IBM System Storage SAN Volume Controller

Host Attachment User's Guide

Version 5.1.0

SC26-7905-06

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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 5.1.0, and to all subsequent releases and modifications until otherwise indicated in new editions. This edition replaces SC26-7905-05.

Contents

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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 either fibre-channel adapters or the SAN Volume Controller Ethernet ports.

The guide is divided into several parts. The first part is the overview, the chapters in the second part describe the fibre-channel connections, and the chapters in the third part describe the Ethernet port connections.

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 SC26-7905-05 and SC26-7905-06 SAN Volume Controller Host Attachment User's Guide

The following list includes changes to this guide since the previous edition (SC26-7905-04).

New information

The following new information has been added to this document for fibre-channel connections:

- Chapter 5, "Attaching to an IBM i host with Virtual I/O Server," on page 39
- Chapter 8, "Attaching to IBM System z server running the IBM z/VSE operating system," on page 59
- Chapter 17, "Attaching to a host running the Microsoft Hyper-V operating system," on page 119
- Chapter 18, "Attaching to Citrix XenServer hosts," on page 125
- Chapter 19, "Attaching to an Apple host," on page 129
- Chapter 20, "Restoring the default settings for an Emulex HBA," on page 133
- Chapter 21, "Restoring the default settings for a QLogic HBA," on page 135

The following new information has been added to this document for Ethernet port connections:

- Chapter 23, “Setting up the host server,” on page 143
- Chapter 26, “Configuring the AIX iSCSI software initiator,” on page 155
- Chapter 28, “Installing the HP-UX iSCSI initiator,” on page 167
- Chapter 24, “Installing the Linux software iSCSI initiator,” on page 145
- Chapter 27, “Installing the Solaris iSCSI initiator,” on page 161
- Chapter 25, “Installing the Windows software iSCSI initiator,” on page 149

Changed information

The following information has been updated in this document:

- “Configuring Device Mapper Multipath Tool (DMMP) for hosts running the Linux operating system” on page 65
- The SAN Volume Controller library and related publications topic has been shortened and includes links to the information center and other related Web sites.

Removed information

The glossary has been removed from the printable PDF. It remains as a topic in the information center builds and is the last entry in the navigation bar.

Summary of changes for SC26-7905-04 SAN Volume Controller Host Attachment Guide

The following list includes changes to this guide since the previous edition (SC26-7905-03).

New information

The following new information has been added to this document:

- “Mapping a virtual disk (VDisk) to HP-UX 11.31 0709 and 0803 hosts” on page 20
- “Mass storage stack and native multipathing” on page 13

Changed information

The following information has been updated in this document:

- “Using a VDisk as a cluster lock disk” on page 19
- “Multipath support for HP 9000 and HP Integrity servers” on page 13
- “Attachment requirements for HP 9000 and HP Integrity servers” on page 9
- “Clustering support for HP 9000 and HP Integrity servers” on page 16
- “Configuring the HP 9000 and HP Integrity servers operating system” on page 12
- “SAN boot support for HP 9000 and HP Integrity servers” on page 16
- “Configuring the QLogic HBA for hosts running the Windows Server operating system” on page 74
- “SDD dynamic pathing on hosts running the Windows 2000 Server and Windows Server 2003 operating systems” on page 77
- “Defining LUN 0 on OpenVMS” on page 29
- “Setting queue depth for Emulex HBAs” on page 48

- "Configuring the QLogic HBA for hosts running the VMware operating system" on page 116
- "Limitations and restrictions when using IBM N Series, NetApp V-Series, or gFiler NAS servers" on page 94

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

Product manuals, other publications, and Web sites contain information that relates to SAN Volume Controller.

SAN Volume Controller Information Center

The IBM System Storage SAN Volume Controller Information Center contains all of the information that is required to install, configure, and manage the SAN Volume Controller. The information center is updated between SAN Volume Controller product releases to provide the most current documentation. The information center is available at the following Web site:

http://publib.boulder.ibm.com/infocenter/svcic/v3r1m0/index.jsp

SAN Volume Controller library

Table 1 on page xvi 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:

www.ibm.com/storage/support/2145

Table 1. SAN Volume Controller library

Title	Description	Order number
IBM System Storage SAN Volume Controller Planning Guide	This guide introduces the SAN Volume Controller and lists the features that 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 Model 2145-CF8 Hardware Installation Guide	This guide provides the instructions that the IBM service representative uses to install the hardware for SAN Volume Controller model 2145-CF8.	GC52-1356
IBM System Storage SAN Volume Controller Model 2145-8A4 Hardware Installation Guide	This guide provides the instructions that the IBM service representative uses to install the hardware for SAN Volume Controller model 2145-8A4.	GC27-2219
IBM System Storage SAN Volume Controller Model 2145-8G4 Hardware Installation Guide	This guide provides the instructions that the IBM service representative uses to install the hardware for SAN Volume Controller model 2145-8G4.	GC27-2220
IBM System Storage SAN Volume Controller Models 2145-8F2 and 2145-8F4 Hardware Installation Guide	This guide provides the instructions that the IBM service representative uses to install the hardware for SAN Volume Controller models 2145-8F2 and 2145-8F4.	GC27-2221
IBM System Storage SAN Volume Controller Software Installation and Configuration Guide	This guide provides guidelines for configuring your SAN Volume Controller. Instructions for backing up and restoring the cluster configuration, using and upgrading the SAN Volume Controller Console, using the CLI, upgrading the SAN Volume Controller software, and replacing or adding nodes to a cluster are included.	SC23-6628

Table 1. SAN Volume Controller library (continued)

Title	Description	Order number
IBM System Storage SAN Volume Controller CIM Agent Developer's Guide	This guide describes the concepts of the Common Information Model (CIM) environment. Steps about using the CIM agent object class instances to complete basic storage configuration tasks, establishing new Copy Services relationships, and performing CIM agent maintenance and diagnostic tasks are included.	SC23-6665
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 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 Troubleshooting Guide	This guide describes the features of each SAN Volume Controller model, explains how to use the front panel, and provides maintenance analysis procedures to help you diagnose and solve problems with the SAN Volume Controller.	GC27-2227
IBM System Storage SAN Volume Controller Hardware Maintenance Guide	This guide provides the instructions that the IBM service representative uses to service the SAN Volume Controller hardware, including the removal and replacement of parts.	GC27-2226
IBM System Storage SAN Volume Controller Master Console Guide	This guide describes how to install, maintain, and service the master console.	GC27-2223
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

Table 2 lists IBM publications that contain information related to the SAN Volume Controller.

Table 2. Other IBM publications

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
Read This First: Installing the IBM System Storage Productivity Center	This guide describes how to install the IBM System Storage Productivity Center hardware.	GI11-8938
IBM System Storage Productivity Center User's Guide	This guide describes how to configure the IBM System Storage Productivity Center software.	SC27-2336
IBM System Storage Multipath Subsystem Device Driver User's Guide	This guide describes the IBM System Storage Multipath Subsystem Device Driver for IBM System Storage products and how to use it with the SAN Volume Controller.	GC52-1309
Implementing the IBM System Storage SAN Volume Controller V4.3	This IBM Redbooks® publication is a detailed technical guide to the IBM System Storage SAN Volume Controller. It provides a high-level overview of storage virtualization and the SAN Volume Controller architecture, discusses implementing and configuring the SAN Volume Controller, tells you how to migrate existing storage to the SAN Volume Controller, and discusses different supported migration activities.	SG24-6423

IBM documentation and related Web sites

Table 3 lists Web sites that provide publications and other information about the SAN Volume Controller or related products or technologies.

Table 3. IBM documentation and related Web sites

Web site	Address
Support for SAN Volume Controller (2145)	www.ibm.com/storage/support/2145
Support for IBM System Storage and IBM TotalStorage® products	www.ibm.com/storage/support/
IBM Publications Center	www.ibm.com/shop/publications/order/
IBM Redbooks publications	www.redbooks.ibm.com/

Related accessibility information

To view a PDF file, you need Adobe Acrobat Reader, which can be downloaded from the Adobe Web site:

www.adobe.com/support/downloads/main.html

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 at no 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:

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

How to send your comments

Your feedback is important to help us provide the highest quality information. If you have any comments about this book or any other documentation, you can submit them in one of the following ways:

- E-mail

  Submit your comments electronically to the following e-mail address:

  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

  Fill out the Readers' Comments form (RCF) at the back of this book. If the RCF has been removed, you can address your comments to:

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

Part 1. Host attachment overview

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 giving you the ability 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
- Provides support 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 with several methods.

You can use any of the following methods to attach to open-systems hosts:

- The SAN Volume Controller to Small Computer System Interface over Internet Protocol (iSCSI) hosts using FCIP ports in your SAN fabric.
- The Small Computer System Interface-Fibre Channel Protocol (SCSI-FCP).
- The iSCSI hosts using the SAN Volume Controller Ethernet ports.

Hosts that use the fibre-channel connections 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 port limits are now shared between fibre-channel WWPNs and iSCSI names.

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:

www.ibm.com/storage/support/2145

Note: iSCSI hosts that are attached with the FCIP ports in the fabric are supported with SAN Volume Controller in a nonfailover configuration. However, the multipathing support that is available with iSCSI configurations does not necessarily provide failover and path recovery for SAN fabric path changes or failures. A concurrent upgrade to SAN Volume Controller can cause errors on an iSCSI host that has multipathing enabled. If multipathing is not configured on the iSCSI driver, you must configure your SAN with only a

single path from SAN Volume Controller to the host. This result can be achieved by zoning a single SAN Volume Controller port from each I/O group to the iSCSI host. In this configuration, a SAN Volume Controller upgrade is disruptive to the host.

Logical unit numbers (LUNs) for fibre-channel ports

The SAN Volume Controller supports a maximum of 2048 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.

Relationship of WWPNs and iSCSI names for host objects

A host can be created with worldwide port names (WWPNs) or iSCSI names. The WWPN name space and the iSCSI name space within SAN Volume Controller share the same internal SAN Volume Controller resources.

As more iSCSI names are used in host objects, the number of fibre-channel WWPNs that can be used reduces. Similarly if a large number of fibre-channel WWPN-based host objects are used, a smaller number of iSCSI hosts can be defined. The iSCSI name in a host object can take up to a maximum equivalent of four WWPNs depending on the number of I/O groups that the host participates in. This affects the maximum number of hosts that you can configure in a SAN Volume Controller cluster.

Each SAN Volume Controller I/O group can have up to 512 WWPN entries. Assuming, for example, that a host is created by using a single iSCSI IQN, the maximum number of hosts (X) that participate in multiple I/O groups (Y) can be calculated by using X < = 512 / Y.

To create iSCSI hosts with a single iSCSI name in a single I/O group (I/O group 0), enter the following command-line interface (CLI) command:

```
svctask mkhost -iscsiname iscsi1 -iogrp 0
```

- A maximum of 256 iSCSI hosts can be created in I/O group 0.
- A mix of up to 256 fibre-channel and iSCSI-based hosts can also be created in I/O group 0.
- An additional 256 fibre-channel or iSCSI-based hosts can be created in I/O groups 1, 2, and 3.
- The total number of hosts for the cluster is 1024.

To create a host with a single iSCSI name in two I/O groups, enter the following command:

```
svctask mkhost -iscsiname iscsi1 -iogrp 0:1
```

- Up to 256 iSCSI hosts can be created in I/O groups 0 and 1.
- An additional 256 fibre-channel or iSCSI hosts can be created in I/O group 2.
- An additional 256 fibre-channel or iSCSI hosts can be created in I/O group 3.
- The total number of hosts for the cluster is 768.

To create a host with a single iSCSI name in three I/O groups, enter the following command:

```
svctask mkhost -iscsiname iscsi1 -iogrp 0:1:2
```

- A maximum of 170 hosts can be created in I/O groups 0, 1, and 2.
- An additional 256 fibre-channel hosts or iSCSI hosts can be created in I/O group 3.
- The total number of hosts for the cluster is 426.

To create a host with single iSCSI name in four I/O groups, enter the following command:

```
svctask mkhost -iscsiname iscsi1
```

- A maximum number of 128 hosts can be created in the four I/O groups, which means 128 total iSCSI hosts for the cluster versus 256 fibre-channel hosts.
- The maximum number of hosts can be created in I/O groups 0, 1, 2, and 3.
- The total number of hosts for the cluster is 128.

Copy Services support

You can use the IBM FlashCopy® and Metro Mirror and Global Mirror Copy Services functions for SAN Volume Controller across the host storage systems to help 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 IBM AIX® operating system, when the host is using a logical volume manager (LVM) with **recreatevg** command.
  - For Hewlett-Packard (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.

Part 2. Fibre-channel host attachment

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 enough fibre-channel adapters 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.
- SAN Volume Controller versions 4.2.1.4 and later support HP-UX version 11.31 September 2007 (and later 0803) releases. Hosts that attach to SAN Volume Controller and that have 0709 patches must also have the following patches applied:
  - PHKL_37453 (esdisk)
  - PHKL_37454 (esctl)
  - PHCO_37483 (scsimgr)

  The 0803 bundle contains these patches. The following IBM Web site provides current interoperability information about supported device driver and firmware levels:

  www.ibm.com/storage/support/2145

  Note: An RPQ is required if you are using a version prior to the HP-UX 11.31 September 2007 release.
- Ensure that you have the documentation for your HP system and the *IBM System Storage SAN Volume Controller Model 2145-XXX Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  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:

  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:

www.ibm.com/storage/support/2145

Host bus adapters (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:

www.ibm.com/storage/support/2145

Drivers and firmware for HP hosts

You must 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:

www.ibm.com/storage/support/2145

OpenVMS on HP Integrity servers

You can manage HP Integrity server devices by using the OpenVMS Extensible Firmware Interface (EFI) utilities.

Managing HP Integrity server devices using the OpenVMS EFI

The following OpenVMS EFI utilities enable you to manage devices for an Integrity server from the EFI console; for example, if you are using SAN boot.

The **VMS_SHOW** EFI utility displays all bootable devices that are mapped by the EFI console, and their corresponding OpenVMS device names. In the following example output, the first line shows the OpenVMS device name and additional device information, including vendor identification and product identification if the device is a disk, or a MAC address if the device is a network device. The second line shows the file system designation (fsx) and its corresponding EFI device path.

```
VMS_SHOW.EFI dev
VMS: DQA0 IDE Drive
EFI: fs0: Acpi(HWP0002,0)/Pci(2|0)/Ata(Primary,Master)

VMS: EIA0 00-30-6E-F3-F2-52
EFI: Acpi(HWP0002,0)/Pci(3|0)/Mac(00306EF3F252)

VMS: DKA0 HP 36.4GST336753LC HPC4 V8.2-1
EFI: fs1: Acpi(HWP0002,100)/Pci(1|0)/Scsi(Pun0,Lun0)

VMS: EWA0 00-30-6E-F3-52-2C
EFI: Acpi(HWP0002,100)/Pci(2|0)/Mac(00306EF3522C)

VMS: DGA78 IBM 2145 V8.2-1
EFI: fs5: Acpi(HWP0002,300)/Pci(1|0)/Pci(4|0)/Fibre(WWN500507680140000c,
 Lun1000000000000)
```

```
VMS: DGA78 IBM 2145 V8.2-1
EFI: fs3: Acpi(HWP0002,300)/Pci(1|0)/Pci(4|0)/Fibre(WWN500507680140000c,
 Lun1000000000000)
```

If specified, the utility matches the specified OpenVMS device name to the EFI console mapping. For multipath fibre-channel devices, the utility displays all paths that are associated with the specified OpenVMS device name. There are several additional options:

- The **debug_dev** option displays the selected OpenVMS debug device.
- The **dump_dev** option displays the selected OpenVMS dump device for the dump-off-system-disk (DOSD) function.
- The **-fs** option displays the names of OpenVMS devices that only have only the system disk.

The **VMS_BCFG** EFI utility adds an entry to the EFI Boot Manager using a specified OpenVMS device name. The following example output from the utility shows a boot option list entry:

```
fs3:\efi\vms> VMS_BCFG.EFI boot show
The boot option list is:
01. VenHw(D65A6B8C-71E5-4DF0-A909-F0D2992B5AA9) "EFI Shell [Built-in]"
02. Acpi(HWP0002,300)/Pci(1|0)/Pci(4|0)/Fibre(WWN500507680140000c,Lun1000000000000)
/HD(Part1,Sig0C516100-6657-11DC-AA2E-AA000400FEFF)/ \efi\vms\vms_loader.efi "OpenVMS
on $1$DGA78: FGA0.5005-0768-0140-000c"
03. Acpi(HWP0002,300)/Pci(1|0)/Pci(4|0)/Fibre(WWN500507680140000c,Lun1000000000000)
/HD(Part1,Sig0C516100-6657-11DC-AA2E-AA000400FEFF)/ \efi\vms\vms_loader.efi "OpenVMS
on $1$DGA78: FGA0.5005-0768-0140-000c"
04. Acpi(HWP0002,100)/Pci(1|0)/Scsi(Pun0,Lun0)/HD(Part1,Sig76D23A51-9B8B-11DB-A618-
 AA000400FEFF)/\efi\vms\vms_loader.efi "DKA0 PKA0.0" OPT
05. Acpi(HWP0002,100)/Pci(1|0)/Scsi(Pun0,Lun0)/HD(Part1,Sig76D23A51-9B8B-11DB-A618-
 AA000400FEFF)/\efi\vms\vms_loader.efi "HP-UX Primary Boot: 0/1/1/0.0.0"
06. Acpi(HWP0002,0)/Pci(2|0)/Ata(Primary,Master) "CDROM" OPT  fs3:\efi\vms>
```

For additional information, see "Configuration requirements for OpenVMS on HP AlphaServer and HP Integrity server hosts" on page 26.

