Hitachi Virtual Storage Platform Family

SVOS RF 9.8.7

Open-Systems Host Attachment Guide

This document describes and provides instructions for configuring open-systems hosts and Hitachi RAID storage systems for attachment and recognition of the new storage devices.

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Preface

This document describes and provides instructions for installing and configuring the storage devices on the Hitachi RAID storage systems for attachment to open-systems hosts. The Hitachi RAID storage systems include the following models:

- Virtual Storage Platform 5100, Virtual Storage Platform 5200, Virtual Storage Platform 5500, Virtual Storage Platform 5600, Virtual Storage Platform 5100H, Virtual Storage Platform 5200H, Virtual Storage Platform 5500H, Virtual Storage Platform 5600H (VSP 5000 series)

- Virtual Storage Platform F1500 (VSP F1500)

- Virtual Storage Platform G1000, G1500 (VSP G1x00)

- Virtual Storage Platform E590, Virtual Storage Platform E790, Virtual Storage Platform E990, Virtual Storage Platform E1090 (VSP E series)

- Virtual Storage Platform (VSP)

- Virtual Storage Platform G350, G370, G700, G900 (VSP G350, G370, G700, G900)

- Virtual Storage Platform F350, F370, F700, F900 (VSP F350, F370, F700, F900)

- Virtual Storage Platform G200, G400, G600, G800

- Virtual Storage Platform F400, F600, F800

- Hitachi Unified Storage VM (HUS VM)

Please read this document carefully to understand how to use this product, and maintain a copy for reference purposes.

Intended audience

This document is intended for system administrators, Hitachi Vantara representatives, and authorized service providers who install, configure, and operate the Hitachi RAID storage systems.

Readers of this document should be familiar with the following:

- Data processing and RAID storage systems and their basic functions.

- The Hitachi RAID storage system and the *Hardware Guide* for the storage system.

- The management software for the storage system (for example, Hitachi Device Manager - Storage Navigator, Hitachi Ops Center Administrator, Hitachi Command Suite) and the applicable user documentation.

- The host operating system (OS), the hardware hosting the system, and the hardware used to attach the storage system to the host, including Fibre Channel or iSCSI cabling, host adapters, switches, and hubs.

Product version

This document revision applies to the following product versions:

- VSP 5000 series: 90-09-21 or later
- VSP G1000, G1500; VSP F1500: 80-06-91 or later
- VSP: 70-01-0*x* or later
- VSP E series: 93-07-21 or later
- VSP G130, G/F350, G/F370, G/F700, G/F900: 88-08-08 or later
- VSP N400, N600, N800: 83-06-18 or later
- VSP G200, G400, G600, G800; VSP F400, F600, F800: 83-05-46 or later
- HUS VM: 73-01-0*x* or later
- SVOS RF 9.8.7 or later

Release notes

Read the release notes before installing and using this product. They may contain requirements or restrictions that are not fully described in this document or updates or corrections to this document. Release notes are available on the Hitachi Vantara Support Website: https://knowledge.hitachivantara.com/Documents.

Changes in this revision

- Updated information about host modes and host mode options (HMOs) for the following systems:
  - VSP 5000 series
  - VSP G1000, G1500; VSP F1500
  - VSP E series
  - VSP G130, G/F350, G/F370, G/F700, G/F900

Document conventions

This document uses the following typographic conventions:

Convention	Description
Bold	▪ Indicates text in a window, including window titles, menus, menu options, buttons, fields, and labels. Example: Click **OK**. ▪ Indicates emphasized words in list items.
Italic	▪ Indicates a document title or emphasized words in text. ▪ Indicates a variable, which is a placeholder for actual text provided by the user or for output by the system. Example: `pairdisplay -g group` (For exceptions to this convention for variables, see the entry for angle brackets.)
`Monospace`	Indicates text that is displayed on screen or entered by the user. Example: `pairdisplay -g oradb`
< > angle brackets	Indicates variables in the following scenarios: ▪ Variables are not clearly separated from the surrounding text or from other variables. Example: `Status-<report-name><file-version>.csv` ▪ Variables in headings.
[ ] square brackets	Indicates optional values. Example: [a | b] indicates that you can choose a, b, or nothing.
{ } braces	Indicates required or expected values. Example: { a | b } indicates that you must choose either a or b.
| vertical bar	Indicates that you have a choice between two or more options or arguments. Examples: [a | b] indicates that you can choose a, b, or nothing. { a | b } indicates that you must choose either a or b.

This document uses the following icons to draw attention to information:

Icon	Label	Description
	Note	Calls attention to additional information.

Icon	Label	Description
	Tip	Provides helpful information, guidelines, or suggestions for performing tasks more effectively.
	Important	Highlights information that is essential to the completion of a task.
	Caution	Warns the user of adverse conditions and/or consequences (for example, disruptive operations, data loss, or a system crash).
	CAUTION	Warns the user of a hazardous situation that, if not avoided, could result in major or minor injury.
	WARNING	Warns the user of a hazardous situation which, if not avoided, could result in death or serious injury.

