and firmware levels for your Sun SPARC hosts.

The following IBM Web site provides current interoperability information about device driver and firmware levels:

http://www.ibm.com/storage/support/2145

## Installing the HBA on a Sun SPARC host

The first step for attaching the Sun SPARC host is to install the host bus adapter (HBA).

Before you install the HBA, ensure that the adapter is supported by the SAN Volume Controller. See the supported hardware list at the following Web site if you need to verify that the HBA is supported:

http://www.ibm.com/storage/support/2145

Use the manufacturer's instructions to install the HBA.

## Installing the HBA driver

After you install the host bus adapter (HBA) into the host machine, you must download and install the appropriate HBA driver.

Use the manufacturer's instructions to install the driver.

## Configuring the HBA on the Sun SPARC host

After you install the host bus adapter (HBA) and driver on your Sun SPARC host, you must configure the HBAs.

### Configuring the JNI or AMCC HBA

After you have installed the JNI or AMCC host bus adapter (HBA) and the driver, you must configure the HBA.

**Note:** JNI and AMCC adapters are supported only on Solaris 8 and 9.

To configure an HBA for the Solaris operating system, use the following steps.

1. Edit the jnic146x.conf file to set up the HBA connection to the switch fabric so that the file contains the following settings:

```
automap=1; (dynamic binding)
FcLoopEnabled=0;
FcFabricEnabled=1;
TargetOfflineEnable=0;
LunDiscoveryMethod=1;  (this is typically the default)
LunRecoveryInterval=10000;
```

   **Note:** If you are using the subsystem device driver (SDD) or are SAN booting the machine, you must use static port binding. Otherwise, use dynamic binding.

2. Modify the sd.config file (in the /kernel/drv/ directory) to inform the Solaris operating system about the new SCSI target device and LUNs. For example, if you had four LUNs, you would add lines similar to the following example lines:

```
name="sd" class="scsi" target=0 lun=0;
name="sd" class="scsi" target=0 lun=1;
name="sd" class="scsi" target=0 lun=2;
name="sd" class="scsi" target=0 lun=3;
```

3. Register the HBA ports and map virtual disks (VDisks) to the host using the following steps.

   **Note:** If a monitor is attached to the host, the user interface will display. If no monitor is attached, you must use an xhost capable client with an attached monitor.

   a. Log on to the attached console of the Sun or the remote host with xhost capability.
   b. Start the EZ Fibre configuration utility by entering the following:

      ```
      /opt/jni/ezfibre/standalone/ezf
      ```

      The user interface will display a list with both adapters listed, and all of the connected remote ports listed as targets.
   c. Use the SAN Volume Controller command-line interface or the SAN Volume Controller Console to register the HBA ports with the SAN Volume Controller.
   d. Create the necessary VDisks and map them to the host.

      **Note:** You can obtain the HBA worldwide port name (WWPN) from the /var/adm/messages file, the EZ Fibre utility, the SAN Volume Controller candidate HBA port list, or by using the Solaris prtconf tool.
   e. When the VDisks are created and mapped, restart the host with the `reboot -- -r` command.
4. After the host has been restarted, restart the EZ Fibre configuration utility. It should show all of the available VDisks under the listing of their corresponding HBA targets.
5. Decide if you want to use dynamic port binding or static (persistent) port binding. If you are using the subsystem device driver (SDD) or are SAN booting the machine, you must use static port binding. Otherwise, use dynamic binding.
6. If you decide to use static binding, use the following steps to map the SAN Volume Controller controlled VDisks to the host with persistent bindings:
   a. Using the EZ Fibre utility, select an HBA.
   b. Select the third tab on the HBA panel.
   c. Click **Select All**.
   d. Click **Commit**.
   e. Click **Activate Changes**.
   f. Select the same HBA.
   g. On the first panel, change the **Dynamic Binding** tab to **Disabled**.
   h. Click **Commit**.
   i. Click **Activate Changes**.
   j. Repeat steps 6a through 6i until you have performed it on all of the HBAs.

      **Attention:** The EZ Fibre configuration utility appends any changes to the end of the /kernel/drv/jnic146x.conf file. After multiple reconfigurations, this file can become very large. Make a copy of the jnic146x.conf file after installing the driver and restore it before making any configuration changes.

7. Restart the host and examine the /var/adm/messages file to ensure that the HBA is set up as a switch-fabric connection.

### Parameter settings for JNI or AMCC HBAs

As part of the configuration process, set the parameters for the host bust adapters (HBAs) on the Sun SPARC hosts.

For the most current information about Fibre Channel adapter parameter settings, see http://www.ibm.com/storage/support/2145.

## Configuring the Emulex HBA for Sun SPARC hosts

After you have installed the Emulex host bus adapter (HBA) and the driver on the Sun SPARC host, you must configure the HBA.

To configure the Emulex HBA for a Sun SPARC host, use the following steps:

1. Modify the sd.conf file (in the /kernel/drv/ directory) to inform the Solaris operating system about the new SCSI target device and LUNs. For example, if you had four LUNs, you would add lines similar to the following example lines:

   ```
   name="sd" class="scsi" target=0 lun=0;
   name="sd" class="scsi" target=0 lun=1;
   name="sd" class="scsi" target=0 lun=2;
   name="sd" class="scsi" target=0 lun=3;
   ```

2. Register the HBA ports and map virtual disks (VDisks) to the host using the following steps.
   a. Log on to the attached console of the Sun or the remote host with xhost capability.
   b. Download and install the HBAnyware utility from http://www.emulex.com/support/.
   c. Start the HBAnyware configuration utility by entering the following:

      ```
      /usr/sbin/hbanyware/hbanyware
      ```

      The user interface will display a list with both adapters listed, and all of the connected remote ports listed as targets.
   d. Use the SAN Volume Controller command line interface or graphical user interface to register the HBA ports with the SAN Volume Controller.
   e. Create the necessary VDisks and map them to the host.

      **Note:** You can obtain the HBA worldwide port name (WWPN) from the /var/adm/messages file, the HBAnyware utility, the SAN Volume Controller/SIS candidate HBA port list, or by using the Solaris prtconf tool.
   f. When the VDisks are created and mapped, restart the host with the `reboot -- -r` command.
3. After the host has been restarted, restart the HBAnyware utility. It should show all of the available VDisks under the listing of their corresponding HBA targets.
4. Decide whether you will use dynamic port binding or static port binding. If you are using the subsystem device driver (SDD) or are SAN booting the machine, you must use static port binding. Otherwise, use dynamic binding. If you use static port binding with the SAN Volume Controller VDisks, perform the following steps:
   a. Run the lputil utility by entering the following:

      ```
      /usr/sbin/lpfc/lputil
      ```

b. From the **Main Menu**, press 5 (Persistent Bindings).
c. From the **Persistent Bindings Menu**, press 1 (Display Current® Bindings). Ensure that there are no current bindings. If there are any existing mappings, remove them.
d. Again, from the **Persistent Bindings Menu**, press 5 (Bind Automapped Targets) and then press the appropriate number to select adapter 0. Assuming that your SAN Volume Controller has four nodes, you should see four targets.
e. Press Enter and then enter `Y` (Yes) to bind the targets.
f. Repeat steps 4d through 4e for adapter 1. After you complete these steps, when you display the current bindings (by pressing 1 from the **Persistent Bindings Menu**), eight persistent targets should display.

5. Restart the host and examine the /var/adm/messages file to ensure that the Emulex HBA is set up as a switch-fabric connection.

## Configuring the QLogic HBA for Sun SPARC hosts

After you have installed the QLogic host bus adapter (HBA) and the driver, you must configure the HBA.

To configure the HBA, use the following steps:

1. Set up the HBA connection to the switch fabric by editing the **qla*xx*00.conf** configuration file. (When you install the driver, this file is installed in the **/kernel/drv/** directory.) Make the following changes in the file:
   a. Set the maximum number of LUNs by adding or editing the following line. You can change the value of `8` to match the maximum number of LUNs that you need.
      ```
      Hba0-maximum-luns-per-target=8;
      ```
   b. Set the HBA to fabric-only mode by including the following line:
      ```
      Hba0-connection-options=2;
      ```
2. Decide if you must use dynamic port binding or static port binding. If you are using the subsystem device driver (SDD) or are SAN booting the machine, you must use static port binding. Otherwise, use dynamic binding. If you use static port binding, make the following changes to the configuration file:
   a. Add a line that is similar to the following example:
      ```
      hba0-SCSI-target-id-2-fibre-channel-port-name="50057680130018";
      ```
   b. Set the Automap parameter to `0` as shown below:
      ```
      Automap=0;
      ```
3. Restart the host and examine the /var/adm/messages file to ensure that the HBA is set up as a switch-fabric connection.

## Configuring the Solaris operating system

You must configure the Solaris operating system before you can use Sun SPARC hosts with the SAN Volume Controller.

Before you configure the Solaris operating system, the following tasks must be completed:

- The IBM service representative must have installed the SAN Volume Controller.
- You must have installed the appropriate host bus adapters.

After the prerequisite tasks are complete, use the following general steps to configure your Solaris operating system.

1. Zone the host system to the SAN Volume Controller on the fibre-channel SAN.
2. Install the appropriate multipathing driver for your host system to enable the management of multiple paths to SAN Volume Controller virtual disks (VDisks).

   **Note:** The subsystem device driver (SDD) does not support the Solaris operating system in a clustering environment.
3. Create the host system on the SAN Volume Controller, using the worldwide port names (WWPNs). Map the VDisks to the host as required.
4. Create volumes/disks on your host using instructions in your host system publications.

## Setting the Sun SPARC host parameters for use with IBM SDD and Symantec or Veritas DMP

You can set the parameters on the Sun SPARC host to optimize the performance between the HBA and the SAN Volume Controller.

To set the system parameters for optimum performance with the supported HBA, use the following instructions:

1. Type `cd /etc` to change to the /etc subdirectory.
2. Back up the system file in the subdirectory.
3. Edit the system file, and set the following parameters for servers with configurations that use the HBA:

   **sd_max_throttle**

   The sd_max_throttle parameter specifies the maximum number of commands that the sd driver can queue to the host adapter driver. The default value is 256, but you must set the parameter to a value less than or equal to a maximum queue depth for each LUN that is connected. Determine the value by using the following formula:

   `256 ÷ (`*`LUNs per adapter`*`)`

   where *LUNs per adapter* is the largest number of LUNs assigned to a single adapter.