Installing host bus adapter (HBA) drivers for HP 9000 and HP Integrity servers

After you install the 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 the HBA that is installed on your host.

      www.ibm.com/storage/support/2145

      The specific versions of the driver are 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 the `ioscan -f -n` 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.

Note: On HP-UX 11iv3 September 2007 (11.31.0709) and later updates, LUN0 must be defined as the CCL (Command Control LUN) for the remaining disks to be recognized. Subsequent HP-UX 11iv3 required updates, PHKL_37453, PHKL_37454, and PHCO_37483, are included in the HP-UX March 2008 GA Bundle 11.31.0803 [with FibrChanl-00 (td) and FibrChanl-01 (fcd) Fibre Channel Mass Storage Drivers remain 11.31.0709]. All of these HP-UX 11iv3 updates are included in SAN Volume Controller 4.2.1.4 and later versions.

After discovering the disks, run the `insf -e` command 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 IBM System Storage Multipath 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 enable the Cisco persistent FC (Fibre Channel) ID feature. See your Cisco documentation 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:

- Your 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. For HP-UX version 11.31, HP does not require installing a separate multipath driver. As part of this version, native multipathing solution is supported with the mass storage stack feature.

   b. The IBM System Storage Multipath 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.

c. SDD does not support an HP-UX 32-bit mode operating environment.
d. 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.

For releases of HP-UX prior to 11.31, multipathing support is available using either of the following software:

- IBM System Storage Multipath Subsystem Device Driver (SDD)
- HP PVLinks

Mass storage stack and native multipathing

Mass storage stack manages I/O devices. In HP-UX 11i v3, the mass storage stack provides native multipathing and agile naming.

With agile naming, rather than being named by the hardware path to the object, I/O devices are named for actual object names. Because these device paths change dynamically, native multipathing provides a single virtualized path which represents multiple paths to single device.

To support the mass storage stack and native multipathing of HP-UX version 11.31, the type attribute of related host objects must be specified as `hpux`. Although Device Special File (DSF) naming and PVLinks (physical volume links) are supported by HP-UX version 11.31, use the agile naming and native multipathing with SAN Volume Controller. For more detailed information on native multipathing support and mass storage stack support for HP-UX version 11.31, refer to related Hewlett-Packard publications.

To discover and show all hardware paths and persistent DSFs of the attached disks, use the HP-UX version 11.31 command `ioscan -fnNC disk`. SAN Volume Controller Virtual disks (VDisks) are discovered as IBM 2145 disks.

To determine the open close state of paths to a SAN Volume Controller VDisk, use the HP-UX version 11.31 command `scsimgr get_info all_lpt`. The value for the World Wide Identifier (WWID) in the output of `scsimgr` matches the unique identifier (UID) of the VDisk on the SAN Volume Controller (vdisk_UID). Also HP-UX version 11.31 September 2007 release and later implements the T10 ALUA support. Implicit ALUA support is integrated to HP-UX host type of SAN Volume Controller 4.2.1.4 and later releases.

To show the asymmetric state of paths to SAN Volume Controller nodes, use the HP-UX version 11.31 command `scsimgr`. The asymmetric state of paths to preferred node of the LUN is shown as `ACTIVE/OPTIMIZED` in the output from the `scsimgr`

command. This value of paths to nonpreferred nodes displays as ACTIVE/NON-OPTIMIZED. The following examples show the output of the scsimgr command:

```
# scsimgr get_info all_lpt -D /dev/rdisk/disk1484
STATUS INFORMATION FOR LUN PATH : lunpath993
Generic Status Information

SCSI services internal state = STANDBY
Open close state  = STANDBY
Protocol = fibre_channel
EVPD page 0x83 description code  = 1
EVPD page 0x83 description association = 0
EVPD page 0x83 description type  = 3
World Wide Identifier (WWID) = 0x600507680184000060000000000005d4
Total number of Outstanding I/Os = 0
Maximum I/O timeout in seconds = 30
Maximum I/O size allowed  = 2097152
Maximum number of active I/Os allowed  = 8
Maximum queue depth = 8
Queue full delay count  = 0
Asymmetric state = ACTIVE/NON-OPTIMIZED
Device preferred path = No
Relative target port identifier  = 256
Target port group identifier  = 1


STATUS INFORMATION FOR LUN PATH : lunpath990

Generic Status Information

SCSI services internal state = ACTIVE
Open close state = ACTIVE
Protocol = fibre_channel
EVPD page 0x83 description code  = 1
EVPD page 0x83 description association  = 0
EVPD page 0x83 description type  = 3
World Wide Identifier (WWID) = 0x600507680184000060000000000005d4
Total number of Outstanding I/Os = 0
Maximum I/O timeout in seconds = 30
Maximum I/O size allowed  = 2097152
Maximum number of active I/Os allowed = 8
Maximum queue depth = 8
Queue full delay count  = 0
Asymmetric state  = ACTIVE/OPTIMIZED
Device preferred path = No
Relative target port identifier  = 0
Target port group identifier = 0
```

The Dynamic LUN expansion feature in HP-UX version 11.31 supports SAN Volume Controller virtual disk (VDisk) expansion. To use this feature, the SAN Volume Controller svctask expandvdisksize command expands the capacity of a VDisk. Refer to Hewlett-Packard publication *HP-UX System Administrator's Guide: Logical Volume Management: HP-UX 11i Version 3* for more information on host-side operations.

SDD dynamic pathing on HP 9000 and HP Integrity servers

HP 9000 and HP Integrity servers support IBM System Storage Multipath 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, the SDD is aware of the preferred paths that are set by SAN Volume Controller for each VDisk. SDD is supported on HP-UX 11.0, 11iv1 and 11iv2. 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 with HP-UX versions 11.0, 11iv1, and 11iv2 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 IBM System Storage Multipath 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. Use SDD, unless you are using a clustering environment or 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, consider the following requirements:

- When you create a volume group, you must 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 IBM System Storage Multipath Subsystem Device Driver (SDD) on HP 9000 and HP Integrity servers.

Table 4 provides the maximum virtual disks (VDisks) and paths per VDisk for SDD.

Table 4. Multipathing configuration maximums for HP 9000 and HP Integrity servers

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 IBM System Storage Multipath Subsystem Device Driver (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 IBM System Storage Multipath 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 to 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.

HP-UX version 11.31 supports ServiceGuard 11.18, which provides a cluster locking mechanism called *cluster lock LUN*. On the SAN Volume Controller, specify the block device name of a virtual disk (VDisk) for `CLUSTER_LOCK_LUN` variable in the cluster configuration ASCII file. The lock LUN among all cluster nodes must point to the same VDisk. This consistency can be guaranteed by determining the world wide identifier (WWID) of the VDisk. The cluster lock LUN cannot be used for multiple cluster locking and cannot be used as a member of a Logical Volume Manager (LVM) volume group or VxVM disk group.

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

www.ibm.com/storage/support/2145

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.

SAN boot is supported for all HP-UX 11.3x releases on both HP 9000 and HP Integrity servers. Refer to the Hewlett-Packard publication, *HP-UX System Administrator's Guide*, for details.

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.

For HP Integrity servers, the HP-UX operating system creates a primary boot partition after the operating system installation on a SAN Volume Controller virtual disk (VDisk). This primary boot partition is created as the default. The primary boot is the upper line of the **setboot** menu at the MP Server console. The boot starts in 10 seconds unless an interruption occurs, which is the same as in a normal boot. You can change the alternative boot partition, change the boot order, or add a boot disk by using the console boot menu. Use the **setboot** command to list, add, or change the primary boot or an HA alternative boot, which is an alternative boot from an operating system that is booted already.

Use OpenVMS Extensible Firmware Interface (EFI) utilities to upgrade firmware for a host or host bus adapter (HBA) or to check for the connected SAN disks.

For more information on SAN boot support and known restrictions, see the following Web site:

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 the SAN Volume Controller port in step 3.
   c. Map the image mode VDisk to the host. For example, you could 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 could 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 HBA ports to the host object that you created in step 4b.
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 the host, as required.

Configuring physical volume timeout

Physical volumes (PV) can be multipathed with the IBM System Storage Multipath 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 to be aware of when you are attaching the SAN Volume Controller to HP 9000 and HP Integrity servers.

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

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.

Setting domain IDs

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

To decide when to set your HP 9000 and HP integrity host domain IDs, consider the following scenarios:

- When two active switches are joined, they determine if the domain ID is already in use. 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 are no longer valid.
- 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.
- Do not use domain ID 8. Domain ID 8 limits the HP-UX host to private loop devices. If domain ID 8 is used, the HP-UX host is not able to detect the SAN Volume Controller.

Attaching HP hosts to a cluster

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).

Note: If you have a degraded VDisk but all of the associated nodes and MDisks are online, call the IBM Support Center for assistance.

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 amount of 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 method for specifying alternate links to a cluster lock disk.

For releases prior to 11.31, 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 whether the paths to the lock disk are different on different servers, you must inspect the hardware path.

Mapping a virtual disk (VDisk) to HP-UX 11.31 0709 and 0803 hosts

With HP-UX 11.31 0709 and 0803 hosts, a VDisk with SCSI LUN ID 0 must be defined in each I/O group for the remaining disks to be recognized.

By default, the lowest available SCSI LUN ID is allocated when a VDisk is mapped to a host; for example, 0 for the first host mapping. A VDisk can also be created manually such as in the following example of defining a virtual disk to host mapping with SCSI LUN ID 0:

```
svctask mkvdiskhostmap -host host_name|host_id -scsi 0 vdisk_name|vdisk_id
```

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 Model 2145-XXX Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  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:

  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:

www.ibm.com/storage/support/2145

Host bus adapters (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:

www.ibm.com/storage/support/2145

Drivers and firmware for HP hosts

You must 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:

www.ibm.com/storage/support/2145

Installing adapter drivers for HP AlphaServer hosts

After you install the host bus adapter (HBA) for 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:

      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`

   Issue the `wwidmgr –show` *`adapter`* command to confirm that each adapter was properly installed.
4. Update the adapter firmware, if required.

The following example shows **wwidmgr** command output. 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 (for example, **dkd100**), log into the system and verify that the disks are available and online by issuing the following command: `boot dkd100`.

Configuration requirements for Tru64 UNIX on HP AlphaServer hosts

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

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

- Your 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 VDisks to the host.
3. For Tru64 UNIX 5.1 and later versions, you can 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 example shows output from 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 example shows output from 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 25 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 Tru64 UNIX version 4.0f, and later. For more information, see the Tru64 UNIX `ddr.dbase` and `ddr_config` man files.

Perform the following steps to set up the Tru64 UNIX device parameter database for features that are specific to the SAN Volume Controller:

1. Quiesce the storage.
2. Place the host system in single-user mode as *root*.
3. Edit the `/etc/ddr.dbase` file 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 example shows output from 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

Configuration requirements for OpenVMS on HP AlphaServer and HP Integrity server hosts

You must configure the OpenVMS operating system before you can use HP AlphaServer and HP Integrity server hosts with the SAN Volume Controller.

Using the AlphaServer Console for configuring the fibre channel

To discover available VDisks, you must issue the `init` command at the AlphaServer Console level. See Figure 3 on page 27.

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


P00>>>show device
dka0.0.0.1.0                DKA0                          RZ2DD-LS  0306
dka100.1.0.1.0              DKA100                        RZ2DD-LS  0306
dka200.2.0.1.0              DKA200                        RZ2DD-LS  0306
dka300.3.0.1.0              DKA300        COMPAQ CD-ROM CR-503BCQ  1.1c
dqa0.0.0.15.0               DQA0                  COMPAQ CDR-8435  0013
dva0.0.0.1000.0             DVA0
eia0.0.0.2004.1             EIA0                00-50-8B-CF-D9-DA
eib0.0.0.2005.1             EIB0                00-50-8B-CF-D9-DB
pga0.0.0.1.1                PGA0          WWN 1000-0000-c93b-bae8
pgb0.0.0.2.1                PGB0          WWN 1000-0000-c930-907b
pgc0.0.0.3.1                PGC0          WWN 1000-0000-c923-1814
pgd0.0.0.4.1                PGD0          WWN 1000-0000-c923-1765
pge0.0.0.5.1                PGE0          WWN 1000-0000-c930-91cf
pgf0.0.0.4.0                PGF0          WWN 1000-0000-c955-502f
pka0.7.0.1.0                PKA0                    SCSI Bus ID 7
pkb0.7.0.2.0                PKB0                    SCSI Bus ID 7  5.57
pkc0.7.0.3.0                PKC0                    SCSI Bus ID 7  5.57
P00>>>
```

Figure 3. Viewing the fibre-channel configuration with the wwidmgr command

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

To recognize VDisks, OpenVMS issues a UDID value.

Each OpenVMS fibre-attached volume requires a user-defined identifier or unit device identifier (UDID). A UDID is a nonnegative integer that is used when an OpenVMS device name is created. All fibre-attached volumes have an allocation class of **1**, followed by the letters **DGA**, followed by the UDID value. All storage unit LUNs that you assign to an OpenVMS system require a UDID so that the operating system can detect and name the device. LUN **0** must be created and present, so OpenVMS system can detect the rest of assigned VDisks. See the

Hewlett-Packard document, *Guidelines for OpenVMS Cluster Configurations*, at http://h71000.www7.hp.com/doc/732FINAL/6318/6318pro_contents.html for more information about fibre-attached storage devices.

An OpenVMS UDID value must be a decimal number 0 to 32767. However, because the CLI utility does not enforce UDID value rules, you must ensure that your input is valid. For example, the CLI accepts values such as **AaBbCcDd** that are not valid for OpenVMS. It is also possible to assign the same UDID value to multiple storage unit volumes. However, each volume that you assign to an OpenVMS system must have a value that is unique within the OpenVMS cluster. For more information on UDID rules, see the HP OpenVMS documentation at http://h71000.www7.hp.com.

Note: Volumes with UDID values greater than **9999** cannot be MSCP-served in an OpenVMS cluster to other systems.

UDID values must be entered during VDisk creation, after MDisk and related group and host information is set up. UDID values can be changed or added using the **chvdisk** command. See Figure 5.

```
svctask mkvdisk -mdiskgrp 0 -size 2 -unit gb -iogrp io_grp0 -mdisk mdisk0 -udid 10 -name ovms_10

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 remaining 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

If the system is already running, locate the WWPN using the **SHOW DEVICE** command or the **ANALYZE/SYSTEM** utility. To run the **SHOW DEVICE** command, enter:

```
show device fg/full
```

To run the **ANALYZE/SYSTEM** utility, you must have OpenVMS **CMKRNL** privilege. To use this utility, perform the following steps:

1. Enter:

   ```
   ANALYZE/SYSTEM
   ```

2. At the **SDA>** prompt, enter:

   ```
   fc show dev fg<adapter>0
   ```

where *adapter* is the letter that identifies the adapter. For example:

```
fc show dev fga0
```

Use the SYSMAN utility to discover new disks on the OpenVMS host. See Figure 7 on page 29.

```
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

Defining LUN 0 on OpenVMS

In SAN Volume Controller 4.1 and later, LUN 0 is represented as a regular disk on OpenVMS hosts.

In earlier versions of SAN Volume Controller and in other storage products, LUN 0 is used as the Command Console LUN (CCL), or pass-through LUN.

OpenVMS hosts require virtual disks (VDisks) with SCSI LUN 0 to be mapped. This action enables an OpenVMS host to recognize any other VDisks mapped to the host. By default, the lowest available SCSI LUN ID is used when mapping a

VDisk to a host. However, you can also set the SCSI LUN ID manually when creating a mapping by using the -scsi parameter. The following example creates a mapping with SCSI LUN ID 0:

```
svctask mkvdiskhostmap -host host_name|host_id -scsi 0 vdisk_name|vdisk_id
```

Multipath support for HP AlphaServer hosts

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

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 5 provides the maximum virtual disks (VDisks) and paths per VDisk for multipathing.

Table 5. 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 6 provides information about the supported cluster software and other information for clustering on an HP AlphaServer host.

Table 6. Clustering support for HP AlphaServer hosts

Operating system	Cluster software	Number of hosts in cluster
Tru64 UNIX	TruCluster Server	2
OpenVMS	OpenVMS Cluster	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 or OpenVMS Cluster software as the multipathing software on the boot device.

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

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 HBA ports to the host object that you created in step 4b.
8. Map any further VDisks to host as required.

FlashCopy 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 server 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 IBM System p AIX hosts

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

The following IBM Web site provides current interoperability information about the AIX hosts that are supported with SAN Volume Controller:

www.ibm.com/storage/support/2145

Attention: In this section, the IBM System p information applies to all AIX hosts that are listed on the SAN Volume Controller interoperability support site, including IBM System i® partitions and IBM BladeCenter® JS blades.

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 Model 2145-XXX Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

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

www.ibm.com/storage/support/2145

Host bus adapters (HBAs) for IBM System p hosts

Ensure that your IBM System p AIX hosts use the correct HBAs.

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

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:

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:
   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, the fast fail and dynamic tracking attributes must be enabled.

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) provides multipathing support.

Configuring SAN Volume Controller devices with multiple paths per LUN

The SAN Volume Controller supports multiple LUNs on an 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 have 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 7 on page 36 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 7. 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:

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:

www.ibm.com/storage/support/2145

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

2 TB On 64-bit AIX 5.3 platforms

2 TB On AIX 6.1 platforms

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

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 an IBM i host with Virtual I/O Server

This section explains the requirements and other information for attaching the SAN Volume Controller to an IBM i host through the Virtual I/O Server. The Virtual I/O Server is software that is located in a logical partition.

The following IBM Web site provides current interoperability information about the IBM i hosts that are supported with SAN Volume Controller:

www.ibm.com/storage/support/2145

Attachment requirements for IBM i hosts

This section provides an overview of the requirements for attaching the SAN Volume Controller to a Virtual I/O Server with an IBM i virtual I/O client.

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

- Check the logical unit number (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 Model 2145-XXX Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  www.ibm.com/storage/support/2145
- Ensure that you have installed the correct operating systems and version levels on your host, including any updates and Authorized Program Analysis Reports (APARS) for the operating system.

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

www.ibm.com/storage/support/2145

Environments for IBM i hosts

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

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

www.ibm.com/storage/support/2145

Host bus adapters for IBM i hosts

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

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

www.ibm.com/storage/support/2145

Drivers and firmware for Virtual I/O Server hosts with IBM i clients

Ensure that you use the correct HBA device driver and firmware levels for your hosts.

The following Web site provides current interoperability information about device driver and firmware levels as well as Virtual I/O Server host and client:

www.ibm.com/storage/support/2145

Configuring the IBM i operating system

You must configure the Virtual I/O Server and the IBM i client operating system before you can use IBM i as a host 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 host operating system:

1. Zone the Virtual I/O Server to the SAN Volume Controller on the fibre-channel SAN.
2. Install the SAN Volume Controller subsystem device driver path-control module (SDDPCM) on the Virtual I/O Server to enable the management of multiple paths to the SAN Volume Controller virtual disks (VDisks).
3. Create the host system on the SAN Volume Controllerusing the worldwide port names (WWPNs). Map the VDisks to the host as required.

   Note: The IBM i virtual I/O client supports startup from a SAN with a virtual disk for the load source of 20 GB or larger.
4. Run the cfgdev command on the Virtual I/O Server to configure the new disks. Use the lspath command to ensure that disks are enlisted to all paths to the SAN Volume Controller.
5. Map the SAN Volume Controller LUNs (hdisks on the Virtual I/O Server) uniquely to the IBM i virtual SCSI client adapters using the mkvdev command.
6. Ensure on the Hardware Management Console (HMC) that the I/O tagging for the IBM i virtual I/O client partition is correctly set for the load source and the alternate restart device.
7. Start installing IBM i version 6 release 1 or later.

Multipath support for Virtual I/O Server with IBM i clients

You must install the multipathing software of the SAN Volume Controller subsystem device driver path-control module (SDDPCM) in the Virtual I/O Server partition.

The following IBM Web site provides current interoperability information:

www.ibm.com/storage/support/2145

Mulitpathing configuration maximums for IBM i hosts

When you configure your hosts to support multipathing, remember the multipathing configuration maximums.

Table 8 provides the configuration maximums for the Virtual I/O Server supporting a IBM i client attached to a SAN Volume Controller.

Table 8. Multipathing configuration maximums for IBM i servers

Object	Maximum	Description
VDisk (HDisk)	512	The maximum number of VDisks that can be supported by the SAN Volume Controller for a host running an IBM i operating system (per host object).
Paths per VDisk	8	The maximum number of paths to each VDisk. The suggested number of paths is 4.[1]
Note: [1] Subsystem device driver path-control module (SDDPCM) for AIX actually supports 16 paths per VDisk, but the SAN Volume Controller supports a maximum of only 8 paths for a reasonable path-failover time.		

Clustering support for IBM i hosts

The SAN Volume Controller provides clustering support for IBM i hosts.

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

www.ibm.com/storage/support/2145

Known IBM i issues and limitations

There are known issues and limitations with the SAN Volume Controller and an IBM i host.

Consider the following items when attaching to a host that runs the IBM i operating system:

- When there are two disks in a remote copy relationship, do not access the read-only secondary VDisk from the IBM i host.
- A maximum of 16 disk virtual LUNs and 16 optical virtual LUNs is supported for each IBM i virtual I/O client SCSI adapter.
- IBM i multipathing for virtual SCSI disks is not supported.
- SAN Volume Controller FlashCopy, Metro Mirror, and Global Mirror are supported for IBM i full-system replication only.
- SAN Volume Controller space-efficient VDisks are supported for IBM i for use as FlashCopy targets only.

Chapter 6. Attaching to IBM System p and BladeCenter JS 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 IBM Web site provides current information about supported software levels:

www.ibm.com/storage/support/2145

Attachment requirements for System p and BladeCenter JS hosts

This section provides an overview of the requirements for attaching the SAN Volume Controller to a System p or BladeCenter JS host that is running the Linux operating system.

The following list provides the requirements for attaching the SAN Volume Controller to your System p and BladeCenter JS hosts that are 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 Model 2145-XXX Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  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 System p and BladeCenter JS hosts

Ensure that each System p and BladeCenter JS host uses a supported Linux distribution.

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

www.ibm.com/storage/support/2145

HBAs for System p and BladeCenter JS hosts running the Linux operating system

Ensure that your System p and BladeCenter JS hosts that are 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:

www.ibm.com/storage/support/2145

Drivers and firmware for System p and BladeCenter JS hosts running the Linux operating system

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

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

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:

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 System p or BladeCenter JS 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.

      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 System p host contains an Emulex host bus adapter (HBA), you must download and install the appropriate Emulex driver for the adapter, unless the Linux distribution already contains the correct driver at a supported level.

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.

      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. Ensure that the SCSI time-out value for the Emulex HBA on a Linux host is set to 60. The default SCSI time-out value is 30. To verify the current time-out setting, check the setting in the `/sys/block/sd*/device/time-out` directory on the Emulex Linux host. For SAN Volume Controller, the value should be 60. If the value is not 60, you can set the value by running the following script:

   ```
   for i in /sys/block/sd*/device;do
     if cat $i/model | grep 2145;then
         echo 60 > $i/timeout
     fi
   done
   ```

   Note: You must make this adjustment every time the HBA driver is loaded; otherwise, the settings are lost when the host is restarted. To save the settings, put the previous code into an executable script, for example, `/sbin/scsi_timeout`, and then add the following line to `/etc/modprobe.conf`:

   ```
   install lpfc /sbin/modprobe --ignore-install lpfc;/sbin/
   scsi_timeout
   ```
4. Restart the host.

Installing a Brocade HBA driver

If your Linux on the System x host contains a Brocade host bus adapter (HBA), you must download and install the appropriate Brocade driver for the adapter.

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

      www.ibm.com/storage/support/2145

      The specific versions of the Brocade driver and the associated firmware version are indicated on the hardware list.
   b. Ensure that your Brocade HBA is running the correct firmware version. If you need to update the firmware to the version that is 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 Brocade 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 System p and BladeCenter JS hosts

You must install multipathing software on all System p and BladeCenter JS hosts that are attached to the SAN Volume Controller.

On System p and BladeCenter JS hosts that are running the Linux operating system, the subsystem device driver (SDD) software provides multipathing support.

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 System p and BladeCenter JS hosts

When you configure, keep in mind the maximum configuration for the subsystem device driver (SDD) on System p and BladeCenter JS hosts that are running the Linux operating system.

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

Table 9. Configuration maximums for SDD on System p and BladeCenter JS 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 System p and BladeCenter JS hosts

The SAN Volume Controller provides SAN boot support for System p and BladeCenter JS hosts that are running the Linux operating system.

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

www.ibm.com/storage/support/2145

Defining the number of disks for System p and BladeCenter JS hosts

When you define the number of disks on System p and BladeCenter JS 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 ql2xfailover=0 ql2xmaxqdepth=new_queue_depth
   ```

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

   ```
   options qla2xxx ql2xfailover=0 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 a SUSE Linux Enterprise Server operating system, run the `mk_initrd` command.
   - If you are running on a Red Hat Enterprise Linux operating system, run the `mkinitrd` command and then restart.

   Note: Some Linux kernel versions omit the `ql2xfailover` parameter from the distribution that is provided with the QLogic HBA driver. If this is the case, an error is generated in the `/var/log/messages` file when booting or loading the qla2xxx module manually. The following error is an example:

   ```
   FATAL: Error inserting qla2xxx
   (/lib/modules/2.6.27.19-5-default/kernel/drivers
   /scsi/qla2xxx/qla2xxx.ko):
   Unknown symbol in module, or unknown parameter
   ```

   In these cases, you can omit the `ql2xfailover=0` option from the modprobe.conf file, and the module will load correctly.

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. For Red Hat Enterprise Linux 4 or later and SUSE Linux Enterprise Server 9 or later, add the following line to the /etc/modprobe.conf.local file:

   ```
   lpfc options lpfc_lun_queue_depth=4
   ```

2. Restart the machine.

Setting queue depth for Brocade 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. After installing the Brocade driver package, set the queue depth. The following example sets a queue depth of 4 with a dual-port HBA:

```
bcu fcpim –qdepth 1/04
bcu fcpim –qdepth 1/14
```

2. Query the settings by using the following commands:

```
bcu port –query 1/0
bcu port –query 1/1
```

3. Restart the host.

SAN Volume Controller storage configuration for System p and BladeCenter JS 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 on page 50 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 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 on page 51 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 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 14. Example of creating a file with the mkfs command

Chapter 7. Attaching to IBM System z hosts running the Linux operating system

This information provides an overview for attaching the SAN Volume Controller to IBM System z® hosts that are running the Linux operating system.

Attachment requirements for System z hosts running the Linux operating system

This section provides an overview of the requirements for attaching the SAN Volume Controller to a System z host that is running the Linux operating system.

The following list provides the requirements for attaching the SAN Volume Controller to your System z hosts that are 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 Model 2145-XXX Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  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 z hosts

Ensure that each System z host uses a supported Linux distribution.

Table 10 provides information about the supported distributions.

Table 10. Linux distributions for System z hosts

Host server	Linux distribution
System z server	SUSE Linux Enterprise Server
System z9® server	SUSE Linux Enterprise Server
System z10 server	SUSE Linux Enterprise Server
System z server	Red Hat Enterprise Linux AS
System z9 server	Red Hat Enterprise Linux AS
System z10 server	Red Hat Enterprise Linux AS

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

www.ibm.com/storage/support/2145

HBAs for System z hosts running the Linux operating system

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

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

www.ibm.com/storage/support/2145

Drivers and firmware for System z hosts

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

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

www.ibm.com/storage/support/2145

Installing and configuring the HBA on System z hosts

The host bus adapters (HBAs) for a System z 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, FICON Express2, or FICON Express4 features are installed on your System z host.
2. Configure the HBA to run in FCP mode.

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

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

Configuring the Linux operating system for System z hosts

You must configure the Linux operating system before you can use System z 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 z hosts that are 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. See the latest versions of the *Linux on zSeries® Device Drivers and Installation Commands for the Linux Kernel* and *Device Drivers,Features and Commands for the Linux Kernel* publications for additional information.

4. See your host system publications for additional configuration tasks.

Multipath support for System z hosts

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

On System z hosts that are running the Linux operating system, the following software provides multipathing support:

Linux Kernel 2.4
The logical volume manager.

Linux Kernel 2.6

- The multipath-tools package on SUSE Linux Enterprise Server.
- The device-mapper-multipath package on Red Hat Enterprise Linux.

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

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

Table 11. 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 z hosts

On a SCSI LUN, you can perform an initial program load (IPL) process.

IPL processes on SCSI LUNs can fail because there is no path failover capability during the boot process. Refer to the latest *How to use FC-attached SCSI devices with Linux on System z* publication for more information about using IPL processes with System z hosts.

Defining the number of disks on System z hosts

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

On the Linux operating system, a device node is used for each path to the disk and a second device node is used for the path grouped device. The maximum number of devices depends on your Linux configuration.

SAN Volume Controller storage configuration for System z hosts

Each attached SAN Volume Controller LUN has a set of device files in the **/dev** Linux directory.

These device files are intended to be used only by the multipath tools. Allowing them to be used directly by your system or applications can produce data inconsistencies. Instead, configure your system and applications to use the device nodes that are created by the multipath tools.

The maximum number of devices depends on your Linux configuration. See the latest *Linux on zSeries Device Drivers and Installation Commands for the Linux Kernel* and *Device Drivers, Features and Commands for the Linux Kernel* publications for additional information about multipathing support.

Known issues and limitations for System z hosts

There are some restrictions for System z hosts that are running the Linux operating system.

The following Web site provides currently known restrictions for the latest Linux on System z releases:

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

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 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
```

Changing the timeout value for the FC transport class

This section describes how to change the timeout value for the Fibre Channel (FC) transport class when the I/O operation stalls.

The FC transport class keeps all outstanding I/O for a certain time until it determines that the remote port will not respond. This time period is controlled by the timeout value. The default time is 60 seconds. This situation causes a temporary I/O stall in the case of FC link incidents or when paths are varied offline.

Change the timeout value.

- Set the timeout value for each remote port by using the `sysfs` file system.
  `/sys/class/fc_remote_ports/rport-0:0-0/dev_loss_tmo`
- Preset the timeout value for all remote ports when you load the `scsi_transport_fc` module by using the `dev_loss_tmo` parameter.

SCSI device state changes from running to offline

In some instances, the Small Computer System Interface (SCSI) mid layer changes the SCSI device state from **running** to **offline**.

I/O that is later sent to that SCSI device is rejected by the mid layer and never reaches the SCSI lower-level device drivers for processing. To solve this problem, you must increase the SCSI timeout value to at least 60 seconds as shown in the following example:

```
SUBSYSTEM=="scsi", ACTION=="add", ATTR{vendor}=="IBM",
ATTR{model}=="2145", ATTR{timeout}="60"
```

Chapter 8. Attaching to IBM System z server running the IBM z/VSE operating system

This information provides an overview for attaching the SAN Volume Controller to IBM System z10™, IBM System z9, and IBM eServer™ zSeries servers (hosts) that are running the IBM z/VSE™ operating system. The z/VSE operating system can operate in a logical partition (LPAR) and in an IBM z/VM® guest environment.

Attachment requirements for System z hosts running the z/VSE operating system

This section provides an overview of the requirements for attaching the SAN Volume Controller to a System z10 host, a System z9 host, or a zSeries host that is running the z/VSE operating system.

The following list identifies the requirements:

- 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 Model 2145-XXX Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  www.ibm.com/storage/support/2145
- Ensure that you have installed a supported z/VSE version. The following IBM Web site provides current interoperability information about supported software levels, including distribution levels:

  www.ibm.com/storage/support/2145

  The following IBM Web site provides general z/VSE information about supported z/VSE releases, and supported IBM System z servers:

  www.ibm.com/servers/eserver/zseries/zvse

HBAs for System z10, System z9, and zSeries hosts

Ensure that your System z10, System z9, and zSeries hosts are using the correct host bus adapters (HBAs) and host software.

You need a FICON Express™ (FICON Express, FICON Express2 or higher) adapter (also named host bus adapter (HBA)) on your System z server.

The following Web site provides information about which FICON Express adapter is supported by the different IBM System z hosts:

www.ibm.com/systems/z/hardware

Installing and configuring the HBA on System z hosts

The host bus adapters (HBAs) for System z servers must be ordered as features. The HBAs 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 an HBA is installed on your System z host.
2. Configure the HBA to run in Fibre Channel Protocol (FCP) mode.

   Note: The phrases *HBA adapter configured in FCP mode* or *FCP adapter* are used interchangeably.

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

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

Configuring the z/VSE operating system

You must configure the z/VSE operating system before you can use it with the SAN Volume Controller.

Before you configure the z/VSE operating system, 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 adapter (HBA) for your System z server.
- You must have configured the HBA in FCP mode. FCP mode means the HBA has been configured with channel path ID (CHPID) type FCP in the input/output control data set (IOCDS) of your System z server.

After the prerequisite tasks are complete, use the following general steps to configure your host system that is running the z/VSE 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) of your FCP adapter. 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.

   Note: With N_Port ID Virtualization (NPIV), multiple virtual FCP adapters can be defined. Each virtual FCP adapter can have its own unique WWPN. You can use the WWPN of a virtual FCP adapter to map VDisks to the host. This action allows you to define multiple hosts that share the same physical FCP adapter. The NPIV support was introduced with System z9.
3. Configure your z/VSE system to use FCP-attached SCSI disks. After you configure a path to the SCSI disk, the SCSI disks are recognized by z/VSE user programs and system programs as fixed block architecture (FBA) disks only. You can use the SCSI disks with existing FBA interfaces. The z/VSE operating system does not provide SCSI command support for applications. See the *IBM z/VSE Administration* (SC33-8304) manual for additional information.

Multipath support in the z/VSE operating system

The z/VSE operating system provides multipath support for high availability.

Using multipath support, you can configure several paths to the same SCSI disk to protect your system against a potential outage.

See the *IBM z/VSE Administration* manual for additional information.