Conventions for storage capacity values

Physical storage capacity values (for example, disk drive capacity) are calculated based on the following values:

Physical capacity unit	Value
1 kilobyte (KB)	1,000 (10^3) bytes
1 megabyte (MB)	1,000 KB or $1,000^2$ bytes
1 gigabyte (GB)	1,000 MB or $1,000^3$ bytes
1 terabyte (TB)	1,000 GB or $1,000^4$ bytes
1 petabyte (PB)	1,000 TB or $1,000^5$ bytes
1 exabyte (EB)	1,000 PB or $1,000^6$ bytes

Logical capacity values (for example, logical device capacity, cache memory capacity) are calculated based on the following values:

Logical capacity unit	Value
1 block	512 bytes
1 cylinder	Mainframe: 870 KB

Logical capacity unit	Value
	Open-systems: - OPEN-V: 960 KB - Others: 720 KB
1 KB	1,024 (2^{10}) bytes
1 MB	1,024 KB or $1,024^2$ bytes
1 GB	1,024 MB or $1,024^3$ bytes
1 TB	1,024 GB or $1,024^4$ bytes
1 PB	1,024 TB or $1,024^5$ bytes
1 EB	1,024 PB or $1,024^6$ bytes

Accessing product documentation

Product user documentation is available on the Hitachi Vantara Support Website: https://knowledge.hitachivantara.com/Documents. Check this site for the most current documentation, including important updates that may have been made after the release of the product.

Getting help

The Hitachi Vantara Support Website is the destination for technical support of products and solutions sold by Hitachi Vantara. To contact technical support, log on to the Hitachi Vantara Support Website for contact information: https://support.hitachivantara.com/en_us/contact-us.html.

Hitachi Vantara Community is a global online community for Hitachi Vantara customers, partners, independent software vendors, employees, and prospects. It is the destination to get answers, discover insights, and make connections. **Join the conversation today!** Go to community.hitachivantara.com, register, and complete your profile.

Comments

Please send comments to doc.comments@hitachivantara.com. Include the document title and number, including the revision level (for example, -07), and refer to specific sections and paragraphs whenever possible. All comments become the property of Hitachi Vantara LLC.

Thank you!

Chapter 1: Overview of host attachment

The Hitachi storage systems provide heterogeneous connectivity to support multiple concurrent attachment to a variety of host operating systems, including UNIX, Windows, VMware, Linux, and mainframe servers, enabling massive consolidation and storage aggregation across disparate platforms. The storage systems are compatible with most Fibre Channel (FC) host bus adapters (HBAs), iSCSI adapters, and FC-over-Ethernet (FCoE) converged network adapters (CNAs).

Host attachment workflow

The RAID storage systems provide heterogeneous connectivity to support multiple concurrent attachment to a variety of host operating systems, including VMware, Windows, Linux, UNIX, and mainframe servers. The storage systems can operate with multi-host applications and host clusters and are designed to handle very large databases as well as data warehousing and data mining applications that store and retrieve terabytes of data. The storage systems are compatible with most Fibre Channel host bus adapters (HBAs), iSCSI adapters, and FC-over-Ethernet (FCoE) converged network adapters (CNAs).

Workflow for host attachment

1. Install the new storage system, or install the new physical storage devices on the existing storage system. This task is performed by the Hitachi Vantara representative. See Storage system installation (on page 23).
2. Configure the storage system for host attachment. This task is performed by the Hitachi Vantara representative and the user. See Configuring the storage system (on page 24).
3. Configure the host for connection to the storage system, including host OS, middleware, and SNMP. This task is performed by the user. See Installing and configuring the host (on page 25).
4. Install and configure the FC adapters for connection to the storage system. This task is performed by the user. See Installing and configuring the host adapters (on page 27).
5. Connect the storage system to the host. This task is performed by the Hitachi Vantara representative and the user. See Connecting the RAID storage system to the host (on page 30).
6. Configure the newly attached hosts and LU paths. This task is performed by the user. See Configuring the new hosts and new LU paths (on page 30).
7. Configure the new storage devices for use on the host. This task is performed by the user.

Logical device types

The following table describes the types of logical devices (LDEVs) on the RAID storage systems that can be configured and used by open-systems hosts. The LDEVs on the storage systems are defined to the host as *SCSI disk devices*, even though the interface is Fibre Channel or iSCSI and the devices are disk drives or flash drives. For information about configuring LDEVs other than OPEN-V, contact customer support.

Device type	Description
OPEN-V devices	SCSI disk devices (Virtual LUN-based volumes) that do not have a predefined size.
OPEN-*x* devices	SCSI disk devices of predefined sizes: ▪ OPEN-3 (2.3 GB) ▪ OPEN-8 (6.8 GB) ▪ OPEN-9 (6.9 GB) ▪ OPEN-E (13.5 GB) ▪ OPEN-L (33 GB) For information about the use of these devices, contact customer support.
VLL devices (OPEN-*x* VLL)	Custom-size LUs that are configured by "slicing" a single fixed-size LU into two or more smaller LUs to improve host access to frequently used files. VLL devices are configured using the Virtual LVI/LUN (VLL) feature. The product name for OPEN-*x* VLL devices is OPEN-*x*-CVS, in which *CVS* stands for *custom volume size*. OPEN-L devices do not support VLL.
LUSE devices (OPEN-*x**n)	Combined LUs composed of multiple OPEN-x devices. LUSE devices are configured using the LUN Expansion (LUSE) feature. A LUSE device can be from 2 to 36 times larger than a fixed-size OPEN-*x* LU. LUSE devices are designated as OPEN-*x** *n*, where *x* is the LU type and 2 < *n* < 36. For example, a LUSE device created by combining 10 OPEN-3 LUs is designated as an OPEN-3*10 device. LUSE lets the host access the data stored on the storage system using fewer LU numbers. **Note**: LUSE devices are supported only on VSP and HUS VM storage systems.