   To set the sd_max_throttle parameter for the SAN Volume Controller LUNs in this example, you would add the following line to the /etc/system file:

   ```
   set sd:sd_max_throttle=5
   ```

   **sd_io_time**

   This parameter specifies the time-out value for disk operations. Add the following line to the /etc/system file to set the sd_io_time parameter for the SAN Volume Controller LUNs:

   ```
   set sd:sd_io_time=0x78
   ```

   **sd_retry_count**

   This parameter specifies the retry count for disk operations. Add the following line to the /etc/system file to set the sd_retry_count parameter for the SAN Volume Controller LUNs:

   ```
   set sd:sd_retry_count=5
   ```

**maxphys**

This parameter specifies the maximum number of bytes that you can transfer for each SCSI transaction. The default value is 126976 (124 KB). If the I/O block size that you requested exceeds the default value, the request is broken into more than one request. The value should be tuned for the application requirements. For maximum bandwidth, set the maxphys parameter by adding the following line to the /etc/system file:

```
set maxphys=1048576 (1 MB)
```

**Note:** Do not set the value for maxphys greater than 1048576 (1 MB). Doing so can cause the system to hang.

If you are using the VERITAS Volume Manager on the SAN Volume Controller LUNs, you must set the VxVM maximum I/O size parameter (vol_maxio) to match the maxphys parameter. When you set the maxphys parameter to 1048576 and you use the VERITAS Volume Manager on your SAN Volume Controller LUNs, set the maxphys parameter like in the following sentence:

```
set vxio:vol_maxio=2048
```

**Note:** The unit for vxio:vol_maxio is disk block (1/2 KB).

## Setting the Sun SPARC host parameters for use with MPxIO

You can set the parameters on the Sun SPARC host to optimize the performance between the HBA and the SAN Volume Controller.

### SAN Volume Controller versions 4.2 and later

SAN Volume Controller 4.2 and later versions include the Target Port Group Support (TPGS) host type that supports load balancing for MPxIO hosts. After installing SAN Volume Controller 4.2, or later, complete the following steps to enable load balancing on Solaris MPxIO hosts:

1. Change the SAN Volume Controller host type from **generic** to **tpgs**.
2. For Solaris 10, ensure that the MPxIO patch level is at least **119130-33**.
3. An IDR from SUN is required for full TPGS support; without an IDR, MPxIO does not function properly. Contact SUN support, refer to ticket number 37949317, and request an IDR for your Solaris version (**uname -a**).
4. Make the following changes to the **/kernel/drv/scsi_vhci.conf** file:

   ```
   load-balance="round-robin";
   auto-failback="enable";
   #device-type-scsi-options-list = "IBM 2145", "symmetric-option";
   #symmetric-option = 0x1000000
   ```

5. Activate the new configuration:
   - On Solaris 9, reboot the Solaris host.
   - On Solaris 10, run the **stmsboot -u** command.
6. Verify that the new configuration is being used:
   a. Run the **luxadm display /dev/rdsk/***cXtYdZs2* command, where *cXtYdZs2* is a SAN Volume Controller device.
   b. Verify that one-half of the paths to the preferred SAN Volume Controller node are shown as **PRIMARY/ONLINE**; verify that the other one-half of the paths are shown as **SECONDARY/ONLINE**.

### SAN Volume Controller versions 3.1.*x* and 4.1.*x*

SAN Volume Controller versions 3.1.*x* and 4.1.*x*, and earlier versions, do not support load balancing for MPxIO hosts. To configure MPxIO hosts to use SAN Volume Controller disks correctly for these versions, complete the following steps:

1. Make the following changes to the **/kernel/drv/scsi_vhci.conf** file:

   ```
   load-balance="none";
   auto-failback="disable";
   device-type-scsi-options-list = "IBM 2145", "symmetric-option";
   symmetric-option = 0x1000000;
   ```

2. If you are configuring MPxIO for the first time on Solaris 10 servers, enable multipathing by running the following command:

   ```
   stmsboot -e
   ```

3. If you are configuring MPxIO for the first time on Solaris 9 servers, shut down the servers and perform reconfiguration boots by running the following commands:

   ```
   shutdown -y -g0 -i0
   ok boot -r
   ```

   A reconfiguration boot creates new Solaris device files and links.

4. If you are reconfiguring MPxIO on Solaris 10 servers, run the following command to update the operating system with the new settings from the configuration file:

   ```
   stmsboot -u
   ```

5. If you are reconfiguring MPxIO on Solaris 9 servers, shut down the servers and perform reconfiguration boots by running the following commands:

   ```
   shutdown -y -g0 -i0
   ok boot -r
   ```

   A reconfiguration boot creates new Solaris device files and links.

## Discovering new LUNs

The LUN discovery method you must use depends on the type of host bus adapter (HBA) that your Sun SPARC host uses.

Use the following instructions to discover new LUNs:

**JNI HBAs**

1. Run `/opt/JNIC146x/jni_update_drv -ar` to initiate an HBA driver process to check for new LUNs
2. Run `devfsadm -C -v` to rebuild the device's file system.

**Emulex HBAs**

**Note:** Emulex HBAs automatically discover new LUNs. Run `devfsadm -C -v` to rebuild the device's file system.

**QLogic HBAs**

**Note:** QLogic HBAs automatically discover new LUNs. Run `devfsadm -C -v` to rebuild the device's file system.

### Configuring LUNs for use with SDD

If you are using the subsystem device driver (SDD) for multipathing support on a Sun SPARC host, you must use these instructions to configure the LUNs.

The following instructions are based on the SunOS 5.8 Generic_108528–16 version. Use a bash shell as root to correctly configure your path.

You can use the following steps for all HBAs that are used with SDD:

1. Delete the following files:
   - `/etc/vpathsave.cfg`
   - `/etc/vpath.cfg`
2. Use the `format` command to check for disks.
   a. If you see disks, proceed to the next step.
   b. If you do not see disks, verify the configuration of your HBAs and clustering configuration and try again.
   c. If you still do not see disks, reboot the machine by issuing a `reboot -- -rv` command.

   **Note:** You may see a "mode sense error" listed for each disk when running format for the first time. This is normal, and will not occur once the disks have been labeled.
3. Configure SDD by issuing the `cfgvpath -c` command.
4. Issue the `devfsadm -C -v` command to scan for disks.
5. After the **devfsadm** command completes, issue the `vpathmkdev` command to create vpaths for the new disks.
6. Issue the `format` command and browse the returned list for your vpaths.
7. The devices are now accessible from /dev/dsk/vpath#.

## Configuring LUNs for use with VERITAS or Symantec DMP

If you are using the VERITAS or Symantec Volume Manager with the Dynamic Multi-Pathing (DMP) for multipathing support on a Sun SPARC host, you must use these instructions to configure the LUNs.

You can use the following steps for all HBAs that are used with the VERITAS or Symantec Volume Manager with DMP:

1. Issue the `format` command to check for disks.
   a. If you see disks, proceed to the next step.
   b. If you do not see disks, verify the configuration of your HBAs and clustering configuration and try again.

   **Note:** You might see a "mode sense error" listed for each disk when running format for the first time. This is normal, and does not occur after the disks are labeled.
2. Label each device by using the Solaris operating system `format` command.
3. Use the `vxdiskadm` utility to initialize the disks, using the following steps:
   a. Start the `vxdiskadm` utility.
   b. From the menu, select **21 (Get the newly connected/zoned disks in VxVM view)**.
   c. Press `c` to continue and then press Enter. Wait for the command to complete.
   d. From the menu, select **1 (Add or initialize one or more disks)** and initialize each disk.
4. Run the `vxdisk list` command to see the devices. You can now use the devices to create VERITAS or Symantec Volume Manager devices when added to a volume group.

## Multipath support for Sun SPARC hosts

You must install a multipathing software on all Sun SPARC hosts that are attached to the SAN Volume Controller.

Multipathing support is available for Sun SPARC hosts using either of the following software:

- Sun MPxIO / Solaris multipathing software
- Subsystem device driver (SDD)
- VERITAS or Symantec Volume Manager

### SDD dynamic pathing on Sun SPARC hosts

Sun SPARC hosts support subsystem device driver (SDD) dynamic pathing when you add paths to an existing virtual disk (VDisk) or when a new VDisk is mapped to a host.

### VERITAS or Symantec Volume Manager with dynamic pathing on Sun SPARC hosts

Ensure that you are familiar with using VERITAS or Symantec Volume Manager with the Dynamic Multi-Pathing (DMP) feature on Sun SPARC hosts.

VERITAS or Symantec Volume Manager with DMP automatically selects the next available I/O path for I/O requests dynamically without action from the administrator. The Volume Manager with DMP is also informed of when you repair or restore a connection and when you add or remove devices after the system has been fully booted (provided that the operating system recognizes the devices correctly).

The Volume Manager with DMP *does not* support the following:

- Preferred pathing with the SAN Volume Controller
- Load balancing across multiple paths with the SAN Volume Controller.

### Coexistence of SDD and VERITAS or Symantec Volume Manager with DMP on Sun SPARC hosts

VERITAS or Symantec Volume Manager with DMP can coexist in "pass-thru" mode with the subsystem device driver (SDD). This means that DMP uses the vpath devices provided by SDD.

The coexistence requires a VERITAS or Symantec Array Support Library. This can be found on the VERITAS or Symantec installation media or from VERITAS or Symantec support.

## Clustering support for Sun SPARC hosts

The SAN Volume Controller provides clustering support for Sun SPARC hosts.

Clustering support can be provided for Sun SPARC hosts with the following cluster software:

- VERITAS or Symantec Cluster Server
- Sun Cluster

The following Web site provides current interoperability information about supported software levels:

http://www.ibm.com/storage/support/2145

## SAN boot support for Sun SPARC hosts

SAN boot for Sun SPARC hosts is supported by the SAN Volume Controller.