SAN boot support for IBM System z servers running the z/VSE operating system

If you have installed the z/VSE operating system on SCSI disks, you can perform the initial program load (IPL) process from the SCSI disks.

See the *IBM z/VSE Administration* manual for information regarding what specifications are required to initiate the IPL process in an LPAR environment and in a z/VM guest environment.

Defining the number of SCSI disks

The maximum number of SCSI disks that can be defined within your z/VSE operating system depends on the number of devices already used in your z/VSE configuration.

Chapter 9. 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 Model 2145-XXX Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  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 distribution.

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:

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:

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:

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:

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)
- SUSE Linux Enterprise Server version 9 and Red Hat Enterprise Linux 4 support both SDD and native multipathing support that is provided by the operating system.
- SUSE Linux Enterprise Server version 10 and later and Red Hat Enterprise Linux 5 and later only support native mulitpathing that is provided by the operating system.

Configuring Device Mapper Multipath Tool (DMMP) for hosts running the Linux operating system

Before configuring the Linux operating system for a host that attaches to the SAN Volume Controller, you should ensure that the correct Device Mapper Multipath Tool (DMMP) has been installed and configured correctly for the Linux hosts which use DMMP as a multipath driver. Currently Red Hat Enterprise Linux 4 or later and SUSE Linux Enterprise Server 9 or later support DMMP as a multipath driver and ship it on a distribution disc.

1. Ensure that the DMMP packages are installed on your Linux host:
   - For Red Hat Enterprise Linux 4 or later, install `device-mapper` and `device-mapper-multipath`.
   - For SUSE Linux Enterprise Server 9 or later, install `device-mapper` and `multipath-tools`.
2. In the DMMP configuration file, `/etc/multipath.conf`, ensure that the default settings have the following values:

```
defaults {
      polling_interval       30
      failback               immediate
      no_path_retry          5
      rr_min_io              100
      path_checker           tur
      user_friendly_names    yes
      }
      # SVC
           device {
                 vendor                  "IBM"
                 product                 "2145"
                 path_grouping_policy    group_by_prio
                 prio_callout            "/sbin/mpath_prio_alua /dev/%n"

           }
```

   Note: If you are using SUSE Linux Enterprise Server 10 Service Pack 2, use `prio "alua"` instead of `prio_callout "/sbin/mpath_prio_alua /dev/%n"` to disable the `Using deprecated prio_callout` message. This value disables only the error message and does not affect operations. If `prio_callout "/sbin/mpath_prio_alua /dev/%n"` is set on SUSE Linux Enterprise Server 10 Service Pack 2, the `Using deprecated prio_callout` message is issued for all devices when the multipath command is used.
3. To enable DMMP autoload during an operating system boot, issue the following commands as root:

- For Red Hat Enterprise Linux 4 or later, issue one of the following commands:
  - `chkconfig multipathd on`
  - `chkconfig --level 345 multipathd on`

    Note: This command enables `multipathd` service startup at boot.
- For SUSE Linux Enterprise Server 9 or later, issue one of the following commands:
  - `chkconfig boot.multipath on`
  - `chkconfig --level 345 boot.multipath on`

    Note: This command enables `boot.multipath` service startup at boot.

  After running one of these commands, issue one of these commands:
  - `chkconfig multipathd on`
  - `chkconfig --level 345 multipathd on`

    Note: This command enables `multipathd` service startup at boot.

4. Manually start DMMP by completing the following steps:
   a. Optional: If you are using SUSE Linux Enterprise Server, run the following command before starting the DMMP: `/etc/init.d/boot.multipath start`.
   b. Start DMMP daemon by issuing the following command: /etc/init.d/multipathd start.
   c. Run the commands multipath or multipath -v2 to scan the multipath devices.
   d. Issue the multipath -ll command to view the detailed information of the multipath devices. The command has the following output:

```
mpath1 (360050768018600229000000000000019a)  IBM,2145
[size=2.0G][features=0][hwhandler=0]
\_ round-robin 0 [prio=200][ enabled]
\_ 4:0:0:1 sdd  8:48   [active][ready]
\_ 5:0:0:1 sdt  65:48  [active][ready]
\_ round-robin 0 [prio=40][ active]
\_ 4:0:2:1 sdak 66:64  [active][ready]
\_ 5:0:2:1 sdal 66:80  [active][ready]
```

Note: If the new device cannot be found after issuing the multipath command, you must reload the HBA driver or reboot the server, and reissue the multipath command after Linux recognizes the new device in the SCSI layer with a name like sd*. The HBA driver must recognize the new devices before DMMP can recognize them and manage them. To view the detailed status of the multipath devices, issue the multipath -ll command.

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

Table 12. Configuration maximums for hosts running the Linux operating system

Object	Maximum	Description
VDisks	512 (for 2.6 kernel operating systems) 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.

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:

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.

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 Linux 2.4 kernel 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 Linux 2.6 kernel 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:

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

- Linux 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...
- Linux 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 71 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:

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 10. Attaching to a host running the Microsoft Windows Server operating system

This information explains the requirements and other information for attaching the SAN Volume Controller to a host that is running the Microsoft Windows® 2000 Server, Windows Server 2003, or Windows Server 2008 operating system.

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

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

Attachment requirements for hosts running the Windows Server operating system

This section provides an overview of the requirements for attaching the SAN Volume Controller to a host running the Windows 2000 Server, Windows Server 2003, or Windows Server 2008 operating system.

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 Model 2145-XXX Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  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:

  www.ibm.com/storage/support/2145

Drivers and firmware for hosts running the Windows Server operating system

This section applies to hosts that are running the Windows 2000 Server, Windows Server 2003, or Windows Server 2008 operating system. Ensure that you use the correct host bus adapter device driver and firmware levels for these hosts.

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

www.ibm.com/storage/support/2145

Installing the HBA driver for hosts running the Windows Server operating system

This section applies to hosts that are running the Windows 2000 Server, Windows Server 2003, or Windows Server 2008 operating system. After you install the host bus adapter (HBA) into the host machine, you must download and install the appropriate HBA driver.

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

Changing the disk timeout on Microsoft Windows Server

The section describes how to change the disk timeout value on Windows Server 2000, 2003, and 2008 operating systems.

On your Windows Server hosts, change the disk I/O timeout value to **60** in the Windows registry, as follows:

1. In Windows, click the **Start** button and select **Run**.
2. In the dialog text box, type **regedit** and press the **ENTER** key.
3. In the registry browsing tool, locate the **HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\Disk\TimeOutValue** key.
4. Confirm that the value for the key is **60** (decimal value). If necessary, change the value to **60**.

Configuring the QLogic HBA for hosts running the Windows Server operating system

This section applies to hosts that are running the Windows 2000 Server, Windows Server 2003, or Windows Server 2008 operating system. After you have installed the QLogic HBA and the device driver, you must configure the HBA.

For more information on supported QLogic models, see the following IBM Web site:

www.ibm.com/storage/support/2145

To configure the HBA BIOS, either use the QLogic HBA manager software or reboot into the Fast!UTIL tool. Configure the following settings:

- Host Adapter BIOS: Disabled (unless the machine is configured for SAN Boot)
- Adapter Hard Loop ID: Disabled

- Connection Options: 1 - point to point only
- LUNs Per Target: 0
- Port Down Retry Count: 15

Set the execution throttle to a suitable queue depth for your environment, for example, a value of 100. If you are using subsystem device driver (SDD) 1.6 or later, set Enable Target Reset to No. See Table 13 to include the required parameters for the registry key.

Table 13. Registry key parameters for QLogic models

Key	Required parameters
HKEY_LOCAL_MACHINE > SYSTEM > CurrentControlSet > Services > ql2*xxx* > Parameters > Device > DriverParameters	**Buschange=0;FixupInquiry=1** **Note:** If you are using QLogic driver version 9.1.2.11 or later, **Buschange** cannot be set to zero. Refer to your device driver documentation for details.

Configuring the Emulex HBA for hosts running the Windows Server operating system

This section applies to hosts that are running the Windows 2000 Server, Windows Server 2003, or Windows Server 2008 operating system. 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 14.

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

Table 14. 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
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 Brocade HBA for hosts running the Windows Server operating system

This section applies to hosts that are running the Windows Server 2003 or Windows Server 2008 operating system.

After you install the Brocade host bus adapter (HBA) and the driver, you must configure the HBA. See the following Web site for more information about supported Brocade models:

www.ibm.com/storage/support/2145

To configure the HBA BIOS, either use the Brocade Host Connectivity Manager (HCM) software or reboot into the Brocade configuration tool. Configure the following settings:

- Host Adapter BIOS: Disabled (unless the machine is configured for SAN Boot)
- Queue depth: 4

You can disable the BIOS by using the command-line configuration tool:

- `bcu bios –disable 1/0`
- `bcu bios –disable 1/0`

You can set the queue depth by using the command-line configuration tool:

- `bcu fcpim –qdepth 1/04`
- `bcu fcpim –qdepth 1/14`

You can query the settings by using the command-line configuration tool:

- `bcu port –query 1/0`
- `bcu port –query 1/1`

Configuring the Windows Server operating system

You must configure hosts that are running the Windows 2000 Server, Windows Server 2003, or Windows Server 2008 operating system before you can use the hosts with the SAN Volume Controller.

Before you configure the Windows host operating system, you must ensure that the following tasks have been completed:

- Your IBM service representative has installed the SAN Volume Controller.
- You have installed the appropriate host bus adapter and driver on the host.

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

You must install multipathing software on all attached hosts that run the Windows 2000 Server, Windows Server 2003, or Windows Server 2008 operating system.

The following Web site provides current interoperability information:

www.ibm.com/storage/support/2145

Multipathing configuration maximums

When you configure multipathing on your hosts, you must consider the maximum supported configuration limits.

The following table provides the configuration maximums for hosts running the Windows 2000 Server, Windows Server 2003, or Windows Server 2008 operating system.

Note: Check your operating system and HBA documentation for limitations that may be imposed by other driver software.

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, Windows 2000 Server, Windows Server 2003, and Windows Server 2008 support submounting drives as directories within other drives.
2. SDD and SDDDSM for Windows 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 the 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.

Notes:

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

   www.ibm.com/storage/support/2145
2. When you use SDD for multipathing, you must use a supported driver for an Emulex HBA and for a QLogic HBA. See the following Web site for the latest support information:

   www.ibm.com/storage/support/2145
3. The SDD driver can coexist on a host that is running the Windows 2000 Server operating system with the IBM DS4000® (FAStT) Redundant

Dual Active Controller (RDAC) or IBM DS5000 drivers. SDD coexistence is not supported on hosts that run the Windows Server 2003 or Windows Server 2008 operating systems.

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 and SDDDSM dynamic pathing

If you use the IBM subsystem device driver device specific module (SDDDSM), you must also use the Microsoft Multipath I/O (MPIO) driver for dynamic pathing.

Restriction:

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

   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 the typical new device discovery on a Windows operating system.

SDDDSM uses a load-balancing policy that attempts 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 the Windows Server operating system for SAN Boot

To use the SAN Volume Controller as a boot device for a host running the Windows 2000 Server, Windows Server 2003, or Windows Server 2008 operating system, you must configure the host.

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

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 the Windows Server operating system

The SAN Volume Controller provides clustering support for the Windows 2000 Server, Windows Server 2003, and Windows Server 2008 operating systems.

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

www.ibm.com/storage/support/2145

Migrating existing SAN boot images

If you have a host that runs the Windows 2000 Server, Windows Server 2003, or Windows Server 2008 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 on page 79.
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 applicable Windows Server 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 HBA ports to the host object that you created in step 5b.
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 the Windows Server operating system

There are known issues and limitations when attaching to a host that runs the Windows 2000 Server, Windows Server 2003, or Windows Server 2008 operating system.

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

www.ibm.com/storage/support/2145

Known limitations for hosts that run the Windows Server 2008 operating system

The following limitations apply when you attach to a host that runs the Windows Server 2008 operating system:

- You cannot bring a Metro Mirror or Global Mirror Auxiliary VDisk online when the relationship is active, because the VDisk is read-only. Attempting this action can cause Disk Management to become unresponsive on the Windows Server 2008 host.
- Disk discovery may require rebooting Windows Server 2008.

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

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.
- To prevent inappropriate failover, set the Port Down Retry Timer to 15 seconds.

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

www.ibm.com/storage/support/2145

Chapter 11. 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 Model 2145-XXX Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  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:

  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: **15**
   h. Link Down Timeout: **30**
   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 83 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 subsystem device driver (SDD) software for multipathing support.

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 15.

Table 15. 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).
Paths per VDisk (See Note 2.)	8	The maximum number of paths to each VDisk.

Table 15. Configuration maximums for SDD for Windows (continued)

Object	SDD maximum	Description
Notes: 1. You can assign a maximum of 26 individual drive letters to a host that runs the Windows NT operating system. 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.
   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 12. 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 Model 2145-XXX Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  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 OS levels

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:

www.ibm.com/storage/support/2145

Open the **Install/use** tab and click-on the **Documentation** link for **Supported** for your release of SAN Volume Controller.

NetWare hardware, firmware, and device drivers

Ensure that your Novell NetWare hosts are using supported hardware.

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

- QLogic (on IBM System x® platforms)

The following IBM Web site provides current interoperability information about the supported platforms, HBAs, firmware, and device drivers:

www.ibm.com/storage/support/2145

Open the **Install/use** tab and click-on the **Documentation** link for **Vx.x.x Supported Hardware list** for your release of SAN Volume Controller. The Novell NetWare section shows Driver and Firmware release information for the supported HBAs.

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:

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 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 Novell Storage Services (NSS) software provides multipathing support.

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 following parameters to the end of the line, separated by spaces: /LUNS /MAXLUNS=## /ALLPATHS /PORTNAMES. Use the following syntax:

      ```
      LOAD adapter_driver_file.HAM SLOT=slot_number /LUNS
        /MAXLUNS=max_number_luns /ALLPATHS
      ```

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

Table 16. 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 I/O errors by ensuring that the SET AUTO RESTART AFTER ABEND line is set to 3. The following line is an example:

   ```
   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 13. 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 an 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 Model 2145-XXX Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  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 14. 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 Model 2145-XXX Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

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

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:

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:

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:

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 preferred
 /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 preferred
 /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 15. Attaching to a Sun Solaris host

This information provides an overview for attaching the SAN Volume Controller to a Sun host that is running the Solaris (SPARC or x86) operating system.

Attachment requirements for Sun hosts

This section provides an overview of the requirements for attaching the SAN Volume Controller to Sun 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 Model 2145-XXX Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  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 hosts

Ensure that each host uses a supported operating system and version.

The SAN Volume Controller supports Sun hosts that run the following operating systems:

- Solaris 8, SPARC Platform Edition
- Solaris 9, SPARC Platform Edition
- Solaris 10, SPARC Platform Edition
- Solaris 10, x86

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

www.ibm.com/storage/support/2145

HBAs for Sun hosts

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

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

www.ibm.com/storage/support/2145

Drivers and firmware for Sun hosts

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

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

www.ibm.com/storage/support/2145

Installing the HBA on a Sun host

The first step for attaching the Sun 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:

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 a Sun host

After you install the host bus adapter (HBA) and driver on your Sun host, you must configure the HBAs.

Configuring the JNI or AMCC HBA (SPARC only)

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 Sun 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 www.ibm.com/storage/support/2145.

Configuring the Emulex HBA using Emulex lpfc driver 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 www.emulex.com/support/supportContact.jsp.
   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 using QLogic qla driver 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 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 host parameters for use with IBM SDD and VERITAS DMP

You can set the parameters on the Sun 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 host parameters for use with MPxIO

You can set the parameters on the Sun 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. See the following Web site for the most current information:

www.ibm.com/storage/support/2145

From the Web site, search on Technical note S1002938.

SAN Volume Controller versions 3.1.*x* and 4.1.*x*

See the following Web site for the most current information:

www.ibm.com/storage/support/2145

From the Web site, search on Technical note S1002938.

Discovering new LUNs

The LUN discovery method you must use depends on the type of host bus adapter (HBA) that your Sun 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 DMP

If you are using the VERITAS Volume Manager with the Dynamic Multi-Pathing (DMP) for multipathing support on a Sun 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 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 Volume Manager devices when added to a volume group.

Multipath support for Sun hosts

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

Multipathing support is available for Sun hosts using the following software:

- Sun MPxIO / Solaris multipathing software
- IBM Subsystem device driver (SDD)
- VERITAS Volume Manager DMP

SDD dynamic pathing on Sun hosts

Sun 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 Dynamic Multipathing (DMP) on Sun hosts

Ensure that you are familiar with using the VERITAS Dynamic Multipathing (DMP) feature on Sun hosts.

The VERITAS Dynamic Multipathing (DMP) feature on Sun hosts automatically selects the next available I/O path for I/O requests dynamically without action from the administrator. DMP is also informed 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.

Coexistence of SDD and VERITAS or Symantec Volume Manager with DMP on Sun hosts

VERITAS or Symantec Volume Manager with DMP can coexist in "pass-thru" mode with the subsystem device driver (SDD); 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.

Coexistence of MPxIO and VERITAS Volume Manager with DMP on Sun hosts

VERITAS Volume Manager with dynamic multipathing (DMP) can coexist in "pass-thru" mode with MPxIO; DMP uses the devices provided by MPxIO.

The coexistence requires a VERITAS Array Support Library. This can be found on the VERITAS installation media or from Symantec support.

Clustering support for Sun hosts

The SAN Volume Controller provides clustering support for Sun hosts.

Clustering support can be provided for Sun 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:

www.ibm.com/storage/support/2145

SAN boot support for Sun hosts

SAN boot for Sun 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:

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 Volume Manager. Encapsulation is the method for placing the boot disk under Volume Manager's management.

You must have your VERITAS Volume Manager administration documentation 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 Volume Manager with DMP.
5. Mirror the boot volume onto the discovered LUNs using the instructions in the VERITAS Volume Manager administration documentation.

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 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:

  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 the previous step.
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 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:

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 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:

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 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 16. 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 logical unit numbers (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 Model 2145-XXX Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  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:

www.ibm.com/storage/support/2145

Host bus adapters (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:

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:

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:

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 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 QLogic HBA for hosts running the VMware operating system

After you have installed the QLogic HBA and the device driver on hosts that are running the VMware operating system, you must configure the HBA.

To configure the QLogic host bus adapter (HBA) on VMware hosts, 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**
   f. Login Retry Count: **8**
   g. Port Down Retry Count: **8**
   h. Link Down Timeout: **10**
   i. Command Timeout: **20**
   j. Extended error logging: **Disabled (might be enabled for debugging)**
   k. RIO Operation Mode: **0**
   l. 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 116 to 12 if more than one QLogic adapter was installed.
14. Restart the server.

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 17 provides the maximum SCSI devices and paths per virtual disk (VDisk).

Table 17. 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:

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:

www.ibm.com/storage/support/2145

Chapter 17. Attaching to a host running the Microsoft Hyper-V operating system

This information explains the requirements and other information for attaching the SAN Volume Controller to various guest operating systems running on the Microsoft Hyper-V operating system. With Microsoft Hyper-V, you can run multiple guest operating systems on one server.

Attachment requirements for hosts running Microsoft Hyper-V operating systems

This section provides an overview of the requirements for attaching the SAN Volume Controller to a host running the Microsoft Hyper-V operating system.

The following list identifies the requirements for attaching the SAN Volume Controller to a host running the Microsoft Hyper-V operating system:

- Ensure that there are enough fibre-channel adapters installed in the server to handle the total logical unit numbers (LUNs) that you want to attach.
- Ensure that you have the documentation for the Microsoft Hyper-V operating system, the guest host operating system, and the *IBM System Storage SAN Volume Controller Model 2145-XXX Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  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 Microsoft Hyper-V or guest operating system patches that you might need.

Environments for hosts running Microsoft Hyper-V operating systems

Ensure that each host that is running the Microsoft Hyper-V operating system uses a supported level of Microsoft Hyper-V and a supported guest operating system.

The following IBM Web site provides current interoperability information about supported host operating systems:

www.ibm.com/storage/support/2145

Host bus adapters for hosts running Microsoft Hyper-V operating systems

Ensure that your hosts that are running the Microsoft Hyper-V operating system use the correct host bus adapters (HBAs).

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

www.ibm.com/storage/support/2145

Drivers and firmware for hosts running Microsoft Hyper-V operating systems

Be sure that you use the correct HBA device driver and firmware levels for hosts that are running the Microsoft Hyper-V operating systems.

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

www.ibm.com/storage/support/2145

Installing the HBA on a host running a Microsoft Hyper-V operating system

Before you can attach the host that is running the Microsoft Hyper-V operating system, you must 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:

www.ibm.com/storage/support/2145

To install the HBA, use the following general steps:

1. Shut down your host and its attached peripheral devices, following the recommendations of the manufacturer.
2. Install the HBA, using the adapter installation instructions of the manufacturer.

Installing the HBA drivers for hosts running the Microsoft Hyper-V operating systems

Follow the instructions provided by Microsoft Hyper-V to install the HBA drivers and firmware. Installing these components are part of the Microsoft Hyper-V installation and setup process.

Configuring the QLogic HBA for a host running the Microsoft Hyper-V operating system

After you have installed the QLogic host bus adapter (HBA) and the device driver on hosts that are running the Microsoft Hyper-V operating system, you must configure the HBA.

To configure the HBA BIOS, either use the QLogic HBA manager software or reboot into the Fast!UTIL tool. Configure the following settings:

- Host Adapter BIOS: Disabled (unless the machine is configured for SAN Boot)
- Adapter Hard Loop ID: Disabled
- Connection Options: 1 - point to point only
- LUNs Per Target: 0
- Port Down Retry Count: 15

Set the execution throttle to a suitable queue depth for your environment. A suggested value is 100. If you are using subsystem device driver (SDD) 1.6 or higher, set **Enable Target Reset** to `No`. See Table 18 on page 121 to include the

required parameters for the registry key.

Table 18. Registry key parameters for QLogic models

Key	Required parameters
HKEY_LOCAL_MACHINE > SYSTEM > CurrentControlSet > Services > ql2*xxx* > Parameters > Device > DriverParameters	**Buschange=0;FixupInquiry=1** **Note:** If you are using QLogic driver version 9.1.2.11 or higher, **Buschange** cannot be set to zero. See your device driver documentation for details.

For more information about supported QLogic models, see the following IBM Web site:

www.ibm.com/storage/support/2145

Configuring the Emulex HBA for hosts running the Microsoft Hyper-V operating system

This section applies to hosts that are running the Microsoft Hyper-V operating system. 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).

Configuring the Microsoft Hyper-V operating system

You must configure the Microsoft Hyper-V operating system and the guest operating system before you can use hosts that are running the Microsoft Hyper-V 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 (WWPN) identifiers. You must locate the list of WWPNs.
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 Microsoft Hyper-V and guest operating system publications.

Multipath support for hosts running the Microsoft Hyper-V operating system

You must install multipathing software on all attached hosts that run the Microsoft Hyper-V operating system.

The following Web site provides current interoperability information:

www.ibm.com/storage/support/2145

The subsystem device driver (SDD) for Windows supports dynamic pathing for hosts that are running the Microsoft Hyper-V operating system.

SDD dynamic pathing on hosts running the Microsoft Hyper-V operating systems

The subsystem device driver (SDD) for Windows supports dynamic pathing for hosts that are running the Microsoft Hyper-V operating system.

Notes:

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

   www.ibm.com/storage/support/2145
2. When you use SDD for multipathing, you must use a supported Emulex HBA driver or QLogic HBA driver. See the following Web site for the latest support information:

   www.ibm.com/storage/support/2145
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) or IBM DS5000 drivers. Coexistence is not supported on hosts that run the Windows Server 2003 or Windows Server 2008 operating systems.

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 what 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 that it does find and uses the least-active nonpreferred path.

Multipathing configuration maximums for hosts running Microsoft Hyper-V operating systems

When you configure multipathing on your hosts, you must consider the maximum supported configuration limits.

Table 19 provides the configuration maximums for hosts running the Microsoft Hyper-V operating system.

Note: Check your operating system and HBA documentation for limitations that might be imposed by other driver software.

Table 19. Configuration maximums for hosts running the Microsoft Hyper-V operating system

Object	Maximum	Description
VDisk	512[1]	The maximum number of VDisks that can be supported by the SAN Volume Controller for a host running the Microsoft Hyper-V operating system (per host object).

Table 19. Configuration maximums for hosts running the Microsoft Hyper-V operating system (continued)

Object	Maximum	Description
Paths per VDisk[2]	8	The maximum number of paths to each VDisk. The suggested 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, Windows 2000 Server, Windows Server 2003, and Windows Server 2008 support submounting drives as directories within other drives.
2. SDDDSM for Windows supports 16 paths per VDisk, but the SAN Volume Controller supports only a maximum of eight paths to support a reasonable path-failover time.

Clustering support for hosts running Microsoft Hyper-V operating system

The SAN Volume Controller provides clustering support for guest operating systems that support Microsoft Cluster Services (MSCS) in the Microsoft Hyper-V operating system.

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

www.ibm.com/storage/support/2145

SAN boot support for hosts running Microsoft Hyper-V operating systems

The SAN Volume Controller does not provide SAN boot support for guest operating systems or the base Microsoft Hyper-V operating system.

Chapter 18. Attaching to Citrix XenServer hosts

This information provides an overview for attaching the SAN Volume Controller to a Citrix XenServer host.

Attachment requirements for Citrix XenServer hosts

This section provides an overview of the requirements for attaching the SAN Volume Controller to a Citrix XenServer host.

You must be aware of the requirements for attaching the SAN Volume Controller to a Citrix XenServer host.

- Ensure that you have the documentation for your host system and the *IBM System Storage SAN Volume Controller Model 2145-XXX Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  www.ibm.com/storage/support/2145
- Ensure that you have installed a supported Citrix XenServer version. The following IBM Web site provides current interoperability information about supported software levels, including distribution levels:

  www.ibm.com/storage/support/2145

The following Web site provides the system requirement information for the Citrix XenServer host:

www.citrix.com

Note: From the Citrix home page, follow this path: **Products & Solutions** → **XenServer/Essentials** → **Essentials for XenServer** → **Specifications**.

Host bus adapters for Citrix XenServer hosts

Your Citrix XenServer hosts must use the correct host bus adapters (HBAs).

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

hcl.xensource.com

Drivers and firmware for Citrix XenServer hosts

You must use the correct HBA device driver and firmware levels for your Citrix XenServer hosts.

The HBA drivers are installed when you install the Citrix XenServer software. No external installation of the driver or firmware is required for an HBA. The following IBM Web site provides current interoperability information about supported device driver and firmware levels:

www.ibm.com/storage/support/2145

The following Citrix XenServer Web site provides current interoperability information about supported device driver and firmware levels, including the hardware compatibility list:

www.citrix.com

Configuring the Citrix XenServer host

You must configure the Citrix XenServer host before you can use the host with the SAN Volume Controller.

The following Citrix XenServer Web site provides the most current information about configuring the Citrix XenServer:

www.citrix.com

Linux operating system

Linux virtual machines (VMs) are always supported in a paravirtualized mode.

Windows operating system

Windows VMs are always supported as hardware-based virtual machines (HVMs) with paravirtualized drivers for storage and network. The drivers are installed from the Citrix XenServer installation CDs.

If you plan to use Windows VMs running under Citrix XenServer, ensure that the server processors have hardware virtualization support, such as Intel Virtualization Technology (VT)-based processors or AMD-V-based processors.

Multipath support for Citrix XenServer hosts

The multipath driver is installed as part of the Citrix XenServer software.

The following Web site provides a general overview of multipathing on Citrix XenServer 5.0:

http://support.citrix.com/article/CTX118791

The following Web site provides the most current information about the IBM configuration file (multipath.conf) for SAN Volume Controller:

www.ibm.com/storage/support/2145

Perform the following steps to find the appropriate configuration file:

1. Search for `subsystem device driver for Linux`.
2. Scroll down the list until you find the device-mapper multipath configuration file for SAN Volume Controller.
3. Select and download the file for Red Hat Enterprise Linux 5.

Clustering support on Citrix XenServer hosts

Clustering for guest operating systems either within or across Citrix XenServer hosts, or clustering of Citrix XenServer hosts is not supported.

Known issues and limitations

There are several known issues and limitations to be aware of when you are attaching the SAN Volume Controller to Citrix XenServer hosts.

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

www.ibm.com/storage/support/2145

SAN boot support for multipath not supported

SAN boot support for Citrix XenServer with multipath is not supported.

SUSE Linux Enterprise Server 9 SP4 VM-related issue

The SPident application tests the current patch level of your system by querying against a specific set of packages and their versions.

When the SPident command is run, it shows information about what it found and what it expected. In the following example, the command query found that SP3 is installed, but it expected SP4. Even though this result indicates that the system is not up-to-date, the virtual machine (VM) is error-free.

```
CONCLUSION: System is NOT up-to-date!
found SLES-9-i386-SP3
expected SLES-9-i386-SP4
```

Assigning more than one virtual CPU

If you are running Citrix XenServer EE 5 Update 2 on a Windows 2008 EE SP1 (x84-64) virtual machine, you can experience the Windows stop message if you configured more than one vCPU.

In this situation, do not assign more than one vCPU to the Windows 2008 EE (x86-64) guest virtual machine.

Multiple Citrix XenServer hosts

If you are running multiple Citrix XenServer hosts as part of a shared resource pool, one of the hosts can become unresponsive when you are doing SAN Volume Controller actions, such as adding and removing nodes, or resetting nodes.

Chapter 19. Attaching to an Apple host

This information provides an overview for attaching the SAN Volume Controller to an Apple Xserve server or an Apple Mac Pro server.

Attachment requirements for Apple hosts

This section provides an overview of the requirements for attaching the SAN Volume Controller to an Apple host system running Mac OS X v10.5.x.

The requirements for attaching the SAN Volume Controller to an Apple host system running Mac OS X v10.5.x 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 Model 2145-XXX Hardware Installation Guide*. All SAN Volume Controller publications are available from the following Web site:

  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.
- Ensure that the host type, Target Port Group Support (TPGS), is enabled if you are using an ATTO Technology 8-Gbps HBA. This host type is available in SAN Volume Controller version 4.2 or later.

Environments for Apple hosts

Ensure that your Apple host uses a supported operating system and version.

The following IBM Web site provides current interoperability information about supported host operating systems:

www.ibm.com/storage/support/2145

Host bus adapters for Apple hosts

Your Apple hosts must use the correct host bus adapters (HBAs).

The SAN Volume Controller supports Apple hosts that are running the Mac OS X server v10.5.x operating system that use ATTO HBAs.

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

www.ibm.com/storage/support/2145

Drivers and firmware for Apple hosts

You must use the correct HBA device driver and firmware levels for the Apple hosts that are running on the Mac OS X server v10.5.x operating system.

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

www.ibm.com/storage/support/2145

For more information on ATTO HBA, device driver, and firmware downloads, select **Obtain Drivers** from the following Web site:

http://attotech.com/solutions/ibm.html

After logging in to the support pages, select **Celerity *xxx* for IBM SAN Volume Controller**, where *xxx* is your HBA type.

Enabling load balancing on an ATTO 8-Gbps HBA

To use load balancing on an ATTO 8-Gbps HBA, you must enable the Target Port Group Support (TPGS) host type.

SAN Volume Controller version 4.2 or later supports load balancing on Apple hosts when you specify the TPGS host type.

To enable load balancing on Apple hosts with an 8-Gbps HBA from ATTO Technology, perform the following steps:

1. Change the SAN Volume Controller host type from **Generic** to **TPGS**.
2. Activate the new configuration by rebooting the Apple host.
3. Verify that the new configuration is active by performing the following steps:
   a. Run the ATTO Configuration Tool which is located in the **ATTO Configuration Tool** Folder for the **Applications** Folder.
   b. Verify that all the 2145 paths are shown as **Preferred/Mixed for Read- and Write-Mode**.
   c. Verify that the paths per LUN show up as **Preferred or Alternate** which depends on the preferred SAN Volume Controller node for that LUN.

The following Web site provides more information about the ATTO Configuration Tool:

http://www.attotech.com/configtool.html

Installing the HBA on an Apple host

The first step for attaching the Apple host is to install the host bust 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:

www.ibm.com/storage/support/2145

To install the HBA, perform the following steps:

1. Shut down your host and its attached peripheral devices by following the recommendations of the manufacturer.
2. Install the HBA by using the adapter installation instructions of the manufacturer.

Configuring the ATTO HBA for Apple hosts

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

For configuration and monitoring, you need to install the ATTO Configuration Tool. The following Web site provides information about the ATTO Configuration tool:

http://www.attotech.com/configtool.html

Follow the readme file and the *ATTO Configuration Guide* that describes the configuration and administration of logical volumes.

SAN boot support for Apple hosts

The SAN Volume Controller does not provide SAN boot support for the ATTO HBA on the Apple host.

Chapter 20. Restoring the default settings for an Emulex HBA

This section describes how to restore the default settings for an Emulex host bus adapter (HBA).

Emulex HBAs have built-in tools to change the HBA settings.

To restore the default settings for the Emulex HBA, perform the following steps:

1. Invoke the Emulex BIOS configuration utility by pressing <CTRL E> or <ALT E>. You see the **Emulex BIOS Utility** panel that lists the host adapters.
2. Type the number of the host adapter for which you want to restore the default settings. You see the adapter panel that corresponds to the number that you typed.
3. From the bottom of the adapter panel, you see **<d> to Default Values**. Press **<d>** to restore the default HBA settings.
4. You see the message `Reboot the System to Make All the Changes to Take Effect`. Type **Y** to save the changes and to reboot the system.

Chapter 21. Restoring the default settings for a QLogic HBA

This section describes how to restore the default settings for a QLogic host bus adapter (HBA).

QLogic HBAs have built-in tools to change the HBA settings.

To restore the default settings for the QLogic HBA, perform the following steps:

1. Press either <CTRL-Q> or <ALT-Q> to get the **Fast!UTIL** menu.
2. If you have more than one fibre-channel HBA installed, all the fibre-channel HBAs are displayed. Scroll down to the adapter that 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** panel, select **Restore Default Settings**. You see the message `Configuration settings modified`. Select **Save changes**.

Chapter 22. Fibre-channel port name identification

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.

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.

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 p, eServer, or an RS/6000 AIX host

You can locate the WWPN for an IBM System p, 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 HBAs 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 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 Management Suite Java™ (MSJ) if you have it, or restart the host and enter Ctrl+Q to open the QLogic BIOS, where you can find the HBA WWPNs.

For Emulex hosts, use the elxcfg tool that is packaged with the firmware. This tool 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-pci`*x*`: 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-hba`*x*`-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**.

3. In the new window, 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 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

Part 3. Ethernet host attachment

Chapter 23. Setting up the host server

The following basic procedure must be performed when setting up a host server for use as an iSCSI initiator with SAN Volume Controller VDisks. The specific steps vary depending on the particular host type and operating system that is involved.

To configure a host, first select a software-based iSCSI initiator or a hardware-based iSCSI initiator. For example, the software-based iSCSI initiator can be a Microsoft Windows iSCSI software initiator, and the hardware-based iSCSI initiator can be an iSCSI host bus adapter inside the host server.

To set up your host server for use as an iSCSI software-based initiator with SAN Volume Controller VDisks, perform the following steps:

1. Set up your SAN Volume Controller cluster for iSCSI.
   a. Select a set of IPv4 or IPv6 addresses for the clustered Ethernet ports on the node that are in the I/O groups that will use the iSCSI VDisks.
   b. Configure the clustered Ethernet ports on each node in the cluster with the `svctask cfgportip` command.
   c. Verify that you have configured the clustered Ethernet ports correctly by reviewing the output of the `svcinfo lsportip` command and `svcinfo lsclusterip` command.
2. Set up your host server.
   a. Ensure that you have configured your IP interfaces on the server.
   b. Install the software for the iSCSI software-based initiator on the server.
3. Create VDisks on the SAN Volume Controller cluster with the `svctask mkhost` command.
4. Create a host object SAN Volume Controller server that describes the iSCSI server initiator to which the VDisks are to be mapped using the `svctask mkvdisk` command.
5. Map the VDisk to the host object in the SAN Volume Controller with the `svctask mkvdiskhostmap` command.
6. On the host server, run the configuration methods for the iSCSI so that the host server iSCSI initiator logs in to the SAN Volume Controller cluster and discovers the SAN Volume Controller VDisks. After this action, the host creates host devices for the VDisks.
7. The VDisks that are presented to the host can now be used by the applications.

The details for setting up each host server type are described in related topics.

Be aware of the following considerations:

- AIX does not support iSCSI with IPv6.
- Each connection between a host initiator and a SAN Volume Controller clustered Ethernet port can use IPv4 or IPv6 (where supported). Concurrent use of both IPv4 and IPv6 for the same initiator to the SAN Volume Controller clustered Ethernet port is not supported.

Chapter 24. Installing the Linux software iSCSI initiator

This section describes how to install the Linux software iSCSI initiator.

All preinstalled open-iSCSI packages need to be removed before you can install the new package.

The rpm for the software iSCSI initiator is shipped with each Linux distribution. For example, for SUSE Linux Enterprise Server 10, the rpm package in the distribution media (SLES-10-SP2-DVD-i386-GM-DVD1.iso) is:

```
./suse/i586/open-iSCSI-2.0.707-0.44.i586.rpm
```

Ensure that you have followed the steps for setting up the host server.

To install the Linux software iSCSI initiator, perform the following steps:

1. Install and run the open-iSCSI programs, iSCSId and iSCSIadm, from the distribution media.
2. If the iSCSI initiator software is not installed on the Linux host, remove all existing open-iSCSI packages on the host.
   a. On RHEL5, use the command `rpm -e iSCSI-initiator-utils`.
   b. On SLES10 SP1/2, use the command `rpm -e open-iSCSI`.
3. Install the rpm package using the following command:
   ```
   rpm -ivh <open-iSCSI-package-name>.rpm
   ```
4. Move to the rpm path and build the binary driver for your kernel:
   ```
   .cd/usr/src/{redhat,OpenLinux,turbo,packages,rpm ..}
   ```

   Note: The rpm path is not the same for all Linux distributions.
5. Install the newly built package.
   a. rpm -ivh <open-iSCSI-package-name>.<arch>.rpm
      where `<arch>` is the machine architecture, such as i386.
   b. rpm -ivh RPMS/i386/<open-iSCSI-package-name>.i386.rpm
6. Start the daemon.
   - For Red Hat Enterprise Linux AS, use `iSCSId`
   - On SUSE Linux Enterprise Server 10 (SP1/2), use `service open-iSCSI start`
7. Specify the iSCSI initiator name in the file `/etc/iSCSI/Initiatorname.iSCSI`. An example of an iSCSI initiator name is `InitiatorName=LinuxInit123`.
8. Run the discovery command:
   ```
   iSCSIadm -m discovery -t st -p.x.x.x.x
   ```
   where *x.x.x.x* is the IP address of each clustered Ethernet port on the SAN Volume Controller cluster. This command returns the iSCSI qualified name (IQN) of the target associated with each SAN Volume Controller node port.
   ```
   iscsiadm -m discovery -t st -p 9.71.43.131

   9.71.43.131:3260, 1 iqn.1986-03.com.ibm:2145.china5.hlnc111874
   ```
9. Log in to the Linux initiator to each SAN Volume Controller target using the following command:
   ```
   iscsiadm -m node -T targetname -I
   ```

For example, submit the following command:

```
iscsiadm -m node -T iqn.1986-03.com.ibm:2145.china5.hlnc111874 -I
```

You see this output:

```
Logging into [iface:default,target:iqn.1986-03.com.ibm:
2145.china5.hlnc111874,portal:
9.71.43.131,3260]
Login to [iface:default,target:iqn.1986-03.com.ibm:
2145.china5.hlnc111874,portal:
9.71.43.131,3260]:successful
```

You can now set up the authentication for your Linux hosts.

Setting up authentication for Linux hosts

This section provides instructions for setting up authentication for Linux hosts.

There are two Challenge Handshake Authentication Protocol (CHAP) methods available for setting up authentication for Linux hosts.

- One-way CHAP authentication (only target authenticates to the initiator).
- Two-way CHAP authentication (both target and initiator authenticate each other).

To set up authentication for a Linux host, perform the following steps:

1. Open `/etc/iscsi/iscsid.conf` or `/etc/iscsid.conf` using an appropriate editor.
2. Go to the CHAP settings paragraph. The following screen shows the output:

```
32
33 # *************
34 # CHAP Settings
35 # *************
36
37 # To enable CHAP authentication set node.session.auth.authmethod
38 # to CHAP. The default is None.
39 #node.session.auth.authmethod = CHAP
40
41 # To set a CHAP username and password for initiator
42 # authentication by the target(s), uncomment the following lines:
43 #node.session.auth.username = username
44 #node.session.auth.password = password
45
46 # To set a CHAP username and password for target(s)
47 # authentication by the initiator, uncomment the following lines:
48 #node.session.auth.username_in = username_in
49 #node.session.auth.password_in = password_in
50
51 # To enable CHAP authentication for a discovery session to the target
52 # set discovery.sendtargets.auth.authmethod to CHAP. The default is None.
53 #discovery.sendtargets.auth.authmethod = CHAP
54
55 # To set a discovery session CHAP username and password for the initiator
56 # authentication by the target(s), uncomment the following lines:
57 #discovery.sendtargets.auth.username = username
58 #discovery.sendtargets.auth.password = password
59
60 # To set a discovery session CHAP username and password for target(s)
61 # authentication by the initiator, uncomment the following lines:
62 #discovery.sendtargets.auth.username_in = username_in
63 #discovery.sendtargets.auth.password_in = password_in
64
65 # ********
```

Figure 24. CHAP settings for a Linux host

3. Set up one-way authentication.
   a. Uncomment line number 39 and line number 53 in Figure 24.
      - `node.session.auth.authmethod = CHAP <normal Session> I`
      - `discovery.sendtargets.auth.authmethod = CHAP <Discovery Session>`
   b. Uncomment line number 43 and line number 57 in Figure 24. Change the username to your initiator name.
      - `node.session.auth.username = iqn.sanvc.com <initiator name>`
      - `discovery.sendtargets.auth.username = iqn.sanvc.com <initiator name>`
   c. Uncomment line number 44 and line number 58 in Figure 24. Change the password to the CHAP secret that you set up using the `chhost` command on the cluster for this host.
      - `node.session.auth.password = <CHAP secret for host>`
      - `discovery.sendtargets.auth.password = <CHAP secret for host>`
4. After you have set up the one-way authentication, follow these steps to set up the two-way authentication.
   a. Uncomment line number 49 and line number 63 in Figure 24. Change the password_in to the CHAP secret that you set up using the `chhost` command on the cluster for this host.
      - `node.session.auth.password = <CHAP secret for cluster>`
      - `discovery.sendtargets.auth.password_in = <CHAP secret for cluster>`
   b. Save these settings.

   Notes:

a. Do not provide a target name to any other input in line number 48 or line number 62. Do not uncomment the <username_in> parameter.
b. The CHAP secrets cannot be the same for one-way authentication and two-way authentication.

Enabling multipathing for Linux hosts

This section provides instructions for enabling multipathing for Linux hosts.

After the iSCSI devices are discovered, you can enable multipathing.

To enable multipathing for a Linux host, perform the following steps:

1. Issue the `service multipathd stop` command if the daemon is already running.
2. Open the `/etc/multipath.conf` file.
3. Go to the device section and add the following entry to the file:

```
device {
        vendor          "IBM"
        product         "2145"
        path_grouping_policy  group_by_prio
        prio_callout      "/sbin/mpath_prio_alua/dev/%n"

}
```

   Note: If you are using SUSE Linux Enterprise Server 10 Service Pack 2, use `prio "alua"` instead of `prio_callout "/sbin/mpath_prio_alua/dev/%n"` to disable the `Using deprecated prio_callout` message. The `prio "alua"` value disables only the error message and does not affect the operations.
4. Save the file.
5. Issue the `service multipathd start` command to start the daemon.

   Note: If you have discovered a new iSCSI disk, repeat all steps.

Multipath commands

This section provides additional multipath commands.

Two other multipath commands are helpful when working with multipath topologies and configurations.

multipath –ll
Shows the current multipath topology from all available information, such as sysfs, the device mapper, or path checkers.

multipathd –k
Puts your session into interactive mode. Commands can be used to list the current configuration or to change the configuration. For example, <show config> lists the current configuration, and <reconfigure> gets the latest configuration from the configuration file (`etc/multipath.conf`).

Chapter 25. Installing the Windows software iSCSI initiator

This section describes how to attach a Windows host to the IBM SAN Volume Controller using iSCSI.

Ensure that you have followed the steps for configuring your SAN Volume Controller cluster for iSCSI host attachment.

If you are running Windows Server 2008, the Microsoft iSCSI software initiator is preinstalled. For Windows Server 2003, you need to download the initiator software from the Microsoft Web site:

http://www.microsoft.com/downloads

When you run the installation program for the initiator, you see a list of components to install:

- **Initiator Service**.
- **Software Initiator**.
- **Microsoft MPIO Multipathing Support for iSCSI**.

The first two options are required. Be sure that you select them. MPIO support is useful if you have a redundant IP network configuration and you want to protect your host I/O against network hardware failures.

Note: MPIO support is not required to support online cluster maintenance such as software updates due to IP failover between nodes in the cluster I/O groups.

After the installation completes, you are prompted to restart the computer. Restart the computer before continuing with the rest of the instructions. The iSCSI initiator can now be configured from the **iSCSI Initiator** control panel.

Setting the iSCSI qualified name

This section describes how to view or change the iSCSI qualified name (IQN).

The iSCSI IQN can be viewed or changed from the **General** tab of the **iSCSI Initiator** control panel on Windows Server 2003 or from the **Configuration** tab on Windows Server 2008.

The initiator name that you choose here must match the iSCSI name given to the SAN Volume Controller host object for this machine. If you are uncertain how to configure the iSCSI name for a host, see the configuring host objects task.

iSCSI target discovery

You can use two methods to discover iSCSI target portals.

The supported methods for discovering iSCSI target portals are:

- Send Targets
- Internet storage name service (iSNS)

Discovering iSCSI targets using Send Targets

This section provides instructions for discovering iSCSI target portals using the Send Targets method.

The Send Targets method is configured from the **Discovery** tab of the **iSCSI Initiator** control panel.

This form of discovery requires you to type the address of one or more of your SAN Volume Controller cluster node Ethernet ports. For each node that you want to perform discovery on, do the following steps:

1. Click the **Add** button (click **Discover Portal** on Windows Server 2008) that is associated with the list of target portals.
2. Type the IP address or DNS name of the node Ethernet port on which you want to perform discovery. Leave the IP port name at the default value of 3260. If CHAP authentication is configured for this host on the SAN Volume Controller cluster, see the ″Authentication for Windows hosts″ topic.
3. Click **OK**. The SAN Volume Controller node port address is added to the list of target discovery portals.

Discovering iSCSI targets using iSNS

This section provides instructions for discovering iSCSI target portals using the Internet storage name service (iSNS) method.

Before you use the iSNS discovery, you must do the following tasks:

- Configure the cluster to use your iSNS server.
- Verify that the SAN Volume Controller nodes have registered their target portals with it.

The iSNS method is configured from the **Discovery** tab of the **iSCSI Initiator** control panel.

1. Click the **Add** button that is associated with the list of iSNS servers.
2. Type the IP address or DNS host name of your iSNS server.

Connecting to discovered targets

This section describes how to connect a specific portal on a discovered target.

SAN Volume Controller supports only one iSCSI session between an initiator and a target. Ensure that you do not attempt to connect to the same target (SAN Volume Controller node) more than once.

Open the **Targets** tab of the **iSCSI Initiator** control panel. The list of discovered targets shows an entry for each SAN Volume Controller node on which you performed discovery.

1. Select the node that you want to connect to from the list and click **Log on...** (click **Connect** on Windows Server 2008). From the Connect to Target window, you can select whether to have the connection restored automatically at boot or to enable multipathing for the iSCSI target.
2. If you want to connect to a specific portal on the target, for example, to perform load balancing between the node Ethernet ports, or to configure CHAP authentication, you can access these settings by clicking **Advanced...**.

3. Click **OK**. The status for the selected targets changes from **Inactive** to **Connected**.

Viewing and managing the discovered disks

This section describes how to use the Windows host to view the discovered disks and how to bind the devices to the **Microsoft iSCSI Initiator Service**.

The SAN Volume Controller VDisks that are mapped to the iSCSI host are now visible to the Windows disk management services. The SAN Volume Controller VDisks can be initialized, formatted, and mounted.

If you want to ensure that the iSCSI devices are available before dependent applications or services are started, you can bind these devices to the **Microsoft iSCSI Initiator Service** from the **Bound Volumes/Devices** tab on the **iSCSI Initiator** control panel.

From the Windows host, you can view the details of the discovered disks to help you differentiate the system disks from the SAN Volume Controller disks by performing the following steps:

1. From the Windows **Command Prompt**, type `diskpart`.
2. Next type `list disk`.
3. Next select the disk for which you want to view the details. Type `select disk` *x* where *x* is the number of the disk that you want to view.
4. Type `detail disk` to see the type of disk and other information.

   The following screen shows a sample output.

```
DISKPART> list disk
  Disk ###  Status      Size     Free     Dyn  Gpt
  --------  ----------  -------  -------  ---  ---
  Disk 0    Online       149 GB    78 GB   *
  Disk 1    Online       149 GB    78 GB   *
  Disk 2    Online       565 MB   565 MB
  Disk 3    Online       337 MB   337 MB

DISKPART> select disk 2

Disk 2 is now the selected disk.

DISKPART> detail disk

IBM      2145             SCSI Disk Device
Disk ID: 00000000
Type   : iSCSI
Bus    : 0
Target : 2
LUN ID : 0

There are no volumes.