Device type	Description
VLL LUSE devices (OPEN-*x**n VLL)	Combined LUs composed of multiple VLL devices. VLL LUSE devices are configured first using the Virtual LUN feature to create custom-size devices and then using the LUSE feature to combine the VLL devices. You can combine from 2 to 36 VLL devices into one VLL LUSE device. For example, an OPEN-3 LUSE volume created from 10 OPEN-3 VLL volumes is designated as an OPEN-3*10 VLL device (product name OPEN-3*10-CVS).
FX devices (3390 3A/B/C, OPEN-*x* FXoto)	The Hitachi Cross-OS File Exchange (FX) feature allows you to share data across mainframe and open-systems platforms using special multiplatform volumes called FX devices. FX devices are installed and accessed as raw devices (not SCSI disk devices). Windows hosts must use FX to access the FX devices as raw devices (no file system, no mount operation). The 3390-3B devices are write-protected from Windows host access. The RAID storage system rejects all Windows host write operations (including FC adapters) for 3390-3B devices. The 3390-3A/C and OPEN-*x* FXoto devices are not write-protected for Windows host access. Do not execute any write operations on these devices. Do not create a partition or file system on these devices. This will overwrite data on the FX device and prevent the Cross-OS File Exchange software from accessing the device. The VLL feature can be applied to FX devices for maximum flexibility in volume size.

The following table lists the specifications for the LDEVs on the RAID storage systems. The sector size for the devices is 512 bytes.

Device type (Note 1)	Category (Note 2)	Product name (Note 3)	Number of blocks (512 B/blk)	Number of cylinders	Number of heads	Number of sectors per track	Capacity (MB) (Note 4)
OPEN-3	SCSI disk	OPEN-3	4806720	3338	15	96	7007
OPEN-8	SCSI disk	OPEN-8	14351040	9966	15	96	2347
OPEN-9	SCSI disk	OPEN-9	14423040	10016	15	96	7042
OPEN-E	SCSI disk	OPEN-E	28452960	19759	15	96	13893
OPEN-L	SCSI disk	OPEN-L	71192160	49439	15	96	34761
OPEN-3*n	SCSI disk	OPEN-3*n	4806720*n	3338*n	15	96	2347*n
OPEN-8*n	SCSI disk	OPEN-8*n	14351040*n	9966*n	15	96	7007*n

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Device type (Note 1)	Category (Note 2)	Product name (Note 3)	Number of blocks (512 B/blk)	Number of cylinders	Number of heads	Number of sectors per track	Capacity (MB) (Note 4)
OPEN-9*n	SCSI disk	OPEN-9*n	14423040*n	10016*n	15	96	7042*n
OPEN-E*n	SCSI disk	OPEN-E*n	28452960*n	19759*n	15	96	13893*n
OPEN-L*n	SCSI disk	OPEN-L*n	71192160*n	49439*n	15	96	34761*n
OPEN-3V LL	SCSI disk	OPEN-3 CVS	(Note 5)	(Note 6)	15	96	(Note 7)
OPEN-8 VLL	SCSI disk	OPEN-8 CVS	(Note 5)	(Note 6)	15	96	(Note 7)
OPEN-9 VLL	SCSI disk	OPEN-9 CVS	(Note 5)	(Note 6)	15	96	(Note 7)
OPEN-E VLL	SCSI disk	OPEN-E CVS	(Note 5)	(Note 6)	15	96	(Note 7)
OPEN-V VLL	SCSI disk	OPEN-V	(Note 5)	(Note 6)	15	128	(Note 7)
OPEN-3*n VLL	SCSI disk	OPEN-3*n CVS	(Note 5)	(Note 6)	15	96	(Note 7)
OPEN-8*n VLL	SCSI disk	OPEN-8*n CVS	(Note 5)	(Note 6)	15	96	(Note 7)
OPEN-9*n VLL	SCSI disk	OPEN-9*n CVS	(Note 5)	(Note 6)	15	96	(Note 7)
OPEN-E*n VLL	SCSI disk	OPEN-E*n CVS	(Note 5)	(Note 6)	15	96	(Note 7)
OPEN-V*n VLL	SCSI disk	OPEN-V*n	(Note 5)	(Note 6)	15	128	(Note 7)
3390-3A	FX otm/mto	3390-3A	5820300	3345	15	116	2844
3390-3B	FX mto	3390-3B	5816820	3343	15	116	2844
3390-3C	FX otm	OP-C-3390-3C	5820300	3345	15	116	2844
FXOPEN-3	FX oto	OPEN-3	4806720	3338	15	96	2347
3390-3A VLL	FX otm/mto	3390-3A-CVS	(Note 5)	(Note 6)	15	116	(Note 7)

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Device type (Note 1)	Category (Note 2)	Product name (Note 3)	Number of blocks (512 B/blk)	Number of cylinders	Number of heads	Number of sectors per track	Capacity (MB) (Note 4)
3390-3B VLL	FX mto	3390-3B-CVS	(Note 5)	(Note 6)	15	116	(Note 7)
3390-3C VLL	FX otm	OP-C-3390-3C-CVS	(Note 5)	(Note 6)	15	116	(Note 7)
FX OPEN-3 VLL	FX oto	OPEN-3-CVS	(Note 5)	(Note 6)	15	96	(Note 7)

Notes:

1. The availability of specific device types depends on the storage system model and the level of microcode installed on the storage system.