See the software restrictions page on the following Web site for any known restrictions for SAN boot support:

http://www.ibm.com/storage/support/2145

### Configuring for SAN boot with Sun SPARC hosts

To use the SAN boot feature with a Sun SPARC host that is using the SAN Volume Controller, the boot disk must be encapsulated by the VERITAS or Symantec Volume Manager. Encapsulation is the method for placing the boot disk under Volume Manager's management.

You must have your VERITAS or Symantec Volume Manager administrator's guide to complete the following steps.

Use these high-level steps to ensure that your boot disk is encapsulated by the Volume Manager:

1. Configure your HBA for SAN boot.
2. Configure the host bus adapter (HBA) for static port binding.
3. Configure the VDisk that is to be used as your SAN boot disk and then map the VDisk to the host.
4. Configure the LUNs for use with VERITAS or Symantec Volume Manager with DMP.
5. Mirror the boot volume onto the discovered LUNs using the instructions in the VERITAS or Symantec Volume Manager administrator's guide.

**Configuring a JNI or AMCC HBA for SAN boot:**

To take advantage of the SAN boot feature on a Sun SPARC host, you must appropriately configure the HBA.

Before you configure the HBA, ensure that you have already done the following:

- Configured the HBA for static port binding.
- Configured and mapped the VDisk that serves as the SAN boot disk.
- Configured the LUNs for use with VERITAS or Symantec Volume Manager with DMP.
- Mirrored the boot volume onto the discovered LUNs.
- Installed the correct level of FCode on your HBA. To find the correct level, see the supported hardware list at the following Web site:

  http://www.ibm.com/storage/support/2145

To configure the HBA for SAN boot, use the following steps:

1. Change to the OpenBoot prompt. For example, you might type in a command similar to the following:

   ```
   shutdown -i0 -g0 -y
   ```

2. At the OK prompt, type `setenv auto-boot? false`. This command specifies that the system does not restart after a power failure or after using the reset command.
3. Type `setenv use-nvramrc? true` to enable script interpretation.
4. Type `reset-all` to clear the system's registers.

5. Type `devalias` to identify the device aliases and the associated paths of devices that are connected to the system. Note the device alias of the HBA, which presents your SAN boot volume.
6. Select the HBA device by typing `" /devicestring" select-dev`, where */devicestring* is the device alias string that you wrote down. The following command is an example:

   ```
   " /pci@1f,2000/JNI,FCR@1" select-dev
   ```

   **Note:** There is a space between the opening quotation mark and the forward slash.
7. Type `set-pconfig`.
8. Type `set-speed`.
9. Run `probe-scsi-all` and note the WWPN associated with the boot volume.
10. Type `set-bootp-wwn` and enter the WWPN found in step 9.
11. Type `set-nvp-valid` and type `FF` as the offset when prompted
12. Type `reset-all`.
13. Type `boot vx-`*`disk`* `–rv`, where *disk* is the name of your boot disk.

**Configuring an Emulex HBA for SAN boot:**

To take advantage of the SAN boot feature with an Emulex host bus adapter (HBA) on a Sun SPARC host, you must appropriately configure the HBA.

Before you configure the Emulex HBA, ensure that you have already done the following:

- Configured the HBA for static port binding.
- Configured and mapped the VDisk that serves as the SAN boot disk.
- Configured the LUNs for use with VERITAS or Symantec Volume Manager with DMP.
- Mirrored the boot volume onto the discovered LUNs.
- Installed the correct level of FCode on your HBA. To find the correct level, see the supported hardware list at the following Web site:

  http://www.ibm.com/storage/support/2145

To configure the Emulex HBA for SAN boot, use the following steps:

1. Start the lputil utility (/usr/sbin/lpfc/lputil).
2. At the main menu, enter `3` (Firmware Maintenance).
3. At the firmware maintenance menu, enter `6` (Boot BIOS Maintenance). If the boot code is currently disabled, press `1` to enable it.
4. Change to the OpenBoot prompt. For example, you might type in a command similar to the following:

   ```
   shutdown -i0 -g0 -y
   ```

   **Note:** An `ok` displays for the prompt when you are at the OpenBoot prompt.
5. Type `setenv auto-boot? false`. This command specifies that the system will not reboot after a power failure or after using the reset command.
6. Type `setenv use-nvramrc? true` to enable script interpretation.
7. Type `reset-all` to clear the system's registers.

8. Type `devalias` to identify the device aliases and the associated paths of devices that are connected to the system. Note the device alias of the HBA, which presents your SAN boot volume.
9. Select the HBA device by typing `" /devicestring" select-dev`, where */devicestring* is the device alias string that you wrote down. The following command is an example:

   ```
   " /pci@1f,2000/lpfc@1" select-dev
   ```

   **Note:** There is a space between the opening quotation mark and the forward slash.
10. Type `set-default-mode` to reset the HBA parameters.
11. Type `set-ptp` to set the HBA to point mode.
12. Run `probe-scsi-all`. Note the WWPN associated with the boot volume, along with its LUN and target IDs. You will use this information for the next step.
13. Type `WWPN yourwwpn lun targetid`, where *yourwwpn* is the WWPN associated with the boot volume, *lun* is the associated LUN, and *targetid* is the associated target ID. The following command is an example:

    ```
    WWPN 5005076803041234 0 3
    ```
14. Type `reset-all`.
15. Type `boot vx-disk –rv`, where *disk* is the name of your boot disk.

**Configuring a QLogic HBA for SAN boot:**

To take advantage of the SAN boot feature with a QLogic host bus adapter (HBA) on a Sun SPARC host, you must appropriately configure the HBA.

Before you configure the QLogic HBA, ensure that you have already done the following:

- Configured the HBA for static port binding.
- Configured and mapped the VDisk that serves as the SAN boot disk.
- Configured the LUNs for use with VERITAS or Symantec Volume Manager with DMP.
- Mirrored the boot volume onto the discovered LUNs.
- Installed the correct level of FCode on your HBA. To find the correct level, see the supported hardware list at the following Web site:

  http://www.ibm.com/storage/support/2145

To configure the QLogic HBA for SAN boot, use the following steps:

1. Change to the OpenBoot prompt. For example, you might type in a command similar to the following:

   ```
   shutdown -i0 -g0 -y
   ```

   **Note:** An `ok` displays for the prompt when you are at the OpenBoot prompt.
2. Type `setenv auto-boot? false`. This command specifies that the system will not reboot after a power failure or after using the reset command.
3. Type `setenv use-nvramrc? true` to enable script interpretation.
4. Type `reset-all` to clear the system's registers.
5. Type `show-devs` to identify the device aliases and the associated paths of devices that are connected to the system. Write down the device alias of the first QLogic HBA.

6. Select the HBA device by typing " */devicestring*" `select-dev`, where */devicestring* is the device alias string that you wrote down. The following command is an example:

   ```
   " /pci@1f,0/pci@1/QLGC,qla@4" select-dev
   ```

   **Note:** There is a space between the opening quotation mark and the forward slash.
7. Type `show-children` and write down the WWPN, loop ID and LUN of the boot device.
8. Type `WWPN` *`yourwwpn loopid lun`* `set-boot-id`, where *yourwwpn* is the WWPN associated with the boot volume, *loopid* is the associated loop ID, and *lun* is the associated LUN. The following command is an example:

   ```
   5005076812345678 80 0 set-boot-id
   ```
9. Type `reset-all`.
10. Type `boot vx-`*`disk`* `–rv`, where *disk* is the name of your boot disk.

## Migrating existing SAN boot images

If you have a Sun SPARC host and existing SAN boot images that are controlled by storage controllers, you can migrate these images to image-mode virtual disks (VDisks) that are controlled by the SAN Volume Controller.

Perform the following steps to migrate your existing SAN boot images:

1. Shut down the host.
2. Perform the following configuration changes on the storage controller:
   a. Remove all the image-to-host mappings from the storage controller.
   b. Map the existing SAN boot image and any other disks that you want to present to the SAN Volume Controller.
3. Zone one port of each host bus adapter (HBA) to one of the SAN Volume Controller ports that is associated with the I/O group for the target image-mode VDisk.
4. Perform the following configuration changes on the SAN Volume Controller:
   a. Create an image-mode VDisk for the managed disk (MDisk) that contains the SAN boot image. Use the MDisk unique identifier to specify the correct MDisk.
   b. Create a host object and assign it to the HBA port that you zoned to SAN Volume Controller port in step 3.
   c. Map the image mode VDisk to the host. For example, you might map the swap disk to the host with SCSI LUN ID 0.
   d. Map the swap disk to the host, if required. For example, you might map the swap disk to the host with SCSI LUN ID 1.

# Chapter 14. Attaching to a host running a VMware operating system

This information explains the requirements and other information for attaching the SAN Volume Controller to a variety of guest host operating systems running on the VMware operating system.

## Attachment requirements for hosts running VMware operating systems

This section provides an overview of the requirements for attaching the SAN Volume Controller to a host running on a VMware operating system.

- Ensure that there are enough fibre-channel adapters installed in the server to handle the total LUNs that you want to attach.
- Ensure that you have the documentation for the VMware operating system, the guest host operating system, and the *IBM System Storage SAN Volume Controller: Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  http://www.ibm.com/storage/support/2145
- Ensure that you have installed the correct operating systems and version levels on your host. Be sure to review the device driver installation documents and configuration utility documents for any additional VMware or guest operating system patches that you might need.

### Environments for hosts running VMware operating systems

Ensure that each host running on a VMware operating system uses a supported level of VMware and a supported guest operating system.

The following IBM Web site provides current interoperability information about supported host operating systems:

http://www.ibm.com/storage/support/2145

### HBAs for hosts running VMware operating systems

Ensure that your hosts running on VMware operating systems use the correct host bus adapters (HBAs).

The following Web site provides current interoperability information about HBA and platform levels:

http://www.ibm.com/storage/support/2145

### Drivers and firmware for hosts running VMware operating systems

Be sure that you use the correct host bus adapter device driver and firmware levels for hosts running on a VMware operating system.

The following IBM Web site provides current interoperability information about device driver and firmware levels:

http://www.ibm.com/storage/support/2145

## Installing the HBA on a host running a VMware operating system

The first step for attaching the host on a VMware operating system is to install the host bus adapter (HBA).