DISKPART>
```

Changes to system registry to optimize the initiator for SAN Volume Controller

This section describes changes that can be made to the system registry to optimize the iSCSI operation.

For reliable iSCSI operation during cluster maintenance, the following changes to the system registry should be made:

Table 20. System registry

Registry key	Type	Value (decimal)
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\Class\{4D36E97B-E325-11CE-BFC1-08002BE10318}\<*bus id*>\Parameters\LinkDownTime	DWORD	120
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\Class\{4D36E97B-E325-11CE-BFC1-08002BE10318}\<*bus id*>\Parameters\MaxRequestHoldTime	DWORD	120
HKEY_LOCAL_MACHINE\SYSTEM\Current\ControlSet\Services\Disk\TimeOutValue	DWORD	60

Note: You must restart the computer for these changes to take effect.

Authentication for Windows hosts

This section describes the authentication methods available for Windows hosts.

There are two Challenge Handshake Authentication Protocol (CHAP) methods available for setting up authentication for Windows hosts.

- One-way CHAP authentication (only target authenticates to the initiator).
- Two-way CHAP authentication (both target and initiator authenticate each other).

Setting up authentication for discovery sessions for Windows hosts

This section provides instructions for setting up authentication for discovery sessions for Windows hosts.

You can set up authentication at the same time that you are connecting to the SAN Volume Controller VDisks because the CHAP authentication information is located on the same **Advanced Settings** panel.

You can set up authentication for a discovery session. To set up one-way authentication for a Windows host, perform the following steps:

1. After you have the initiator software installed, you can set up authentication for your Windows host. Go to the Control Panel.
2. From the Control Panel, select the **iSCSI Initiator** option.
3. From the **iSCSI Initiator Properties** panel, click the **Discovery** tab.
4. After clicking the **Discovery** tab, click **Add** under the **Target Portals** section. You see the **Add Target Portal** dialog box.
5. Click **Advanced...**. You see the **Advanced Settings** panel.
6. Select **CHAP logon information**.
7. Type in a value for the **User name**. The user name must be the initiator name.

8. Type in a value for the **Target secret**. The target secret can be a value up to 12 characters. This value is the same value that you set with the `chhost` command on the SAN Volume Controller cluster for this host.
9. Click **OK**.

Setting up authentication for normal sessions for Windows hosts

This section provides instructions for setting up authentication for normal sessions for Windows hosts.

You can set up authentication at the same time that you are connecting to a target or volume because the CHAP authentication information is located on the same **Advanced Settings** panel.

You can set up authentication for a normal session. To set up one-way authentication for a Windows host, perform the following steps:

1. Go to the Control Panel.
2. From the Control Panel, select the **iSCSI Initiator** option.
3. From the **iSCSI Initiator Properties** panel, click the **Targets** tab.
4. After clicking the **Targets** tab, click **Log On...** under the **Targets** section. You see the **Log On to Target** panel.
5. Click **Advanced...**. You see the **Advanced Settings** panel.
6. Select **CHAP logon information**.
7. Type in a value for the **User name**. The user name must be the initiator name.
8. Type in a value for the **Target secret**. The target secret can be a value up to 12 characters. This value is the same value that you set with the `chhost` command on the SAN Volume Controller cluster for this host.
9. Click **OK**.

Setting up two-way authentication for Windows hosts

This section provides instructions for setting up two-way authentication for Windows hosts.

The one-way authentication settings apply here as well.

You can set up two-way authentication for a Windows host. To set up two-way authentication for a Windows host, perform the following steps:

1. Go to the Control Panel.
2. From the Control Panel, select the **iSCSI Initiator** option.
3. From the **iSCSI Initiator Properties** panel, click the **General** tab.
4. After clicking the **General** tab, click **Secret**. You see an **iSCSI Initiator** panel from which you can type your CHAP secret. Type your CHAP secret.
5. Click **OK**.

Notes:

a. This setting applies to both the discovery session and normal session.
b. The same length restrictions for CHAP secrets that apply to one-way authentication apply to two-way authentication.

c. The secrets for one-way authentication and two-way authentication cannot be the same.

Chapter 26. Configuring the AIX iSCSI software initiator

This section describes how to configure the AIX iSCSI software initiator.

Ensure that you have followed the steps for setting up the host server.

Install the AIX software initiator on your AIX host if it is not already installed.

1. To verify that the file set `devices.iSCSI_sw.rte` is installed, use the `lslpp -l` command.
2. If necessary, install the interim fix for the SAN Volume Controller Object Data Manager (ODM) stanzas.

The software initiator is configured using the System Management Interface Tool (SMIT). Perform the following steps to configure the software initiator:

1. Select **Devices**.
2. Select **iSCSI**.
3. Select **Configure iSCSI Protocol Device**.
4. Select **Change / Show Characteristics of an iSCSI Protocol Device**.
5. Verify that the **Initiator Name** value is correct. The initiator name value is used by the iSCSI target during login.

   Note: A default initiator name is assigned when the software is installed. You can change the initiator name to match the local network naming conventions.
6. The **Maximum Targets Allowed** field corresponds to the maximum number of iSCSI targets that can be configured. If you reduce this number, you also reduce the amount of network memory that is preallocated for the iSCSI protocol driver during configuration.

Adding the iSCSI targets

This section describes how to add targets during the device configuration

These steps are to be performed after the AIX software initiator is configured.

iSCSI device configuration requires that the iSCSI targets can be reached through a properly configured network interface. Perform the following steps to add the iSCSI targets:

1. Edit the `/etc/iscsi/targets` file to include the iSCSI targets that are needed during device configuration.

   Each uncommented line in the file represents an iSCSI target.

   Although the iSCSI software initiator can work using a 10/100 Ethernet LAN, the initiator is designed to work with a gigabit Ethernet network that is separate from other network traffic. The following example shows a sample targets file:

   ```
   192.168.1.7     3260      iqn.1986-03.com.ibm.:2145.sahyadri.node1
   ```
2. After editing the `/etc/iscsi/targets` file, type the following command to reconfigure the software initiator driver:

   ```
   cfgmgr -v -l iSCSI0
   ```

This command causes the driver to attempt to communicate with the targets that are listed in the /etc/iscsi/targets file and to define a new hard disk (hdisk) for each LUN on the targets that are found.

Note: If the appropriate disks are not defined, review the configuration of the initiator, the target, and any iSCSI gateways to ensure that they are correct. Run the cfgmgr command again.

3. If you want to configure additional configuration parameters for iSCSI software initiator devices, use the following SMIT procedures:
   a. Select **Devices**.
   b. Select **Fixed Disk**.

   The iSCSI 2145 disk device is reported as shown in the following output:

   ```
   hdisk2   Available              IBM 2145 iSCSI Disk Drive
   ```

   The iSCSI disk supports command tag queuing and NACA=1 in the control byte, you might want to change the queue depth setting of the disk from the default value of 8 to a larger value. A larger value might improve device performance. The optimal queue depth setting cannot exceed the actual queue size on the drive. Setting the queue depth to a value larger than the queue size of the drive might degrade performance. To determine the queue size of the drive, consult the documentation for the drive.

   A suggested value of the rw_timeout setting is 60 seconds.

Discovering targets in AIX

This section describes how to use the file discovery method in AIX.

To use the file discovery method, perform the following steps:

1. Verify that the initiator is installed and in Available state with the following command:

   ```
   lsdev -C | grep iSCSI
   ```

2. If you want, you can change the initiator name either through the SMIT interface or issuing the following command:

   ```
   chdev -l iSCSI0 -a initiator_name="myinitiator"
   ```

3. Add the target IP and IQN name entries for your target in the /etc/iscsi/targets file:

   ```
   :19.168.1.167 3260 iqn.1986-03.com.ibm:2145.Ranjith.node1
   ```

4. Ensure that the SAN Volume Controller VDisks are mapped to the AIX initiator.
5. Discover the target by issuing the following command:

   ```
   cfgmgr -l iSCSI0
   ```

6. New iSCSI devices that correspond to the SAN Volume Controller VDisks are now configured on the host. You can identify them by using the following command:

   ```
   lsdev -C
   ```

Setting up authentication in AIX hosts

This section describes how to set up authentication in AIX hosts.

CHAP settings are defined in the /etc/iscsi/targets file on the host. This file is specified in the Discovery Filename parameter.

- The inbound password of the storage system must match the `CHAPSecret` of the initiator in the `/etc/iscsi/targets` file on the host.
- The inbound user name of the storage system must match the initiator node name of the host.
- The AIX initiator or HBA always uses its iSCSI node name as its CHAP user name.

The storage system recognizes two types of Challenge Handshake Authentication Protocol (CHAP) user names and passwords. These types of authentication indicate the direction of authentication relative to the storage system:

Inbound
The storage system authenticates the initiator or host bus adapter (HBA). Inbound settings are required if you are using CHAP authentication.

Outbound
The AIX software initiator or HBA does not support authentication of the storage system using CHAP. Do not specify outbound settings for AIX hosts.

To set up authentication on an AIX host, perform the following steps:

1. Open the `/etc/iscsi/targets` file with any editor.
2. Add one line for one interface on each storage system. Be sure to use an interface that is enabled for iSCSI traffic. Each entry for a target is like the following entry:

   ```
   HostNameOrAddress PortNumber iSCSIName [CHAPSecret]
   ```

   a. `HostNameOrAddress` is the host name or IP address of a gigabit Ethernet interface on the storage system. Specify an interface that is enabled for iSCSI communication.

   b. `PortNumber` is always 3260.

   c. `iSCSIName` is the iSCSI target node name of the storage system.

   d. `CHAPSecret` is the optional CHAP password for the host. Enclose the text string in quotation marks. This value must match the `valueconfigured` on the storage system for this initiator. For example, add the following line to the end of the file:

   ```
   192.168.2.175 3260 iqn.1986-03.com.ibm:2145.moscow.dvt110706 "svcchapsecret"
   ```

   `CHAPSecret` is the string enclosed in quotation marks. The quotation marks are required, but they are not part of the secret.

   You can also use a continuation of the line as shown in the following example:

   ```
   192.168.2.175 3260 iqn.1986-03.com.ibm:2145.moscow.dvt110706 \
             "svcchapsecret"
   ```

   The backwards slash (\) indicates that the line is continued.

   An example of the file entries is shown in Figure 25 on page 158.

```
# iscsiNameChars = 1*alphanum *{allowedPunc alphanum }
                          ; includes alphanumeric. dot. dash. underbar. colon.
#
#alphanum               = %x30-39 / %41-5a / %x61-7a
#
#allowedPunc            = %x2d / %x2e /%x5f / %x58
                        ; dash, dot, underbar, colon
#
#dot                    = %x2e
#                       ; "."
#
#ChapSecret             = %x22 *( any character ) %x22
#                       ;   "                     "
#                       ; ChapSecret is a string enclosed in double quotes. The
#                       ; quotes are required, but are not part of the secret.
#
#EXAMPLE 1: iSCSI Target without CHAP(MD5) authentication
#      Assume the target is at address 192.168.3.2,
#      the valid port is 5003
#      the name of the target is iqn.com.ibm-4125-23WTT26
#The target line would look like:
#192.168.3.2 5003 iqn.com.ibm-4125-23WWT26
#
#EXAMPLE 2: iSCSI Target with CHAP(MD5) authentication
#      Assume the target is at address 10.2.1.105,
#      the valid port is 3260
#      the name of the target is iqn.com.ibm-x167-42.fc1a
#      the CHAP secret is "This is my password."
#The target line would look like:
#10.2.1.105 3260 iqn.com.ibm-x167-42.fc1a "This is my password."
#
#EXAMPLE 3: iSCSI Target with CHAP(MD5) authentication and line continuation
#      Assume the target is at address 10.2.1.106,
#      the valid port is 3260
#      the name of the target is iqn.com.ibm:00.fcd0ab21.shark128
#      the CHAP secret is "123isaysecretpassword.fc1b"
#The target line would look like:
#10.2.1.105 3260 iqn.com.ibm:00.fcd0ab21.shark128 \
#              "123isaysecretpassword.fc1b"


192.168.1.10 3260 iqn.1986-03.com.ibm:2145.pahar.dvt110702
192.168.2.175 3260 iqn.1986-03.com.ibm:2145.moscow.dvt110706 "svcchapsecret"
```

Figure 25. CHAP settings for an AIX host

At the end of the example, you see that the two targets are listed.

- Target `iqn.1986-03.com.ibm:2145.pahar.dvt110702` is not configured to have authentication; therefore, the `CHAPSecret` field is blank.
- Target `iqn.1986-03.com.ibm:2145.moscow.dvt110706` is configured for authentication; therefore, the `CHAPSecret` field contains a value.

Updating ODM stanzas for SAN Volume Controller iSCSI devices

This section describes how to update the Object Data Manager (ODM) stanzas for the SAN Volume Controller iSCSI devices.

An interim fix is available to update the AIX ODM stanzas to recognize iSCSI SAN Volume Controller VDisks. The package is called `svc_odm.090728.epkg.Z`.

When you install the interim fix package, the AIX host can recognize iSCSI SAN Volume Controller VDisks.

To update the ODM stanzas, perform the following steps:

Install the package with the emgr command:

```
emgr -e svc_odm.090728.epkg.Z
```

This package is valid for all supported levels of AIX. After you install the package, you see the following attributes:

```
lsdev -C -l hdisk1

hdisk1     Available              IBM 2145 iSCSI Disk Drive


# lsattr -E -l hdisk1
clr_q          no                            Device CLEARS its Queue on error True
host_addr      9.71.43.106                   Hostname or IP Address           False
location                                     Location Label                   True
lun_id         0x0                           Logical Unit Number ID           False
max_transfer   0x40000                       Maximum TRANSFER Size            True
port_num       0xcbc                         PORT Number                      False
pvid           none                          Physical volume identifier       False
q_err          yes                           Use QERR bit                     True
q_type         simple                        Queuing TYPE                     True
queue_depth    8                             Queue DEPTH                      True
reassign_to    120                           REASSIGN time out value          True
reserve_policy no_reserve                    Reserve Policy                   True
rw_timeout     60                            READ/WRITE time out value        True
start_timeout  60                            START unit time out value        True
target_name    iqn.1986-03.com.ibm:2145.china6.hlcn111890   Target NAME      False
unique_id      3521360050768019102968800000000000002042145O3IBMiscsi Unique device
identifier      False

lscfg -v -l hdisk1


  hdisk1             IBM 2145 iSCSI Disk Drive

        Manufacturer.................IBM
        Machine Type and Model......2145
        ROS Level and ID............30303030
        Serial Number...............
        Device Specific.(Z0).........0000043268101002
        Device Specific.(Z1).........
        Device Specific.(Z2).........
        Device Specific.(Z3).........
```

Chapter 27. Installing the Solaris iSCSI initiator

This section describes how to install the Solaris iSCSI initiator.

Confirm that the initiator service is installed by issuing this command:

```
pkginfo SUNWiscsiu SUNWiscsir
```

If the initiator service is not installed, follow the Solaris operating system instructions to install the service.

To install the Solaris iSCSI initiator, perform the following steps:

1. Run the discovery command.

   ```
   iSCSIadm -m discovery -t st -p x.x.x.x
   ```

   where *x.x.x.x* is the IP address of each clustered Ethernet port on the SAN Volume Controller cluster. This command reports the IQN name of the target that is associated with each SAN Volume Controller node port. The following example shows a sample output:

   ```
   iscsiadm -m discovery -t st -p 9.71.43.131

   9.71.43.131:3260,1 iqn.1986-03.com.ibm:2145.china5.hlnc111874
   ```

2. Use the IP address with the `iscsiadm add` command to indicate which discovery address to use with the host and SAN Volume Controller cluster connection.

   ```
   iscsiadm add discovery-address 192.168.1.97:3260
   ```

   Issue this command for all SAN Volume Controller clustered Ethernet ports that you are using.

3. If you are using the Internet Storage Name Service (iSNS) server facility, issue the `iscsiadm add iSNS-server` command to locate the facility.

   ```
   iscsiadm add iSNS-server 10.0.0.1:3205
   ```

4. Enable the iSCSI target discovery method with the `iscsiadm modify discovery` command.

   - For file-based discovery, the command uses this form:

     ```
     iscsiadm modify discovery --sendtargets enable
     ```

   - For iSNS discovery, the command uses this form:

     ```
     iscsiadm modify discovery --iSNS enable
     ```

5. Create the iSCSI device links for the local system.

   ```
   devfsadm -i iscsi
   ```

Solaris configuration parameters

Several commands are available to list the parameters for items such as initiator, discovered targets, and active sessions.

You can use commands to list configuration parameters, remove a discovered target, and change the parameter of an iSCSI initiator.

Working with the Solaris initiator parameters

This section describes how to list and modify the parameters for the Solaris iSCSI initiator.

To list or modify the parameters for the Solaris iSCSI initiator, perform the following steps:

1. To see a list of the initiators, issue the following command:

   ```
   iscsiadm list initiator-node
   ```

   You see the following output:

   ```
   Initiator node name: iqn.1986-03.com.sun:01:0003bad935da.4906be64

   Initiator node alias: -
   Login Parameters (Default/Configured):
                  Header Digest: NONE/-
                  Data Digest: NONE/-
                 Authentication Type: NONE
                  RADIUS Server: NONE
                  RADIUS access: unknown
                  Configured Sessions: 1
   ```

2. Modify the parameter for the iSCSI initiator:
   - Set the header digest to CRC32.

     ```
     iscsiadm modify initiator-node -h CRC32
     ```

   - Set the data digest to CRC32.

     ```
     iscsiadm modify initiator-node –d CRC32
     ```

3. Verify that the parameter was modified.

   ```
   iscsiadm list initiator-node
   ```

Listing the Solaris target and session parameters

This section describes how to list the parameters for the Solaris targets and sessions.

To list the parameters for the Solaris discovered targets and active sessions, perform the following steps:

1. To see a list of discovered targets and active sessions, issue the following command:

   ```
   iscsiadm list target
   ```

   You see the following output:

   ```
   Target: iqn.1986-03.com.ibm:2145.lodestoneGB1.node1
   Alias: -       TPGT: 1
            ISID: 4000002a0000
            Connections: 1
   ```

2. Display a list of the target parameters by using one of the following commands.
   - Issue the `iscsiadm list target -v` command:

     ```
     iscsiadm list target -v iqn.1986-03.com.ibm:
     2145.lodestoneGB1.node1 <your target name>
     ```

     You see the following output:

     ```
     Target: iqn.1986-03.com.ibm:2145.lodestoneGB1.node1

     Alias: - TPGT: 1
              ISID: 4000002a0000
              Connections: 1
                     CID: 0
                       IP address (Local): 192.168.1.93:32828
                       IP address (Peer): 192.168.1.97:3260
                       Discovery Method: SendTargets
                       Login Parameters (Negotiated):
                             Data Sequence In Order: yes
                             Data PDU In Order: yes
     ```