2. The category of a device (SCSI disk or Cross-OS File Exchange) determines its volume usage. SCSI disk devices (for example, OPEN-V) are usually formatted with file systems but can also be used as raw devices (for example, some applications use raw devices).

3. The product name for Virtual LUN devices is OPEN-x CVS, where CVS = custom volume size. The command device (used for Command Control Interface operations) is distinguished by "–CM" on the product name (for example, OPEN-V-CM).

4. This capacity is the maximum size that can be entered. The device capacity can sometimes be changed by the BIOS or host adapter. Also, different capacities may be due to variations such as 1 MB = 1000^2 bytes or 1024^2 bytes.

5. The number of blocks for a Virtual LVI/LUN volume is calculated as follows:

```
# of blocks = (# of data cylinders) × (# of heads) × (# of sectors per track)
```

The number of sectors per track is 128 for OPEN-V and 96 for the other emulation types. Example for an OPEN-3 VLL volume with capacity = 37 MB:

```
# of blocks = (53 cylinders – see Note 3) × (15 heads) × (96 sectors per track) = 76320
```

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Device type (Note 1)	Category (Note 2)	Product name (Note 3)	Number of blocks (512 B/blk)	Number of cylinders	Number of heads	Number of sectors per track	Capacity (MB) (Note 4)

6. The number of data cylinders for a Virtual LVI/LUN volume is calculated as follows (ceil (value) means that the value should be rounded up to the next integer):

   - Number of data cylinders for OPEN-*x* VLL volume (except for OPEN-V)

   ```
   # of cylinders =  ceil((capacity (MB) × 1024/720 )
   ```

   Example: For OPEN-3 VLL volume with capacity = 37 MB:

   ```
   # of cylinders = ceil(37 × 1024/720) = ceil(52.62) = 53 cylinders
   ```

   - Number of data cylinders for an OPEN-V VLL volume

   ```
   # of cylinders = ceil((capacity (MB) specified by user) × 16/15)
   ```

   Example: For OPEN-V VLL volume with capacity = 50 MB:

   ```
   # of cylinders = ceil(50 × 16/15) = ceil(53.33) = 54 cylinders
   ```

7. The size of an OPEN-*x* VLL volume is specified by capacity in MB, not number of cylinders. The size of an OPEN-V VLL volume can be specified by capacity in MB or number of cylinders.

Host queue depth

You can adjust the queue depth settings as needed to optimize the I/O performance of the devices. While the technical limit of queue depth for the Hitachi RAID storage systems is high, the appropriate queue depth settings (max tag count) for each operational environment must be carefully researched and determined. In addition, the requirements for host queue depth depend on the storage system model.

The following table lists the recommended queue depth settings to ensure smooth processing at the ports and best average performance. Other queue depth settings, higher or lower than these recommended values, can provide improved performance for certain workload conditions.

⚠ **Caution:** Higher queue depth settings (for example, >2,048 per port) can impact host response times. Exercise caution when using queue depth settings that are higher than these recommended values.

Recommended queue depth settings

Storage system	Recommended queue depth settings
VSP 5000 series	Target ports: ▪ 2,048 per port ▪ 32 per LDEV Bidirectional ports: ▪ 1,024 per port ▪ 32 per LDEV
VSP G1x00, VSP F1500	▪ 2,048 per port ▪ 32 per LDEV
VSP	▪ 2,048 per port ▪ 32 per LDEV
VSP E series	Target ports: ▪ 2,048 per port ▪ 32 per LDEV Universal ports: ▪ 1,024 per port ▪ 32 per LDEV
VSP G130, G/F350, G/F370, G/F700, G/F900	Target ports: ▪ 2,048 per port ▪ 32 per LDEV Universal ports: ▪ 1,024 per port ▪ 32 per LDEV
VSP G200, G400, G600, G800, VSP F400, F600, F800	▪ 1,024 per port ▪ 32 per LDEV
HUS VM	▪ 2,048 per port ▪ 32 per LDEV

Chapter 1: Overview of host attachment

Chapter 2: Preparing for host attachment

This chapter describes how to install and configure the RAID storage system, host, and host adapters in preparation for host attachment.