Before you install the HBA, ensure that it is supported by the SAN Volume Controller. See the supported hardware list at the following IBM Web site if you need to verify that the HBA is supported:

http://www.ibm.com/storage/support/2145

To install the HBA, use the following general steps:

1. Shutdown your host and its attached peripherals, following the manufacturer's recommendations.
2. Install the HBA, using the adapter manufacturer's installation instructions.

## Installing the HBA drivers for hosts running VMware operating systems

Follow the instructions provided by VMware to install the HBA drivers and firmware. Installing these components should be part of the VMware installation and setup process.

## Configuring the VMware operating system

You must configure the VMware operating system and the guest operating system before you can use hosts running on a VMware platform with the SAN Volume Controller.

Before you configure the host operating systems, the following tasks must be completed:

- The IBM service representative must have installed the SAN Volume Controller.
- You must have installed the appropriate host bus adapters.

After the prerequisite tasks are complete, use the following general steps to configure your host system.

1. Define the host system with the worldwide port name identifiers. You will have to locate the list of worldwide port names.
2. Define the fibre-channel port configuration if it was not done during the installation of the SAN Volume Controller or fibre-channel adapters.
3. Configure the host system for the SAN Volume Controller by using the instructions in your VMware and guest operating system publications.

### Multipath support for hosts running VMware operating systems

The VMware operating system provides multipathing support; installing multipathing software is not required.

#### VMware multipathing software dynamic pathing

VMware multipathing software does not support dynamic pathing.

Preferred paths set in SAN Volume Controller are ignored.

VMware multipathing software performs static load balancing for I/O, based upon a host setting that defines the preferred path for a given volume.

### Multipathing configuration maximums for hosts running VMware operating systems

When you configure, keep in mind the maximum configuration for the VMware multipathing software.

Table 13 provides the maximum SCSI devices and paths per virtual disk (VDisk).

*Table 13. Configuration maximums for VMware multipathing software*

| Object | VMware maximum | Description |
|---|---|---|
| SCSI devices | 256 | The maximum number of SCSI devices supported by the VMware software. Note that each path to a VDisk equates to a single SCSI device |
| Paths per VDisk | 4 | The maximum number of paths to each VDisk. |

## Clustering support for hosts running VMware operating systems

The SAN Volume Controller provides clustering support on VMware guest operating systems.

The following IBM Web site provides current interoperability information about HBA and platform levels:

http://www.ibm.com/storage/support/2145

## SAN boot support for hosts running VMware operating systems

The SAN Volume Controller can be used as a boot device for the VMware guest operating system.

For SAN boot support for hosts running a VMware operating system, you must meet the following requirement:

- The guest operating system must be on a SAN disk.

See the software restrictions page on the following IBM support Web site for any other restrictions for SAN boot support:

http://www.ibm.com/storage/support/2145

# Chapter 15. Fibre-channel port name identification

This is an overview of the fibre-channel port name identification for the following host systems:

- HP 9000
- HP AlphaServer
- IBM System p5, eServer, or RS/6000
- Linux
- NetApp
- SGI
- Sun
- Windows 2000 and Windows 2003
- Windows NT
- VMware

The WWPN consists of 16 hexadecimal characters (0 - 9 and A - F). The SAN Volume Controller uses it to uniquely identify the fibre-channel HBA that is installed in your host system. The SAN Volume Controller automatically finds the WWPN for your host fibre-channel HBA when you attach your host system to the SAN Volume Controller.

**Note:** If your host uses more than one fibre-channel HBA to connect to your SAN Volume Controller, you must add multiple entries to the host list for this host. You must add one for each fibre-channel HBA. Each HBA will have a unique WWPN.

The format and content of the fibre-channel port identifier are determined by the manufacturer of the link control facility for the applicable fibre-channel port. The identifier is an eight-byte field, which the fibre-channel protocols use to uniquely identify the fibre-channel port.

## Locating the WWPN for an HP host

You can locate the WWPN for an HP (Hewlett-Packard) host by following the steps in this topic.

1. Go to the root directory.
2. Type: `ioscan -fnC fc`
3. Look under the description for the Fibre Channel Mass Storage adapter.
   For example, look for the device path name /dev/td1 or /dev/fcms1.
4. Type: `fcmsutil` */dev/td1* where */dev/td1* is the path.

## Locating the WWPN for an IBM System p5, eServer, or an RS/6000 AIX host

You can locate the WWPN for an IBM System p5, eServer or an RS/6000 AIX host by following the steps in this topic.

1. Log in as root.
2. Type `lscfg -vl fcs`*x*, where *x* is the adapter number.

The network address is the fibre-channel adapter port WWPN value.

## Locating the WWPN for a host running the Linux operating system

You can locate the WWPN for a host running the Linux operating system with a QLogic adapter by following the steps in this topic.

1. Restart the server.
2. Press Alt+Q to get the **FAST!Util** menu.

   If you have more than one fibre-channel host bus adapter (HBA) installed, all the fibre-channel HBA are displayed. Scroll down to the adapter you want. Press Enter.
3. From the **FAST!Util** menu, scroll down and select **Select Host Adapter**.
4. Scroll up and highlight **Configuration Settings**. Press Enter.
5. From the **Configuration Settings** menu, click **Host Adapter Settings**.
6. Write down the 16-digit alphanumeric string that is displayed.

## Locating the WWPN for a host running the Microsoft Windows 2000 or 2003 operating system

Determining the WWPN of a host that runs a Windows operating system depends on the type of HBA in your host server.

For Qlogic, you can use the SANsurfer GUI/IBM FAStT MSJ (management suite java) if you have it, or restart the host and enter ctrl+Q to enter the Qlogic BIOS, where you can find the HBA WWPNS.

For Emulex hosts, use the elxcfg tool that is packaged with the firmware. This opens in the Windows operating system and does not require a restart.

## Locating the WWPN for a host running the Windows NT operating system

You can locate the worldwide port names (WWPNs) for a host running the Windows NT operating system with a QLogic host bus adapter (HBA) within the QLogic BIOS.

Restart the host and enter ctrl+Q to enter the Qlogic BIOS. There you will find the HBA WWPNs.

## Locating the WWPN for a Sun SPARC host

You can locate the worldwide port name (WWPN) for a Sun SPARC host by following the steps in this topic.

1. After you install the adapter and you restart the host system, view the /var/adm/messages file.
2. Search for the line that contains the applicable phrase for your host bus adapter (HBA):
   a. For the JNI SBUS HBA, search for `fcaw`*x*`: Fibre Channel WWNN`, where *x* is the adapter number (0, 1, and so on). You can find the WWPN on the same line immediately after the worldwide node name (WWNN).

b. For the JNI PCI HBA, search for `fca-pcix: Fibre Channel WWNN`, where *x* is the adapter number (0, 1, and so on). You can find the WWPN on the same line following the WWNN.

c. For the QLogic QLA2200F HBA, search for `qla2200-hbax-adapter-port-name` where *x* is the adapter number (0, 1, and so on).

## Locating the WWPNs for a host running a VMware operating system

You can locate the worldwide port names (WWPNs) for a host running a VMware operating system.

Perform the following steps to locate the WWPNs for the host:

1. Open the VMware Management Interface and click the **Options** tab.
2. Select **Storage Management**. and then in the new window
3. Click the **Adapter bindings** tab. The WWPN will then be listed at the end of each port heading line, which are the lines starting with `vmhba`. For example, in the following line, **21:00:00:E0:8B:1A:E4:C6** is the WWPN of the HBA port:

   ```
   vmhba0: QLogic Corp QLA231x/2340 (rev 02) (21:00:00:E0:8B:1A:E4:C6)
   ```

## Locating the WWPN for a NetApp server

You can locate the WWPN for a NetApp server by following the steps in this topic.

1. Start the NetApp server.
2. At the NetApp system console, run the following command: `sysconfig -v`.

   Figure 22 shows an example of the command output where the WWPNs are 500a098200004060 and 500a098300004060.

```
netapp_system_console> sysconfig -v
<snip>
        slot 0: FC Host Adapter 0a (Dual-channel, QLogic 2322 rev. 3, 64-bit, N-port,<UP>)
                Firmware rev:   3.3.220
                Host Port Id:   0x690913        FC Node Name:   5:00a:098200:004060
<snip>
        slot 0: FC Host Adapter 0b (Dual-channel, QLogic 2322 rev. 3, 64-bit, N-port,<UP>)
                Firmware rev:   3.3.220
                Host Port Id:   0x640913        FC Node Name:   5:00a:098300:004060
<snip>
netapp_system_console>
```

*Figure 22. An example of the sysconfig command output*

## Locating the WWPN for an SGI Origin host

You can locate the WWPN for an SGI Origin host running the IRIX operating system with a QLogic adapter by following the steps in this topic.

1. Restart the server.
2. Type the `scsiha -w [bus_number | device]` command. For example, type `scsiha -w 6 7 8 9`. Figure 23 on page 100 shows an example of the command output.

```
# scsiha -w 6 7 8 9
6 Portname: 210000e08b05d207
7 Portname: 210000e08b04d539
8 Portname: 210000e08b050808
9 Portname: 210000e08b038fe6
#
```

*Figure 23. An example of the scsiha — bus_number device | command*

# Accessibility

Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully.

## Features

These are the major accessibility features in the SAN Volume Controller Console :

- You can use screen-reader software and a digital speech synthesizer to hear what is displayed on the screen. The following screen readers have been tested: WebKing v5.5 and Window-Eyes v5.5.
- You can operate all features using the keyboard instead of the mouse.
- You can change the initial delay and repeat rate of the up and down buttons to two seconds when you use the front panel of the SAN Volume Controller to set or change an IP address. This feature is documented in the applicable sections of the SAN Volume Controller publications.

## Navigating by keyboard

You can use keys or key combinations to perform operations and initiate many menu actions that can also be done through mouse actions. You can navigate the SAN Volume Controller Console and help system from the keyboard by using the following key combinations:

- To traverse to the next link, button, or topic, press Tab inside a frame (page).
- To expand or collapse a tree node, press → or ←, respectively.
- To move to the next topic node, press V or Tab.
- To move to the previous topic node, press ^ or Shift+Tab.
- To scroll all the way up or down, press Home or End, respectively.
- To go back, press Alt+←.
- To go forward, press Alt+→.
- To go to the next frame, press Ctrl+Tab.
- To move to the previous frame, press Shift+Ctrl+Tab.
- To print the current page or active frame, press Ctrl+P.
- To select, press Enter.