```
                                        Default Time To Retain: 20
                                        Default Time To Wait: 2
                                        Error Recovery Level: 0
                                        First Burst Length: 32768
                                        Immediate Data: no
                                        Initial Ready To Transfer (R2T): yes
                                        Max Burst Length: 32768
                                        Max Outstanding R2T: 1
                                        Max Receive Data Segment Length: 8192
                                        Max Connections: 1
                                        Header Digest: NONE
                                        Data Digest: NONE
```

- Issue the `iscsiadm list target-param -v` command:

  ```
  iscsiadm list target-param -v iqn.1986-03.com.ibm:2145.lodestoneGB1.node1
  ```

  You see the following output:

  ```
  Target: iqn.1986-03.com.ibm:2145.lodestoneGB1.node1
          Alias: -
          Bi-directional Authentication: disabled
          Authentication Type: NONE
          Login Parameters (Default/Configured):
                  Data Sequence In Order: yes/-
                  Data PDU In Order: yes/-
                  Default Time To Retain: 20/-
                  Default Time To Wait: 2/-
                  Error Recovery Level: 0/-
                  First Burst Length: 65536/-
                  Immediate Data: yes/-
                  Initial Ready To Transfer (R2T): yes/-
                  Max Burst Length: 262144/-
                  Max Outstanding R2T: 1/-
                  Max Receive Data Segment Length: 8192/-
                  Max Connections: 1/-
                  Header Digest: NONE/-
                  Data Digest: NONE/-
          Configured Sessions: 1
  ```

Removing a discovered target

This section describes how to remove a discovered target on a Solaris host.

To remove a discovered target, issue the following command:

```
iscsiadm remove discovery-address 192.168.1.97:3260
```

Considerations for Solaris hosts

There are several considerations to be aware of when working with a Solaris host for iSCSI.

Header digest and data digest

This section describes how to reset the digest fields to none.

When you are discovering a target, do not set the header digest and data digest to CRC32 because it is not supported in the discovery phase. Set the value to none.

To set the header digest and data digest parameter to none, use the following commands:

1. Issue the following command:

   ```
   iscsiadm modify initiator-node –h none –d none
   ```

2. After you have set up the connection to the target, you can change the digest fields to CRC32.
   - Set the header digest to CRC32.

     ```
     iscsiadm modify initiator-node -h CRC32
     ```

   - Set the data digest to CRC32.

     ```
     iscsiadm modify initiator-node –d CRC32
     ```

3. Display the updated parameter information for the iSCSI target device.

   ```
   iscsiadm list target-param -v iqn.1992-08.com.abcstorage:sn.84186266
   Target: iqn.1992-08.com.abcstorage:sn.84186266
           Alias: -
           Bi-directional Authentication: disabled
           Authentication Type: NONE
           Login Parameters (Default/Configured):
                   Data Sequence In Order: yes/-
                   Data PDU In Order: yes/-
                   Default Time To Retain: 20/-
                   Default Time To Wait: 2/-
                   Error Recovery Level: 0/-
                   First Burst Length: 65536/-
                   Immediate Data: yes/-
                   Initial Ready To Transfer (R2T): yes/-
                   Max Burst Length: 262144/-
                   Max Outstanding R2T: 1/-
                   Max Receive Data Segment Length: 65536/-
                   Max Connections: 1/-
                   Header Digest: CRC32/-
                   Data Digest: CRC32/-
           Configured Sessions: 1
   ```

4. The initiator reconnects with the target after you modify the parameter.
5. Verify that the iSCSI initiator reconnects to the iSCSI target.

   ```
   iscsiadm list target -v iqn.1992-08.com.abcstorage:sn.84186266
   Target: iqn.1992-08.com.abcstorage:sn.84186266
           TPGT: 2
           ISID: 4000002a0000
           Connections: 1
                   CID: 0
                     IP address (Local): nnn.nn.nn.nnn:64369
                     IP address (Peer): nnn.nn.nn.nnn:3260
                     Discovery Method: SendTargets
                     Login Parameters (Negotiated):
                           .
                           .
                           .
                           Header Digest: CRC32
                           Data Digest: CRC32
   ```

Changing the default I/O timeout

This section describes how to change the default I/O timeout used by the Solaris iSCSI stack.

The `sd_io_time` variable sets the limit on how long an I/O can be outstanding before an error condition is returned. The Solaris default is 60 seconds (0x3c), but this variable is often set to 31 seconds (0x1f). To change the default timeout value, perform the following steps:

1. Open the file `/etc/system`.
2. Add this line to the end of the file:

   ```
   set sd:sd_io_time = 0x3c
   ```

3. Reboot the machine.

Miscellaneous considerations for Solaris hosts

There are several miscellaneous considerations to be aware of when working with a Solaris host for iSCSI.

- You can view the disks by using the <format> utility.
- You need to label all disks before running I/O on them. You can use the <format> utility to label them.
- Slice and partition are common Solaris terms. s2 slice represents the whole disk. If you have used partitioning, you can use s0 to s7. If you have not used partitioning, you can use s2 slice.

Enabling multipathing on a Solaris host

This section describes how to enable multipathing on a Solaris host.

By default, multipathing is always enabled.

If multipathing is disabled on a Solaris host, perform the following steps to enable multipathing:

1. Open the `/kernel/drv/iscsi.conf` file.
2. Set the `mpxio-disable` parameter to yes.

   ```
   mpxio-disable="yes"
   ```
3. Verify that the parameter was modified.
4. For each candidate SCSI target device, the `scsi_vhci` variable must identify a failover module to support the device. If a failover module cannot be identified, the device cannot operate under `scsi_vhci(7D)` multipathing control. A product-specific override mechanism is available. You can use the scsi_vhci.conf base mechanism to direct a device to a specific failover module.
   a. Add a third-party (non-Sun) symmetric storage device to run under `scsi_vhci`. This action takes advantage of `scsi_vhci` multipathing.
   b. Add the vendor ID and product ID for the device to the `/kernel/drv/scsi_vhci.conf` file. The `SCSI Inquiry` command returns those strings.

      ```
      device-type-scsi-options-list ="IBM     2145", "symmetric-option";
      symmetric-option = 0x1000000;
      ```

      where <IBM> is the vendor ID, and <2145> is the product ID.
   c. Save the file.
5. Reboot the system.

   ```
   reboot --- -r
   ```

   The -r option is the boot argument for reconfiguration boot. The system searches all attached hardware devices and configures the logical namespace in `/dev`.
6. Use the format command to find the device:

   ```
   c2t6005076801A9027E6000000000000006d0<IBM-2145-0000 cyl
   10238 alt 2 hd 32 sec  64>
    /scsi_vhci/ssd@g6005076801a9027e6000000000000006
   ```

Disabling multipathing on a Solaris host

This section describes how to disable multipathing on a Solaris host.

By default, multipathing is always enabled.

To disable multipathing on a Solaris host, use the following steps:

1. Open the `/kernel/drv/iscsi.conf` file.
2. Set the `mpxio-disable` parameter to no.

   ```
   mpxio-disable="no"
   ```
3. Reboot the system.

   ```
   reboot --- -r
   ```

   The -r option is the boot argument for reconfiguration boot. The system searches all attached hardware devices and configures the logical namespace in `/dev`.
4. Use the format command to find the device. If you have two paths for the same LUN, you see output like the following example:

   ```
   c5t3d0 <IBM-2145-0000 cyl 5118 alt 2 hd 32 sec 64>
   /iscsi/disk@0000iqn.1986-03.com.ibm%3A2145.nilgir.dvt1105980001,0
   c5t4d0 <IBM-2145-0000 cyl 5118 alt 2 hd 32 sec 64>
   /iscsi/disk@0000iqn.1986-03.com.ibm%3A2145.nilgir.dvt1109120001,0
   ```

   The output shows that the targets are different for both paths, but they refer to the same LUN.

   Note: The `SCSI Inquiry` command is available under the `format` command. For iSCSI support, you cannot enable nor disable multipathing on a per device basis.

Chapter 28. Installing the HP-UX iSCSI initiator

This section describes how to install the HP-UX iSCSI initiator.

Ensure that you have followed the steps for setting up the host server.

To install the HP-UX iSCSI initiator, perform the following steps:

1. Log in as root.
2. Download the HP-UX iSCSI initiator from the following Web site:
   http://h20293.www2.hp.com/portal/swdepot/displayProductInfo.do?productNumber=T1452A
3. After you have downloaded the iSCSI-00_B.11.31.01_HP-UX_B.11.31_IA+PA.depot file, use the `mv` command to move it to the `/tmp` directory on your system.
4. Verify that the depot file was downloaded correctly by using the `swlist` command.

   ```
   # swlist -d @ /tmp/iSCSI-00_B.11.31.01_HP-UX_B.11.31_IA+PA.depot

   Initializing...
   Contacting target "myhost"...

   Target:  myhost:/tmp/iSCSI-00_B.11.31.01_HP-UX_B.11.31_IA+PA.depot

   Bundle(s):

   iSCSI-00    B.11.31.01    HP-UX iSCSI Software Initiator
   ```
5. On a stand-alone system, run the `swinstall` command to install the product.

   ```
   # swinstall -x autoreboot=true -s
   /tmp/iSCSI-00_B.11.31.01_HP-UX_B.11.31_IA+PA.depot iSCSI-00
   ```

   Note: The HP-UX iSCSI software initiator is a kernel product. The `autoreboot=true` option causes the system to reboot after the installation is complete.

Configuring the HP-UX iSCSI initiator

This section describes how to configure the HP-UX iSCSI initiator.

For more information about configuring the HP-UX iSCSI software initiator, see the following HP-UX Web site:

http://www.docs.hp.com/en/T1452-90012/index.html

To configure the HP-UX iSCSI initiator, perform the following steps:

1. Add the path for the `iscsiutil` executable program and other iSCSI executable programs to the root path.

   ```
   # PATH=$PATH:/opt/iscsi/bin
   ```

   Note: Add the previous string to the `/.profile` file to avoid manually updating the PATH environment variable each time.
2. Display the iSCSI initiator name that was configured.

```
#iscsiutil –l
Initiator Name             : iqn.2001-04.com.hp.stor:svcio
Initiator Alias            :
Authentication Method      : None
CHAP Method                : CHAP_UNI
Initiator CHAP Name        :
CHAP Secret                :
NAS Hostname               :
NAS Secret                 :
Radius Server Hostname     :
Header Digest              : None,CRC32C (default)
Data Digest                : None,CRC32C (default)
SLP Scope list for iSLPD   :
```

3. Change the iSCSI initiator name.

   ```
   iscsiutil -i -N <initiator name in iqn or eui format>
   ```

   Notes:

   a. Confirm the initiator name change by using the `iscsiutil -l` command.
   b. You must use standard iSCSI naming conventions; otherwise, HP-UX does not recognize the SAN Volume Controller hosts.

4. Add a discovery target with the `iscsiutil -a -l <IP>` command.

   ```
   # iscsiutil -a -I 192.168.1.149

   Target address "192.168.1.149:3260,1" has been successfully added.
   ```

   Note: HP-UX iSCSI software initiator does not support IPv6 addresses. Do not configure IPv6 addresses as a target IP.

5. Display the discovery targets using the `iscsiutil -p -D` command.

   ```
   # iscsiutil –pD
   ```

   You see the following output:

   ```
   Discovery Target Information
   ----------------------------

   Target # 1
   ---------
           IP Address               : 192.168.1.149
           iSCSI TCP Port           : 3260
           iSCSI Portal Group Tag   : 1

     User Configured:
     ----------------

           Authenticaton Method     : None
           CHAP Method              : CHAP_UNI
           Initiator CHAP Name      :
           CHAP Secret              :
           Header Digest            : None,CRC32C (default)
           Data Digest              : None,CRC32C (default)
   ```

6. Discover the operational target devices and create device special files.

   ```
   # /usr/sbin/ioscan -NH 64000

   H/W Path       Class                   Description
   ================================================
   64000/0x0               usbmsvbus    USB Mass Storage
   64000/0x0/0x0           escsi_ctlr   USB Mass Storage Virt Ctlr
   64000/0x0/0x0.0x0       tgtpath      usb target served by usb_ms_scsi driver
   64000/0x0/0x0.0x0.0x0   lunpath      LUN path for disk9
   64000/0x2               iscsi        iSCSI Virtual Root
   64000/0x2/0x0           escsi_ctlr   iSCSI Virtual Controller
   ```

```
64000/0x2/0x0.0x10       tgtpath      iscsi target served by isvctlr driver
64000/0x2/0x0.0x10.0x0   lunpath      LUN path for disk586
64000/0xfa00             esvroot      Escsi virtual root
64000/0xfa00/0x0         disk         HP      DG146BABCF
64000/0xfa00/0x1         disk         HP      DG146BABCF
64000/0xfa00/0x2         disk         HP      DG146BABCF
64000/0xfa00/0x3         disk         HP      DG146BABCF
64000/0xfa00/0x4         disk         TEAC    DVD-ROM DW-224EV
64000/0xfa00/0xae        disk         IBM     2145
```

7. Display the operational targets by using the `iscsiutil` command.

   ```
   # iscsiutil –pO
   ```

   You see the following output:

   ```
   Operational Target Information
   ------------------------------
   Target # 1
   -----------
           Target Name              : iqn.1986-03.com.ibm:2145.LodestHP99.node1
           Target Alias             :
           No. of Target Addresses  : 1

   Target Address # 1
   ------------------
           IP Address               : 192.168.1.149
           iSCSI TCP Port           : 3260
           iSCSI Portal Group Tag   : 1
     User Configured:
     ----------------
           Authenticaton Method     : None
           CHAP Method              : CHAP_UNI
           Initiator CHAP Name      :
           CHAP Secret              :
           Header Digest            : None,CRC32C (default)
           Data Digest              : None,CRC32C (default)
   ```

8. Display all the LUNs that are exported by using the `ioscan` command.

   ```
   # ioscan -kfnC disk
   ```

   You see the following output:

   ```
   Class     I  H/W Path        Driver S/W State   H/W Type     Description
   ===================================================================
   disk      0  0/1/1/0.0.0.0.0  sdisk   CLAIMED     DEVICE       HP  DG146BABCF
                                /dev/dsk/c0t0d0   /dev/rdsk/c0t0d0
   disk      1  0/1/1/0.0.0.1.0  sdisk   CLAIMED     DEVICE       HP  DG146BABCF
                                /dev/dsk/c0t1d0   /dev/rdsk/c0t1d0
   disk      3  0/1/1/0.0.0.2.0  sdisk   CLAIMED     DEVICE       HP  DG146BABCF
                                /dev/dsk/c0t2d0   /dev/rdsk/c0t2d0
   disk      2  0/1/1/0.0.0.3.0  sdisk   CLAIMED     DEVICE       HP  DG146BABCF
   disk    485  255/0/16.0.0.0  sdisk   CLAIMED     DEVICE       IBM  2145
                                /dev/dsk/c15t0d0   /dev/rdsk/c15t0d0
   disk      8  255/1/0.0.0     sdisk   CLAIMED     DEVICE       TEAC DVD-ROM
   DW-224EV /dev/dsk/c1t0d0   /dev/rdsk/c1t0d0
   ```

9. Check the disk information.

   ```
   diskinfo -v <disk>
   ```

Known limitations

There are several considerations to be aware of when working with an HP-UX host for iSCSI.

- The HP-UX iSCSI software initiator does not support IPv6 addresses. Do not configure IPv6 addresses as target addresses. In the discovery phase, the target sends all IP addresses to the initiator, and the IPv6 addresses could cause the HP-UX system to crash.

- The HP-UX iSCSI initiator tries to log in on all the target IP addresses that have been found in the discovery phase. In this situation, the SAN Volume Controller iSCSI login toggles.

HP-UX native multipathing

This section provides an overview of the multipathing support that is available on an HP-UX system that was configured for an iSCSI initiator.

After the iSCSI initiator is configured, the HP-UX native multipathing is statically linked with the kernel, which means no setup is required to use the multipathing support.

You need to find out the pseudo device or persistent device-specific file that was created by the multipathing kernel module. If you see I/Os going through the persistent device-specific file, then HP-UX native multipathing is operating. If you do not see the I/Os going through the persistent device-specific file, then native multipathing is not operating.

For more information about multipathing, see the HP-UX Web site:

http://docs.hp.com/en/native-multi-pathing/native_multipathing_wp_AR0709.pdf

If you have one LUN that is exported to the HP-UX system and the initiator logs in to both targets, the LUN is accessible from the two different paths. In this case, HP-UX 11i v3 creates only one persistent device-specific file per LUN.

The `ioscan` command queries the mapping combinations between LUN and lunpaths using the persistent device-specific file

Part 4. Appendixes

Appendix. 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 reader has been tested: Window-Eyes v6.1.
- You can operate all features using the keyboard instead of the mouse.
- When setting or changing an IP address on the SAN Volume Controller front panel, you can disable the fast increase function to reduce the address scrolling speed of the up and down buttons to two seconds. This feature is documented in the topic that discusses initiating cluster creation from the front panel, which is located in the IBM System Storage SAN Volume Controller Information Center and the *IBM System Storage SAN Volume Controller Software Installation and Configuration Guide*.

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 find the HTML version of the IBM System Storage SAN Volume Controller information at the following Web site:

http://publib.boulder.ibm.com/infocenter/svcic/v3r1m0/index.jsp

You can access this information using screen-reader software and a digital speech synthesizer to hear what is displayed on the screen. JAWS version 10 has been tested.

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Host Attachment User's Guide
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