Installation and configuration requirements

The following table lists the requirements for installing and configuring the storage system for attachment to an open-systems host server

Item	Requirements
RAID storage system	▪ The availability of features and devices depends on the storage system model and the level of microcode installed on the storage system. ▪ The Hitachi Device Manager - Storage Navigator software must be installed and operational. For details, see the *System Administrator Guide* for the storage system. ▪ The Hitachi LUN Manager feature must be enabled. For details, see the *System Administrator Guide* for the storage system.
Host server hardware	▪ Review the hardware requirements for attaching new storage to the host server. For details, see the user documentation for the host server. ▪ For details about supported host server hardware, see the Hitachi Vantara Product Compatibility Guide: https://compatibility.hitachivantara.com
Hardware for host attachment	For details about supported hardware for host attachment (optical cables, hubs, switches, and so on), see the Hitachi Vantara Product Compatibility Guide: https://compatibility.hitachivantara.com

Item	Requirements
Host operating system	▪ This document covers the following host platforms. Check the Hitachi Vantara Product Compatibility Guide: https://compatibility.hitachivantara.com for the latest information about host OS support. 　• AIX® 　• HP-UX 　• Red Hat Linux 　• Solaris 　• SUSE Linux 　• VMware 　• Windows 　• XenServer ▪ Verify that the OS version, architecture, relevant patches, and maintenance levels are supported by the storage system. For details about supported OS versions, see the Hitachi Vantara Product Compatibility Guide: https://compatibility.hitachivantara.com ▪ Verify that the host meets the latest system and software requirements for attaching new storage. For details, see the host OS user documentation. ▪ Verify that you have the host OS software installation media. ▪ Verify that you have root/administrator login access to the host system.

Item	Requirements
Host adapters (HBAs and CNAs)	▪ *HBAs* The storage systems support FC HBAs equipped as follows: • 8-Gbps FC interface, including shortwave non-OFC (open fibre control) optical interface and multimode optical cables with LC connectors. • 4-Gbps FC interface, including shortwave non-OFC optical interface and multimode optical cables with LC connectors. • 2-Gbps FC interface, including shortwave non-OFC optical interface and multimode optical cables with LC connectors. • 1-Gbps FC interface, including shortwave non-OFC optical interface and multimode optical cables with SC connectors. For OM3 fiber and 200-MB/s data transfer rate, the total cable length attached to each FC HBA must not exceed 500 meters (1,640 feet). Do not connect any OFC type connectors to the storage system. ▪ *iSCSI HBAs* The storage systems have the following iSCSI SAN requirements: • 10 Gigabit Ethernet switch • 10 Gb NIC or HBA card in each host computer • 10 Gb iSCSI initiator • LC-LC optical cables VSP G1000, VSP G1500, VSP F1500: • Minimum microcode level: 80-03-3x For details about iSCSI support, see the *Hardware Guide* for your storage system model.

Item	Requirements
	▪ *CNAs* The storage systems support FCoE converged network adapters (CNAs) equipped as follows: · 10 Gbps Fibre Channel over Ethernet interface, including shortwave non-OFC (open fibre control) optical interface and multimode optical cables with LC connectors. For OM3 fiber and 10-Gb/s transfer rate, the total cable length attached to each CNA must not exceed 300 meters (984 feet). The diskless storage system model (no internal drives) does not support the FCoE option. VSP G1000, VSP G1500, VSP F1500: · Minimum microcode level: 80-02-0x · Host OS: Red Hat Enterprise Linux, VMware, Windows VSP: · Host OS: VMware, Windows For details about FCoE support, see the *Hardware Guide* for your storage system model. For details about installing the adapter and using the utilities and tools for the adapter, see the user documentation for the adapter. For details about supported host adapters and drivers, see the Hitachi Vantara Product Compatibility Guide: https://compatibility.hitachivantara.com
Storage area network (SAN)	A SAN may be required to connect the storage system to the host. For details about supported switches, topology, and firmware versions for SAN configurations, see the Hitachi Vantara Product Compatibility Guide: https://compatibility.hitachivantara.com

Storage system installation

The storage systems come with all hardware and cabling required for installation. The Hitachi Vantara representative follows the instructions and precautions in the *Maintenance Manual* for the storage system when installing the product. The installation tasks include:

▪ Checking all specifications to ensure proper installation and configuration.

▪ Installing and assembling all hardware and cabling.

- Verifying that the Device Manager - Storage Navigator software is installed and ready for use. For details, see the *System Administrator Guide* for the storage system.

- Installing and formatting the logical devices (LDEVs). The user provides the desired parity group and LDEV configuration information to the Hitachi Vantara representative. For details, see the *Provisioning Guide* for the storage system.

Configuring the storage system

This section describes how to configure the RAID storage system for attachment to the host server.

Setting the system option modes

To provide greater flexibility, the storage systems have additional operational parameters called system option modes (SOMs) that allow you to tailor the storage system to your unique operating requirements. The SOMs are set on the storage system by the Hitachi Vantara representative. For information about SOMs, contact customer support.

Port configuration

Before the storage system is connected to the host, you must configure the ports on the storage system. Select the appropriate settings for each port based on the device to which the port is connected. The settings for FC ports include attribute (for example, target or bidirectional), security, speed, address (loop ID), fabric, and connection type. The settings for iSCSI ports include IPv4 settings, IPv6 mode and settings, attribute, security, TCP port number, selective ACK, delayed ACK, Ethernet MTU size, keep alive timer, VLAN tagging mode, iSNS server, IP address, CHAP user name, and secret. For the latest information about port topology configurations supported by OS versions and adapter/switch combinations, see the Hitachi Vantara Product Compatibility Guide: https://compatibility.hitachivantara.com

For details about configuring the ports, see the *Provisioning Guide* for the storage system.