## Accessing the publications

You can view the publications for the SAN Volume Controller in Adobe Portable Document Format (PDF) using the Adobe Acrobat Reader. The PDFs are provided at the following Web site:

http://www.ibm.com/storage/support/2145

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European community contact:

IBM Technical Regulations
Pascalstr. 100, Stuttgart, Germany 70569
Telephone: 0049 (0)711 785 1176
Fax: 0049 (0)711 785 1283
E-mail: tjahn@de.ibm.com

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Verantwortlich für die Konformitätserklärung des EMVG ist die IBM Deutschland GmbH, 70548 Stuttgart.

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## European Contact Information

This topic contains the product service contact information for Europe.

European Community contact:
IBM Technical Regulations
Pascalstr. 100, Stuttgart, Germany 70569
Tele: 0049 (0)711 785 1176
Fax: 0049 (0)711 785 1283
e-mail: mailto:tjahn@de.ibm.com

## Taiwan Contact Information

This topic contains the product service contact information for Taiwan.

IBM Taiwan Product Service Contact Information:
IBM Taiwan Corporation
3F, No 7, Song Ren Rd., Taipei Taiwan
Tel: 0800-016-888

台灣IBM 產品服務聯絡方式：
台灣國際商業機器股份有限公司
台北市松仁路7號3樓
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# Glossary

This glossary includes terms for the IBM System Storage SAN Volume Controller.

This glossary includes selected terms and definitions from A Dictionary of Storage Networking Terminology (http://www.snia.org/education/dictionary), copyrighted 2001 by the Storage Networking Industry Association, 2570 West El Camino Real, Suite 304, Mountain View, California 94040-1313. Definitions derived from this book have the symbol (S) after the definition.

The following cross-references are used in this glossary:

**See** Refers the reader to one of two kinds of related information:

- A term that is the expanded form of an abbreviation or acronym. This expanded form of the term contains the full definition.
- A synonym or more preferred term.

**See also**
Refers the reader to one or more related terms.

**Contrast with**
Refers the reader to a term that has an opposite or substantively different meaning.

## Numerics

**2145** A hardware machine type for the IBM System Storage SAN Volume Controller. Models of the SAN Volume Controller are expressed as the number 2145 followed by "-xxx", such as 2145-8G4. Hardware models for the 2145 include 2145-4F2, 2145-8F2, 2145-8F4, and 2145-8G4.

## A

**access mode**
One of three different modes in which a logical unit (LU) in a disk controller system can operate. See also *image mode*, *managed space mode*, and *unconfigured mode*.

**Address Resolution Protocol (ARP)**
A protocol that dynamically maps an IP address to a network adapter address in a local area network.

**agent code**
An open-systems standard that interprets Common Information Model (CIM) requests and responses as they transfer between the client application and the device.

**application server**
A host that is attached to the storage area network (SAN) and that runs applications.

**ARP** See *Address Resolution Protocol*.

**array** An ordered collection, or group, of physical storage devices that are used to define logical volumes or devices.

**association**
A class that contains two references that define a relationship between two referenced objects.

**asymmetric virtualization**
A virtualization technique in which the virtualization engine is outside the data path and performs a metadata-style service. The metadata server contains all the mapping and locking tables while the storage devices contain only data. See also *symmetric virtualization*.

**auxiliary virtual disk**
The virtual disk that contains a backup copy of the data and that is used in disaster recovery scenarios. See also *master virtual disk*.

**availability**
The ability of a system to continue working, with perhaps a decrease in performance, after individual components fail.

## B

**bandwidth**
The range of frequencies an electronic system can transmit or receive. The greater the bandwidth of a system, the more information the system can transfer in a given period of time.

**bitmap**
A coded representation in which each bit, or group of bits, represents or corresponds to an item; for example, a configuration of bits in main storage in which each bit indicates whether a peripheral device or a storage block is available or in which each group of bits corresponds to one pixel of a display image.

**blade** One component in a system that is designed to accept some number of components (blades). Blades could be individual servers that plug into a multiprocessing system or individual port cards that add connectivity to a switch. A blade is typically a hot-swappable hardware device.

**block** A unit of data storage on a disk drive.

**block virtualization**
The act of applying virtualization to one or more block-based (storage) services for the purpose of providing a new aggregated, higher-level, richer, simpler, or secure block service to clients. Block virtualization functions can be nested. A disk drive, RAID system, or volume manager all perform some form of block-address to (different) block-address mapping or aggregation. See also *virtualization*.

**Boolean**
Pertaining to the processes used in the algebra formulated by George Boole.

## C

**cache** A high-speed memory or storage device used to reduce the effective time required to read data from or write data to lower-speed memory or a device. Read cache holds data in anticipation that it will be requested by a client. Write cache holds data written by a client until it can be safely stored on more permanent storage media such as disk or tape.

**Call Home**
A communication service that links a machine to a service provider. The

machine can use this link to place a call to IBM or to another service provider when service is required. With access to the machine, service personnel can perform service tasks, such as viewing error and problem logs or initiating trace and dump retrievals.

**cascading**
The process of connecting two or more fibre-channel hubs or switches together to increase the number of ports or extend distances.

**CIM** See *Common Information Model*.

**CIM object manager (CIMOM)**
The common conceptual framework for data management that receives, validates, and authenticates the CIM requests from the client application. It then directs the requests to the appropriate component or service provider.

**CIMOM**
See *CIM object manager*.

**class** The definition of an object within a specific hierarchy. A class can have properties and methods and can serve as the target of an association.

**CLI** See *command line interface*.

**client** A computer system or process that requests a service of another computer system or process that is typically referred to as a server. Multiple clients can share access to a common server.

**client application**
A storage management program that initiates Common Information Model (CIM) requests to the CIM agent for the device.

**cluster**
In SAN Volume Controller, up to four pairs of nodes that provide a single configuration and service interface.

**command line-interface (CLI)**
A type of computer interface in which the input command is a string of text characters.

**Common Information Model (CIM)**
A set of standards developed by the Distributed Management Task Force (DMTF). CIM provides a conceptual framework for storage management and an open approach to the design and implementation of storage systems, applications, databases, networks, and devices.

**concurrent maintenance**
Service that is performed on a unit while it is operational.

In SAN Volume Controller, the ability for one node in the cluster to be turned off for maintenance without interrupting access to the VDisk data provided by the cluster.

**configuration node**
A node that acts as the focal point for configuration commands and manages the data that describes the cluster configuration.

**connected**
In a Global Mirror relationship, pertaining to the status condition that occurs when two clusters can communicate.

**consistency group**
A group of copy relationships between virtual disks that are managed as a single entity.

**consistent copy**
In a Metro or Global Mirror relationship, a copy of a secondary virtual disk (VDisk) that is identical to the primary VDisk from the viewpoint of a host system, even if a power failure occurred while I/O activity was in progress.

**consistent-stopped**
In a Global Mirror relationship, the state that occurs when the secondary virtual disk (VDisk) contains a consistent image, but the image might be out-of-date with respect to the primary VDisk. This state can happen when a relationship was in the consistent-synchronized state when an error occurred that forced a freeze of the consistency group. This state can also happen when a relationship is created with the create-consistent flag set to `TRUE`.

**consistent-synchronized**
In a Global Mirror relationship, the status condition that occurs when the primary virtual disk (VDisk) is accessible for read and write I/O operations. The secondary VDisk is accessible for read-only I/O operations. See also *primary virtual disk* and *secondary virtual disk*.

**container**
A data storage location; for example, a file, directory, or device.

A software object that holds or organizes other software objects or entities.

**copied**
In a FlashCopy mapping, a state that indicates that a copy has been started after the copy relationship was created. The copy process is complete and the target disk has no further dependence on the source disk.

**copying**
A status condition that describes the state of a pair of virtual disks (VDisks) that have a copy relationship. The copy process has been started but the two virtual disks are not yet synchronized.

**Copy Services**
The services that enable you to copy virtual disks (VDisks): FlashCopy, Metro, and Global Mirror.

**counterpart SAN**
A nonredundant portion of a redundant storage area network (SAN). A counterpart SAN provides all the connectivity of the redundant SAN but without the redundancy. Each counterpart SANs provides an alternate path for each SAN-attached device. See also *redundant SAN*.

**cross-volume consistency**
In SAN Volume Controller, a consistency group property that guarantees consistency between virtual disks when an application issues dependent write operations that span multiple virtual disks.

## D

**data migration**
The movement of data from one physical location to another without disrupting I/O operations.

**degraded**
Pertaining to a valid configuration that has suffered a failure but continues to be supported and legal. Typically, a repair action can be performed on a degraded configuration to restore it to a valid configuration.

**dense wavelength division multiplexing (DWDM)**
A technology that places many optical signals onto one single-mode fiber using slightly different optical frequencies. DWDM enables many data streams to be transferred in parallel.

**dependent write operations**
A set of write operations that must be applied in the correct order to maintain cross-volume consistency.

**destage**
A write command initiated by the cache to flush data to disk storage.

**device** In the CIM Agent, the storage server that processes and hosts client application requests.

IBM definition: A piece of equipment that is used with the computer and does not generally interact directly with the system, but is controlled by a controller.

HP definition: In its physical form, a magnetic disk that can be attached to a SCSI bus. The term is also used to indicate a physical device that has been made part of a controller configuration; that is, a physical device that is known to the controller. Units (virtual disks) can be created from devices after the devices have been made known to the controller.

**device provider**
A device-specific handler that serves as a plug-in for the Common Information Model (CIM); that is, the CIM object manager (CIMOM) uses the handler to interface with the device.

**directed maintenance procedures**
The set of maintenance procedures that can be run for a cluster. These procedures are run from within the SAN Volume Controller application and are documented in the *IBM System Storage SAN Volume Controller: Service Guide*.