> 📄 **Note:**
>
> - If you plan to use LUN security, enable the security setting before the port is attached to the host. If you enable LUN security on a port when host I/O is in progress, I/Os will be rejected with a security guard.
>
> - If you plan to connect different types of servers to the storage system through the same fabric switch, use the zoning function of the fabric switch.
>
> - For FC direct attachment at 16 Gbps or higher, you must use point-to-point (P-to-P) topology, not FC-AL.

Setting the host modes and host mode options

Before the storage system is connected to the hosts, you must configure the host groups or iSCSI targets for the new hosts and set the host mode and host mode options (HMOs) for each host group/iSCSI target. When you connect multiple hosts of different platforms to a single port, you must group hosts connected to the storage system by host groups/iSCSI targets that are segregated by platform. For example, if VMware, Windows, and Solaris hosts will be connected to a single port, you must create a host group/iSCSI target for each platform and set the host mode and HMOs for each host group/iSCSI target. When the storage system is connected to the hosts, you will register the hosts in the appropriate host groups/iSCSI targets.

While a host group can include more than one WWN, it is recommended that you create one host group for each host adapter and name the host group the same as the nickname for the adapter. Creating one host group per host adapter provides flexibility and is the only supported configuration when booting hosts from a SAN.

For instructions on setting the host modes and HMOs, see the *Provisioning Guide* for the storage system. For lists of the host modes and HMOs for the storage systems, see Host modes and host mode options (on page 205).

> ! **Important:** There are differences in host mode and HMO support among the storage system models, so it is important that you refer to the lists for your specific storage system model.

> ⚠ **Caution:**
> - Changing host modes or HMOs on a storage system that is already installed and attached to the host is disruptive and requires the host server to be rebooted.
> - Before setting any HMO, review its functionality carefully to determine whether it can be used for your configuration and environment. If you have any questions or concerns, contact your Hitachi Vantara representative.

Installing and configuring the host

The user is responsible for configuring the host system as needed for the new storage devices.

- For assistance with host configuration, see the user documentation for the product or contact the vendor's technical support.

- For assistance with specific configuration issues related to the storage system, contact customer support.

Installing the host OS software

The host operating system (OS) software must be loaded, configured, and operational before the storage system is attached.

Procedure

1. Verify that the OS version, architecture, relevant patches, and maintenance levels are supported by the storage system. For details about supported OS versions, see the Hitachi Vantara Product Compatibility Guide: https://compatibility.hitachivantara.com

2. Verify that the host meets the latest system and software requirements for attaching new storage. For details, see the user documentation for the OS.

3. Verify that you have the host OS software installation media.

4. Verify that you have root/administrator login access to the host system.

LVM software installation

The storage systems support industry-standard products and functions that provide logical volume management (LVM). You must configure the LVM products on the host servers to recognize and operate with the new storage devices before the new storage is attached. For assistance with LVM operations, see the user documentation for the LVM software or contact the vendor's technical support.

Installing the failover software

The storage systems support industry-standard products and functions that provide host, application, and path failover. You should configure the failover products to recognize and operate with the new storage devices before the new storage is attached.

-   Supported host and application failover products include PowerHA®, High Availability Cluster Multi-Processing (HACMP™), Veritas Cluster Server, Sun Cluster, Microsoft Cluster Server (MSCS), and MC/ServiceGuard.

-   Supported path failover products include Hitachi Dynamic Link Manager (HDLM), Veritas Volume Manager, DM Multipath, XenCenter dynamic multipathing, and HP UX alternate link path failover.

For assistance with failover operations, see the user documentation for the failover product or contact the vendor's technical support.

For details about HDLM, see the HDLM User's Guide for the host platform (for example, *Hitachi Command Suite Dynamic Link Manager (for Windows®) User Guide*), or contact your Hitachi Vantara representative.

> **Note:** Failover products may not provide a complete disaster recovery or backup solution and are not a replacement for standard disaster recovery planning and backup/recovery.

Installing the SNMP software

The storage systems support the industry-standard simple network management protocol (SNMP) for remote storage system management from the host servers. You must configure the SNMP software on the host before the new storage is attached. For assistance with SNMP configuration on the host, see the SNMP user documentation or contact the vendor's technical support.

SNMP is a part of the TCP/IP protocol suite that supports maintenance functions for storage and communication devices. The storage systems use SNMP to transfer status and management commands to the SNMP Manager on the host (see the following figure). When the SNMP Manager requests status information or when a service information message (SIM) occurs, the SNMP Agent on the storage system notifies the SNMP Manager on the host. Notification of error conditions is made in real time, enabling you to monitor the storage system from the open-systems host.

When a SIM occurs, the SNMP Agent initiates trap operations, which alert the SNMP Manager of the SIM condition. The SNMP Manager receives the SIM traps from the SNMP Agent and can request information from the SNMP Agent at any time.
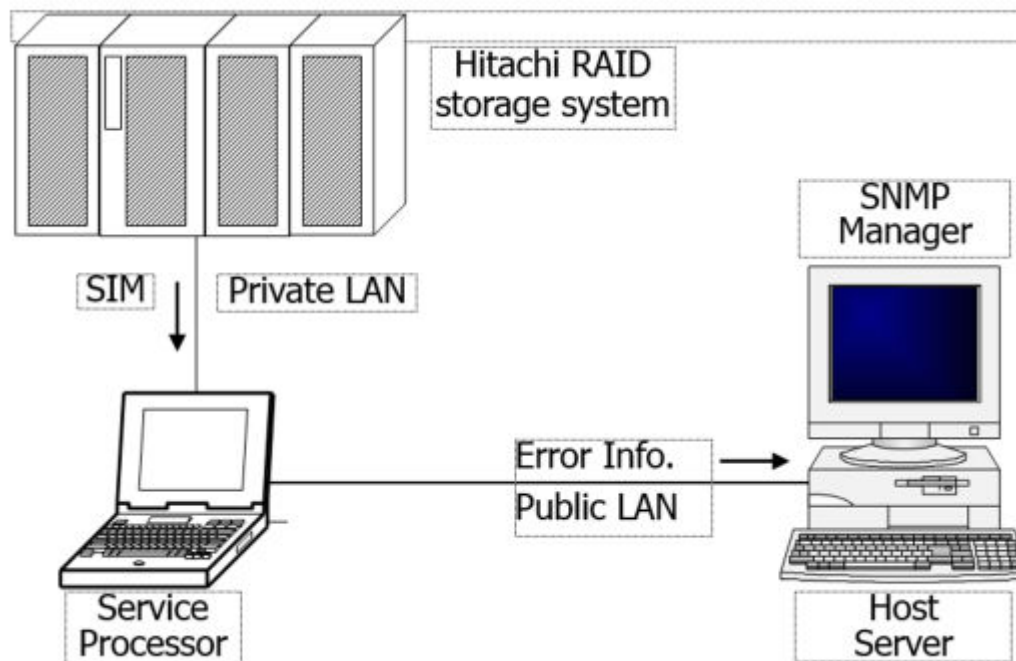
Installing and configuring the host adapters

The host adapters must be installed on the host before the storage system is attached. You also need to discover and write down the WWNs of the adapters to be connected to the storage system.

Follow the instructions in the vendor documentation for preparing your hosts, HBAs, CNAs, NICs, and iSCSI initiators for use with the storage system. For iSCSI specifications and requirements, see the *Hardware Guide* for your storage system model.

> **Note:** The user is responsible for installing and configuring the adapters as needed for the new storage devices.
>
> - For assistance with host adapter configuration, see the user documentation for the adapter or contact the vendor's technical support.
>
> - For assistance with specific configuration issues related to the storage system, contact customer support.

Procedure

1. Verify interoperability.

   Verify that the host adapters are supported by the storage system. For details, see the Hitachi Vantara Product Compatibility Guide: https://compatibility.hitachivantara.com

2. Install and verify the adapters.

   Install the host adapters on the host server, and verify that the adapters are functioning properly. For details about installing the adapter and using the utilities for the adapter, see the user documentation for the adapter.

   > **Note:**
   >
   > - Do not connect OFC-type FC interfaces to the storage system.
   >
   > - If a switch or adapter with a 1-Gbps transfer rate is used, configure the device to use a fixed 1-Gbps setting instead of Auto Negotiation. Otherwise, it may prevent a connection from being established. However, the transfer speed of CHF port cannot be set as 1 Gbps when the CHF model type is 8US/8UFC/16UFC. Therefore 1-Gbps adapter and switch cannot be connected.

3. Configure the adapter.

   Use the setup utilities to configure the adapters to be connected to the storage system. The adapters have many configuration options. The minimum requirements for configuring the adapters for operation with the storage system are:

   - *I/O timeout value (TOV)*: The disk I/O timeout value (TOV) requirement for the storage system is 60 seconds (0x3c hex).

   - *Queue depth*: The following table lists the recommended queue depth settings. You can adjust the queue depth later as needed to optimize the I/O performance of the devices. For details about queue depth, see Host queue depth (on page 18).

   - *BIOS*: The BIOS may need to be disabled to prevent the system from trying to boot from the storage system.

   Use the same settings and device parameters for all devices on the storage system. Several other parameters (for example, FC fabric) might also need to be set. See the user documentation for the host adapter to determine whether other options are required to meet your operational requirements.

Storage system	Recommended queue depth settings
VSP 5000 series	Target ports: - 2,048 per port - 32 per LDEV

Storage system	Recommended queue depth settings
	Bidirectional ports: ■ 1,024 per port ■ 32 per LDEV
VSP G1x00, VSP F1500	■ 2,048 per port ■ 32 per LDEV
VSP	■ 2,048 per port ■ 32 per LDEV
VSP E series	Target ports: ■ 2,048 per port ■ 32 per LDEV Universal ports: ■ 1,024 per port ■ 32 per LDEV
VSP G130, G/F350, G/F370, G/F700, G/F900	Target ports: ■ 2,048 per port ■ 32 per LDEV Universal ports: ■ 1,024 per port ■ 32 per LDEV
VSP G200, G400, G600, G800, VSP F400, F600, F800	■ 1,024 per port ■ 32 per LDEV
HUS VM	■ 2,048 per port ■ 32 per LDEV

4. Record the WWNs of the adapters.

   Find and write down the WWN of each host adapter. You will need to enter these WWNs when you configure the new hosts on your storage system.