**disconnected**
In a Metro or Global Mirror relationship, pertains to two clusters when they cannot communicate.

**discovery**
The automatic detection of a network topology change, for example, new and deleted nodes or links.

**disk controller**
A device that coordinates and controls the operation of one or more disk drives and synchronizes the operation of the drives with the operation of the system as a whole. Disk controllers provide the storage that the cluster detects as managed disks (MDisks).

**disk drive**
A disk-based, nonvolatile, storage medium.

**disk zone**
A zone defined in the storage area network (SAN) fabric in which the SAN Volume Controller can detect and address the logical units that the disk controllers present.

**Distributed Management Task Force (DMTF)**
An organization that defines standards for the management of distributed systems. See also *Common Information Model*.

**DMP** See *directed maintenance procedures*.

**DMTF**
See *Distributed Management Task Force*.

**domain name server**
In the Internet suite of protocols, a server program that supplies name-to-address conversion by mapping domain names to IP addresses.

**DRAM**
See *dynamic random access memory*.

**DWDM**
See *dense wavelength division multiplexing*.

**dynamic random access memory (DRAM)**
A storage in which the cells require repetitive application of control signals to retain stored data.

## E

**EC** See *engineering change.*

**EIA** See *Electronic Industries Alliance*.

**Electronic Industries Alliance (EIA)**
An alliance of four trade associations: The Electronic Components, Assemblies & Materials Association (ECA); the Government Electronics and Information Technology Association (GEIA); the JEDEC Solid State Technology Association (JEDEC); and the Telecommunications Industry Association (TIA). Prior to 1998, EIA was the Electronic Industries Association and the group dates back to 1924.

**empty** In a Global Mirror relationship, a status condition that exists when the consistency group contains no relationships.

**engineering change (EC)**
A correction for a defect of hardware or software that is applied to a product.

**error code**
A value that identifies an error condition.

**ESS** See *IBM TotalStorage® Enterprise Storage Server®*.

**exclude**
To remove a managed disk (MDisk) from a cluster because of certain error conditions.

**excluded**
In SAN Volume Controller, the status of a managed disk that the cluster has removed from use after repeated access errors.

**extent** A unit of data that manages the mapping of data between managed disks and virtual disks.

## F

**fabric** In fibre-channel technology, a routing structure, such as a switch, that receives addressed information and routes it to the appropriate destination. A fabric can consist of more than one switch. When multiple fibre-channel switches are interconnected, they are described as cascading. See also *cascading*.

**fabric port (F_port)**
A port that is part of a fibre-channel fabric. An F_port on a fibre-channel fabric connects to the node port (N_port) on a node.

**failover**
In SAN Volume Controller, the function that occurs when one redundant part of the system takes over the workload of another part of the system that has failed.

**FCIP** See *Fibre Channel over IP*.

**fibre channel**
A technology for transmitting data between computer devices at a data rate of up to 4 Gbps. It is especially suited for attaching computer servers to shared storage devices and for interconnecting storage controllers and drives.

**fibre-channel extender**
A device that extends a fibre-channel link over a greater distance than is supported by the standard, usually a number of miles or kilometers. Devices must be deployed in pairs at each end of a link.

**Fibre Channel over IP (FCIP)**
A network storage technology that combines the features of the Fibre Channel Protocol and the Internet Protocol (IP) to connect distributed SANs over large distances.

**Fibre Channel Protocol (FCP)**
A protocol that is used in fibre-channel communications with five layers that define how fibre-channel ports interact through their physical links to communicate with other ports.

**field replaceable unit (FRU)**
An assembly that is replaced in its entirety when any one of its components fails. An IBM service representative performs the replacement. In some cases, a field replaceable unit might contain other field replaceable units.

**FlashCopy mapping**
A relationship between two virtual disks.

**FlashCopy relationship**
See *FlashCopy mapping*.

**FlashCopy service**
In SAN Volume Controller, a copy service that duplicates the contents of a source virtual disk (VDisk) to a target VDisk. In the process, the original contents of the target VDisk are lost. See also *point-in-time copy.*

**F_port** See *fabric port*.

**FRU** See *field replaceable unit*.

## G

**gateway**
An entity that operates above the link layer and translates, when required, the interface and protocol used by one network into those used by another distinct network.

**GB** See *gigabyte*.

**GBIC** See *gigabit interface converter*.

**gigabit interface converter (GBIC)**
An interface module that converts the light stream from a fibre-channel cable into electronic signals for use by the network interface card.

**gigabyte (GB)**
In decimal notation, 1 073 741 824 bytes.

**Global Mirror**
An asynchronous copy service that enables host data on a particular source virtual disk (VDisk) to be copied to the target VDisk that is designated in the relationship.

**grain** In a FlashCopy bitmap, the unit of data represented by a single bit.

**GUI** See *graphical user interface*.

**graphical user interface (GUI)**
A type of computer interface that presents a visual metaphor of a real-world scene, often of a desktop, by combining high-resolution graphics, pointing devices, menu bars and other menus, overlapping windows, icons and the object-action relationship.

## H

**hardcoded**
Pertaining to software instructions that are statically encoded and not intended to be altered.

**HBA** See *host bus adapter*.

**HLUN**
See *virtual disk*.

**host** An open-systems computer that is connected to the SAN Volume Controller through a fibre-channel interface.

**host bus adapter (HBA)**
In SAN Volume Controller, an interface card that connects a host bus, such as a peripheral component interconnect (PCI) bus, to the storage area network.

**host ID**
In SAN Volume Controller, a numeric identifier assigned to a group of host fibre-channel ports for the purpose of logical unit number (LUN) mapping. For each host ID, there is a separate mapping of Small Computer System Interface (SCSI) IDs to virtual disks (VDisks).

**host zone**
A zone defined in the storage area network (SAN) fabric in which the hosts can address the SAN Volume Controllers.

**hub** A fibre-channel device that connects nodes into a logical loop by using a physical star topology. Hubs will automatically recognize an active node and insert the node into the loop. A node that fails or is powered off is automatically removed from the loop.

A communications infrastructure device to which nodes on a multi-point bus or loop are physically connected. Commonly used in Ethernet and fibre-channel networks to improve the manageability of physical cables. Hubs maintain the logical loop topology of the network of which they are a part, while creating a “hub and spoke” physical star layout. Unlike

switches, hubs do not aggregate bandwidth. Hubs typically support the addition or removal of nodes from the bus while it is operating. (S) Contrast with *switch*.

## I

**ID** See *identifier*.

**identifier (ID)**
A sequence of bits or characters that identifies a user, program device, or system to another user, program device, or system.

**idle** In a FlashCopy mapping, the state that occurs when the source and target virtual disks (VDisks) act as independent VDisks even if a mapping exists between the two. Read and write caching is enabled for both the source and the target.

**idling** The status of a pair of virtual disks (VDisks) that have a defined copy relationship for which no copy activity has yet been started.

In a Metro or Global Mirror relationship, the state that indicates that the master virtual disks (VDisks) and auxiliary VDisks are operating in the primary role. Consequently, both VDisks are accessible for write I/O operations.

**idling-disconnected**
In a Global Mirror relationship, the state that occurs when the virtual disks (VDisks) in this half of the consistency group are all operating in the primary role and can accept read or write I/O operations.

**illegal configuration**
A configuration that will not operate and will generate an error code to indicate the cause of the problem.

**image mode**
An access mode that establishes a one-to-one mapping of extents in the managed disk (MDisk) with the extents in the virtual disk (VDisk). See also *managed space mode* and *unconfigured mode*.

**image VDisk**
A virtual disk (VDisk) in which there is a direct block-for-block translation from the managed disk (MDisk) to the VDisk.

**IML** See *initial microcode load*.

**inconsistent**
In a Metro or Global Mirror relationship, pertaining to a secondary virtual disk (VDisk) that is being synchronized with the primary VDisk.

**inconsistent-copying**
In a Global Mirror relationship, the state that occurs when the primary virtual disk (VDisk) is accessible for read and write input/output (I/O) operations, but the secondary VDisk is not accessible for either. This state occurs after a **start** command is issued to a consistency group that is in the inconsistent-stopped state. This state also occurs when a **start** command is issued, with the force option, to a consistency group that is in the idling or consistent-stopped state.

**inconsistent-disconnected**
In a Global Mirror relationship, a state that occurs when the virtual disks (VDisks) in the half of the consistency group that is operating in the secondary role are not accessible for either read or write I/O operations.

**inconsistent-stopped**
In a Global Mirror relationship, the state that occurs when the primary virtual disk (VDisk) is accessible for read and write input/output (I/O) operations, but the secondary VDisk is not accessible for either read or write I/O operations.

**indication**
An object representation of an event.

**initial microcode load (IML)**
In SAN Volume Controller, the process by which the run-time code and data for a node are loaded into memory and initialized.

**initiator**
The system component that originates an I/O command over an I/O bus or network. I/O adapters, network interface cards, and intelligent controller device I/O bus control ASICs are typical initiators. (S) See also *logical unit number*.

**input/output (I/O)**
Pertaining to a functional unit or communication path involved in an input process, an output process, or both, concurrently or not, and to the data involved in such a process.

**instance**
An individual object that is a member of some class. In object-oriented programming, an object is created by instantiating a class.

**integrity**
The ability of a system to either return only correct data or respond that it cannot return correct data.

**Internet Protocol (IP)**
In the Internet suite of protocols, a connectionless protocol that routes data through a network or interconnected networks and acts as an intermediary between the higher protocol layers and the physical network.

**interswitch link (ISL)**
The physical connection that carries a protocol for interconnecting multiple routers and switches in a storage area network.

**I/O** See *input/output.*

**I/O group**
A collection of virtual disks (VDisks) and node relationships that present a common interface to host systems.

**I/O throttling rate**
The maximum rate at which an I/O transaction is accepted for this virtual disk (VDisk).

**IP** See *Internet Protocol*.

**IP address**
The unique 32-bit address that specifies the location of each device or workstation in the Internet. For example, 9.67.97.103 is an IP address.

**ISL** See *interswitch link*.

**ISL hop**
Considering all pairs of node ports (N-ports) in a fabric and measuring distance only in terms of interswitch links (ISLs) in the fabric, the number

of ISLs traversed is the number of ISL hops on the shortest route between the pair of nodes that are farthest apart in the fabric.

## J

**JBOD (just a bunch of disks)**
IBM definition: See *non-RAID*.

HP definition: A group of single-device logical units not configured into any other container type.

## L

**LBA** See *logical block address*.

**least recently used (LRU)**
An algorithm used to identify and make available the cache space that contains the least-recently used data.

**line card**
See *blade*.

**local fabric**
In SAN Volume Controller, those storage area network (SAN) components (such as switches and cables) that connect the components (nodes, hosts, switches) of the local cluster together.

**local/remote fabric interconnect**
The storage area network (SAN) components that are used to connect the local and remote fabrics together.

**logical block address (LBA)**
The block number on a disk.

**logical unit (LU)**
An entity to which Small Computer System Interface (SCSI) commands are addressed, such as a virtual disk (VDisk) or managed disk (MDisk).

**logical unit number (LUN)**
The SCSI identifier of a logical unit within a target. (S)

**longitudinal redundancy check (LRC)**
A method of error checking during data transfer that involves checking parity.

**LRC** See *longitudinal redundancy check*.

**LRU** See *least recently used*.

**LU** See *logical unit*.

**LUN** See *logical unit number*.

**LUN masking**
A process that allows or prevents I/O to the disk drives through the host-bus-adapter (HBA) device or operating-system device driver.

## M

**managed disk (MDisk)**
A Small Computer System Interface (SCSI) logical unit that a redundant array of independent disks (RAID) controller provides and a cluster manages. The MDisk is not visible to host systems on the storage area network (SAN).

**managed disk group**
A collection of managed disks (MDisks) that, as a unit, contain all the data for a specified set of virtual disks (VDisks).

**managed space mode**
An access mode that enables virtualization functions to be performed. See also *image mode* and *unconfigured mode*.

**Management Information Base (MIB)**
Simple Network Management Protocol (SNMP) units of managed information that specifically describe an aspect of a system, such as the system name, hardware number, or communications configuration. A collection of related MIB objects is defined as a MIB.

**mapping**
See *FlashCopy mapping*.

**master console**
A single point from which to manage the IBM System Storage SAN Volume Controller. The master console can be purchased as software that is installed and configured on a server or as a hardware platform with the operating system and master console software preinstalled.

**master virtual disk**
The virtual disk (VDisk) that contains a production copy of the data and that an application accesses. See also *auxiliary virtual disk.*

**MB** See *megabyte*.

**MDisk**
See *managed disk*.

**megabyte (MB)**
In decimal notation, 1 048 576 bytes.

**mesh configuration**
A network that contains a number of small SAN switches configured to create a larger switched network. With this configuration, four or more switches are connected together in a loop with some of the paths short circuiting the loop. An example of this configuration is to have four switches connected together in a loop with ISLs for one of the diagonals.

**method**
A way to implement a function on a class.

**Metro Mirror**
A synchronous copy service that enables host data on a particular source virtual disk (VDisk) to be copied to the target VDisk that is designated in the relationship.

**MIB** See *Management Information Base*.

**migration**
See *data migration*.

**mirrorset**
IBM definition: See *RAID-1*.

HP definition: A RAID storageset of two or more physical disks that maintain a complete and independent copy of the data from the virtual disk. This type of storageset has the advantage of being highly reliable and extremely tolerant of device failure. Raid level 1 storagesets are referred to as mirrorsets.

## N

**namespace**
The scope within which a Common Information Model (CIM) schema applies.

**node** One SAN Volume Controller. Each node provides virtualization, cache, and Copy Services to the storage area network (SAN).

**node name**
A name identifier associated with a node. (SNIA)

**node port (N_port)**
A port that connects a node to a fabric or to another node. N_ports connect to fabric ports (F_ports) or to other N_ports of other nodes. N_ports handle creation, detection, and flow of message units to and from the connected systems. N_ports are end points in point-to-point links.

**node rescue**
In SAN Volume Controller, the process by which a node that has no valid software installed on its hard disk drive can copy the software from another node connected to the same fibre-channel fabric.

**non-RAID**
Disks that are not in a redundant array of independent disks (RAID). HP definition: See *JBOD*.

**N_port**
See *node port*.

## O

**object** In object-oriented design or programming, a concrete realization of a class that consists of data and the operations associated with that data.

**object model**
A representation, such as a diagram, of objects in a given system. Using symbols similar to standard flowchart symbols, an object model depicts the classes the objects belong to, their associations with each other, the attributes that make them unique, and the operations that the objects can perform and that can be performed on them.

**object name**
An object that consists of a namespace path and a model path. The namespace path provides access to the Common Information Model (CIM) implementation managed by the CIM Agent, and the model path provides navigation within the implementation.

**object path**
An object that consists of a namespace path and a model path. The namespace path provides access to the Common Information Model (CIM) implementation managed by the CIM Agent, and the model path provides navigation within the implementation.

**offline**
Pertaining to the operation of a functional unit or device that is not under the continual control of the system or of a host.

**online** Pertaining to the operation of a functional unit or device that is under the continual control of the system or of a host.

**operating set**
In SAN Volume Controller, the set of nodes that are operating together to deliver storage services.

**oversubscription**
The ratio of the sum of the traffic that is on the initiator N-node connections to the traffic that is on the most heavily loaded interswitch links (ISLs), where more than one ISL is connected in parallel between these switches. This definition assumes a symmetrical network and a specific workload that is applied equally from all initiators and sent equally to all targets. See also *symmetrical network*.

## P

**partition**
IBM definition: A logical division of storage on a fixed disk.

HP definition: A logical division of a container represented to the host as a logical unit.

**partner node**
The other node that is in the I/O group to which this node belongs.

**partnership**
In Metro or Global Mirror operations, the relationship between two clusters. In a cluster partnership, one cluster is defined as the local cluster and the other cluster as the remote cluster.

**paused**
In SAN Volume Controller, the process by which the cache component quiesces all ongoing I/O activity below the cache layer.

**pend** To cause to wait for an event.

**petabyte (PB)**
In decimal notation, 1 125 899 906 842 624 bytes.

**PDU** See *power distribution unit*.

**PLUN** See *managed disk*.

**point-in-time copy**
The instantaneous copy that the FlashCopy service makes of the source virtual disk (VDisk). In some contexts, this copy is known as a $T_0$ *copy*.

**port** The physical entity within a host, SAN Volume Controller, or disk controller system that performs the data communication (transmitting and receiving) over the fibre channel.

**port ID**
An identifier associated with a port.

**power distribution unit (PDU)**
A device that distributes electrical power to multiple devices in the rack. It typically is rack-mounted and provides circuit breakers and transient voltage suppression.

**power-on self-test**
A diagnostic test that servers or computers run when they are turned on.

**prepared**
In a Global Mirror relationship, the state that occurs when the mapping is ready to start. While in this state, the target virtual disk (VDisk) is offline.

**preparing**
In a Global Mirror relationship, the state that occurs when any changed write data for the source virtual disk (VDisk) is flushed from the cache. Any read or write data for the target VDisk is discarded from the cache.

**primary virtual disk**
In a Metro or Global Mirror relationship, the target of write operations issued by the host application.

**property**
In the Common Information Model (CIM), an attribute that is used to characterize instances of a class.

**PuTTY**
A client program that allows you to run remote sessions on your computer through specific network protocols, such as SSH, Telnet, and Rlogin.

## Q

**qualifier**
A value that provides additional information about a class, association, indication, method, method parameter, instance, property, or reference.

**quorum**
A set of nodes that operates as a cluster. Each node has a connection to every other node in the cluster. If a connection failure causes the cluster to split into two or more groups of nodes that have full connection within the group, the quorum is the group that is selected to operate as the cluster. Typically, this is the larger group of nodes, but the quorum disk serves as a tiebreaker if the groups are the same size.

**queue depth**
The number of I/O operations that can be run in parallel on a device.

**quorum disk**
A managed disk (MDisk) that contains a reserved area that is used exclusively for cluster management. The quorum disk is accessed in the event that it is necessary to determine which half of the cluster continues to read and write data.

**quorum index**
The pointer that indicates the order used to resolve a tie. Nodes attempt to lock the first quorum disk (index 0), followed by the next disk (index 1), and finally the last disk (index 2). The tie is broken by the node that locks them first.

## R

**rack** A free-standing framework that holds the devices and card enclosure.

**RAID** See *redundant array of independent disks*.

**RAID 0**
IBM definition: RAID 0 allows a number of disk drives to be combined and presented as one large disk. RAID 0 does not provide any data redundancy. If one drive fails, all data is lost.

HP definition: A RAID storageset that stripes data across an array of disk drives. A single logical disk spans multiple physical disks, allowing parallel data processing for increased I/O performance. While the

performance characteristics of RAID level 0 is excellent, this RAID level is the only one that does not provide redundancy. Raid level 0 storagesets are referred to as stripesets.

**RAID 1**
SNIA dictionary definition: A form of storage array in which two or more identical copies of data are maintained on separate media. (S)

IBM definition: A form of storage array in which two or more identical copies of data are maintained on separate media. Also known as mirrorset.

HP definition: See *mirrorset*.

**RAID 5**
SNIA definition: A form of parity RAID in which the disks operate independently, the data strip size is no smaller than the exported block size, and parity check data is distributed across the array's disks. (S)

IBM definition: See the SNIA definition.

HP definition: A specially developed RAID storageset that stripes data and parity across three or more members in a disk array. A RAIDset combines the best characteristics of RAID level 3 and RAID level 5. A RAIDset is the best choice for most applications with small to medium I/O requests, unless the application is write intensive. A RAIDset is sometimes called parity RAID. RAID level 3/5 storagesets are referred to as RAIDsets.

**RAID 10**
A type of RAID that optimizes high performance while maintaining fault tolerance for up to two failed disk drives by striping volume data across several disk drives and mirroring the first set of disk drives on an identical set.

**redundant ac power switch**
A device that provides input power redundancy by attaching a SAN Volume Controller to two independent power sources. If the main source becomes unavailable, the redundant ac power switch automatically provides power from a secondary (backup) source. When power is restored, the redundant ac power switch automatically changes back to the main power source.

**redundant array of independent disks (RAID)**
A collection of two or more disk drives that present the image of a single disk drive to the system. In the event of a single device failure, the data can be read or regenerated from the other disk drives in the array.

**redundant SAN**
A storage area network (SAN) configuration in which any one single component might fail, but connectivity between the devices within the SAN is maintained, possibly with degraded performance. This configuration is normally achieved by splitting the SAN into two, independent, counterpart SANs. See also *counterpart SAN.*

**reference**
A pointer to another instance that defines the role and scope of an object in an association.

**rejected**
A status condition that describes a node that the cluster software has removed from the working set of nodes in the cluster.

**relationship**
In Metro or Global Mirror, the association between a master virtual disk (VDisk) and an auxiliary VDisk. These VDisks also have the attributes of a primary or secondary VDisk. See also *auxiliary virtual disk, master virtual disk, primary virtual disk, and secondary virtual disk.*

**reliability**
The ability of a system to continue to return data even if a component fails.

**remote fabric**
In Global Mirror, the storage area network (SAN) components (switches and cables) that connect the components (nodes, hosts, and switches) of the remote cluster.

**roles** Authorization is based on roles that map to the administrator and service roles in an installation. The switch translates these roles into SAN Volume Controller administrator and service user IDs when a connection is made to the node for the SAN Volume Controller.

## S

**SAN** See *storage area network*.

**SAN Volume Controller fibre-channel port fan in**
The number of hosts that can see any one SAN Volume Controller port.

**SATA** See *Serial Advanced Technology Attachment*.

**schema**
A group of object classes defined for and applicable to a single namespace. Within the CIM Agent, the supported schemas are the ones that are loaded through the managed object format (MOF).

**SCSI** See *Small Computer Systems Interface*.

**SCSI back-end layer**
The layer in a Small Computer Systems Interface (SCSI) network that performs the following functions: controls access to individual disk controller systems that are managed by the cluster; receives requests from the virtualization layer, processes them, and sends them to managed disks; addresses SCSI-3 commands to the disk controller systems on the storage area network (SAN).

**SCSI front-end layer**
The layer in a Small Computer Systems Interface (SCSI) network that receives I/O commands sent from hosts and provides the SCSI-3 interface to hosts. SCSI logical unit numbers (LUNs) are mapped to virtual disks (VDisks) in this layer as well. Thus, the layer converts SCSI read and write commands that are addressed to LUNs into commands that are addressed to specific VDisks.

**SDD** See *subsystem device driver (SDD).*

**secondary virtual disk**
In Metro or Global Mirror, the virtual disk (VDisk) in a relationship that contains a copy of data written by the host application to the primary VDisk.

**Secure Shell (SSH)**
A program to log in to another computer over a network, to execute commands in a remote machine, and to move files from one machine to another.

**sequential VDisk**
A virtual disk that uses extents from a single managed disk.

**Serial Advanced Technology Attachment (SATA)**
The evolution of the ATA interface from a parallel bus to serial connection architecture. (S)

**Serial ATA**
See *Serial Advanced Technology Attachment*.

**server** In a network, the hardware or software that provides facilities to other stations; for example, a file server, a printer server, a mail server. The station making the request of the server is usually called the client.

**Service Location Protocol (SLP)**
In the Internet suite of protocols, a protocol that identifies and uses network hosts without having to designate a specific network host name.

**Simple Mail Transfer Protocol (SMTP)**
An Internet application protocol for transferring mail among users of the Internet. SMTP specifies the mail exchange sequences and message format. It assumes that the Transmission Control Protocol (TCP) is the underlying protocol.

**Simple Network Management Protocol (SNMP)**
In the Internet suite of protocols, a network management protocol that is used to monitor routers and attached networks. SNMP is an application-layer protocol. Information on devices managed is defined and stored in the application's Management Information Base (MIB).

**SLP** See *Service Location Protocol*.

**Small Computer System Interface (SCSI)**
A standard hardware interface that enables a variety of peripheral devices to communicate with one another.

**SMI-S** See *Storage Management Initiative Specification*.

**SMTP** See *Simple Mail Transfer Protocol*.

**SNIA** See *Storage Networking Industry Association*.

**SNMP**
See *Simple Network Management Protocol*.

**SSH** See *Secure Shell*.

**stand-alone relationship**
In FlashCopy, Metro Mirror, and Global Mirror, relationships that do not belong to a consistency group and that have a null consistency group attribute.

**stop** A configuration command that is used to stop the activity for all copy relationships in a consistency group.

**stopped**
The status of a pair of virtual disks (VDisks) that have a copy relationship that the user has temporarily broken because of a problem.

**storage area network (SAN)**
A network whose primary purpose is the transfer of data between computer systems and storage elements and among storage elements. A SAN consists of a communication infrastructure, which provides physical connections, and a management layer, which organizes the connections, storage elements, and computer systems so that data transfer is secure and robust. (S)

**Storage Management Initiative Specification (SMI-S)**
A design specification developed by the Storage Networking Industry Association (SNIA) that specifies a secure and reliable interface that allows storage management systems to identify, classify, monitor, and control physical and logical resources in a storage area network. The interface is intended as a solution that integrates the various devices to be managed in a storage area network (SAN) and the tools used to manage them.

**Storage Networking Industry Association (SNIA)**
An association of producers and consumers of storage networking products whose goal is to further storage networking technology and applications. See www.snia.org.

**striped**
Pertains to a virtual disk (VDisk) that is created from multiple managed disks (MDisks) that are in the MDisk group. Extents are allocated on the MDisks in the order specified.

**stripeset**
See *RAID 0*.

**subsystem device driver (SDD)**
An IBM pseudo device driver designed to support the multipath configuration environments in IBM products.

**superuser authority**
Can issue any command-line interface (CLI) command. A superuser can view and work with the following panels: View users, Add cluster, Remove cluster, Add users, and Modify users. Only one Superuser role is available.

**suspended**
The status of a pair of virtual disks (VDisks) that have a copy relationship that has been temporarily broken because of a problem.

**switch** A network infrastructure component to which multiple nodes attach. Unlike hubs, switches typically have internal bandwidth that is a multiple of link bandwidth, and the ability to rapidly switch node connections from one to another. A typical switch can accommodate several simultaneous full link bandwidth transmissions between different pairs of nodes. (S) Contrast with *hub*.

**symmetrical network**
A network in which all the initiators are connected at the same level and all the controllers are connected at the same level.

**symmetric virtualization**
A virtualization technique in which the physical storage in the form of Redundant Array of Independent Disks (RAID) is split into smaller chunks of storage known as *extents*. These extents are then concatenated, using various policies, to make virtual disks (VDisks). See also *asymmetric virtualization*.

**synchronized**
In Metro or Global Mirror, the status condition that exists when both virtual disks (VDisks) of a pair that has a copy relationship contain the same data.

**system**
A functional unit, consisting of one or more computers and associated software, that uses common storage for all or part of a program and also for all or part of the data necessary for the execution of the program. A computer system can be a stand-alone unit, or it can consist of multiple connected units.

## T

**terabyte**
In decimal notation, 1 099 511 628 000 bytes.

**topology**
The logical layout of the components of a computer system or network and their interconnections. Topology deals with questions of what components are directly connected to other components from the standpoint of being able to communicate. It does not deal with questions of physical location of components or interconnecting cables. (S)

**IBM TotalStorage Enterprise Storage Server (ESS)**
An IBM product that provides an intelligent disk-storage subsystem across an enterprise.

**trigger**
To initiate or reinitiate copying between a pair of virtual disks (VDisks) that have a copy relationship.

## U

**UID** See *unique identifier*.

**unconfigured mode**
A mode in which I/O operations cannot be performed. See also *image mode* and *managed space mode*.

**uninterruptible power supply (UPS)**
A device that is connected between a computer and its power source that protects the computer against blackouts, brownouts, and power surges. The uninterruptible power supply contains a power sensor to monitor the supply and a battery to provide power until an orderly shutdown of the system can be performed.

**unique identifier (UID)**
An identifier that is assigned to storage system logical units when they are created. It is used to identify the logical unit regardless of the logical unit number (LUN), status of the logical unit, or whether alternate paths exist to the same device. Typically, a UID is only used once.

**unmanaged**
An access mode that pertains to a managed disk (MDisk) that is not used by the cluster.

**UPS** See *uninterruptible power supply*.

## V

**valid configuration**
A configuration that is supported.

**VDisk** See *virtual disk*.

**virtual disk (VDisk)**
In SAN Volume Controller, a device that host systems attached to the storage area network (SAN) recognize as a Small Computer System Interface (SCSI) disk.

**virtualization**
In the storage industry, a concept in which a pool of storage is created that contains several disk subsystems. The subsystems can be from various vendors. The pool can be split into virtual disks that are visible to the host systems that use them.

**virtualized storage**
Physical storage that has virtualization techniques applied to it by a virtualization engine.

**virtual storage area network (VSAN)**
A fabric within the SAN.

**vital product data (VPD)**
Information that uniquely defines system, hardware, software, and microcode elements of a processing system.

**VLUN** See *managed disk*.

**VPD** See *vital product data*.

**VSAN** See *virtual storage area network*.

## W

**WBEM**
See *Web-Based Enterprise Management*.

**Web-Based Enterprise Management (WBEM)**
A tiered, enterprise-management architecture that was developed by the Distributed Management Task Force (DMTF). This architecture provides the management design framework that consists of devices, device providers, the object manager, and the messaging protocol for the communication between client applications and the object manager.

**worldwide node name (WWNN)**
An identifier for an object that is globally unique. WWNNs are used by Fibre Channel and other standards.

**worldwide port name (WWPN)**
A unique 64-bit identifier that is associated with a fibre-channel adapter port. The WWPN is assigned in an implementation- and protocol-independent manner.

**WWNN**
See *worldwide node name*.

**WWPN**
See *worldwide port name*.

## Z

**zoning**

In fibre-channel environments, the grouping of multiple ports to form a virtual, private, storage network. Ports that are members of a zone can communicate with each other, but are isolated from ports in other zones.

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**Host Attachment User's Guide**
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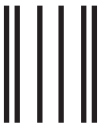

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