   For details about finding the WWN of an adapter, see the user documentation for the adapter. The method for finding the WWN varies depending on the adapter type, host platform, and topology. You can use the adapter utility (for example, the LightPulse Utility for Emulex), or the host OS (for example, the `dmesg |grep Fibre` command in Solaris), or the fabric switch connected to the host (for example, an AIX® host).

Connecting the RAID storage system to the host

The storage system can be physically connected to the host system after configuring the storage system and the host. Some of the steps are performed by the Hitachi Vantara representative, and some are performed by the user.

📄 **Note:** The Hitachi Vantara representative must use the *Maintenance Manual* for the storage system during all installation activities. Follow all precautions and procedures in the *Maintenance Manual*, and always check all specifications to ensure proper installation and configuration.

Procedure

1. Verify the storage system installation: The Hitachi Vantara representative verifies the configuration and operational status of the storage system ports, LDEVs, and paths.

2. Shut down and power off the host: The user shuts down and powers off the host. The power must be off when the FC/FCoE/iSCSI cables are connected.

3. Connect the storage system to the host system: The Hitachi Vantara representative connects the cables between the storage system and the host or switch. Verify the ready status of the storage system and peripherals.

4. Power on and boot the host system: The user powers on and boots the host system after the storage system has been connected:

    a. Power on the host system display.

    b. Power on all peripheral devices. The storage system must be on, and the ports and modes must be configured before the host is powered on. If the ports are configured after the host is powered on, the host may need to be restarted to recognize the new settings.

    c. Confirm the ready status of all peripheral devices, including the storage system.

    d. Power on and boot the host system.

Configuring the new hosts and new LU paths

After discovering the WWNs of the host adapters and connecting the storage system to the host, you need to configure the new hosts and new LU paths on the storage system.

1. Add new hosts: Before you can configure LU paths, you must register the new hosts in host groups/iSCSI targets. For details, see the *Provisioning Guide* for the storage system.

    When registering hosts in multiple host groups, set the security switch (LUN security) to enabled, and then specify the WWN of the host adapter.

2. Configure LU paths: Configure the LU paths for the newly attached storage devices, including defining primary LU paths and alternate LU paths and setting the UUID. For details, see the *Provisioning Guide* for the storage system.

3. Set Fibre Channel authentication: Set Fibre Channel authentication as needed on host groups, ports, and fabric switches of the storage system. For details, see the *Provisioning Guide* for the storage system.

For details about iSCSI network configuration (for example, registering hosts in iSCSI targets, adding CHAP users, defining LU paths), see the *Provisioning Guide* for the storage system.

Note: Hitachi multipathing best practice is Single-Initiator Single-Targets configuration in which each HBA has only one path to the same LU. For example, you can provide four paths to each LU if you have four HBAs. For details, contact customer support.

Chapter 3: AIX® configuration and attachment

This chapter describes how to configure and manage the new disk devices on an AIX® host. Configuration of the devices should be performed by the AIX® system administrator. Configuration requires superuser/root access to the host system. If you have questions or concerns, contact your Hitachi Vantara representative.

Storage system configuration for AIX® operations

The storage system must be fully configured before being attached to the AIX® host, as described in Configuring the storage system (on page 24).

- *Devices types*: The following devices types are supported for AIX® operations. For details, see Logical device types (on page 14).

  - OPEN-V

  - OPEN-3/8/9/E/L

  - LUSE (OPEN-*x**n)

  - VLL (OPEN-*x* VLL)

  - VLL LUSE (OPEN-*x**n VLL)

  - Cross-OS File Exchange (FX) (3390-3A/B/C, OPEN-*x*-FXoto)

- *Host mode*: The required host mode for AIX® is *0F*. Do not select a host mode other than *0F* for IBM AIX®. For a complete list of host modes for the storage system, see Host modes and host mode options (on page 205). For instructions on setting the host modes, see the *Provisioning Guide* for the storage system.

- *Host mode options*: You may also need to set host mode options (HMOs) to meet your operational requirements. For a complete list of HMOs for the storage system, see Host modes and host mode options (on page 205). For instructions on setting the HMOs, see the *Provisioning Guide* for the storage system.

Verifying new device recognition for AIX®

The first step after attaching to the AIX® host is to verify that the host system recognizes the new devices. The host system automatically creates a device file for each new device recognized.

The devices should be installed and formatted with the fibre ports configured before the host system is powered on. Enter the `cfgmgr` command to check for new devices.

> 📄 **Note:** When you create the FX volume definition file (`datasetmount.dat`), provide the device file names for the FX devices. For example, if hdisk3 is a 3390-3B FX device, the entry for this volume in the FX volume definition file is: `\ \.\PHYSICALDRIVE3` *XXXXXX* `3390-3B` (where *XXXXXX* is the VOLSER)

Procedure

1. Log in to the host system as *root*.

2. Display the system device data by entering the `lsdev -C -c disk` command. See the following example for more details.

3. Verify that the host system recognizes all new disk devices, including OPEN-x, LUSE, VLL, VLL LUSE, and FX devices. The devices are listed by device file name.

4. Record the following device data for each new device: device file name, bus number, TID, LUN, and device type. The following figure shows a sample worksheet for recording the device data. You need this information to change the device parameters.

Device File Name	Bus No.	TID	LUN	Device Type	Alternate Paths	
hdisk1					TID:_____ LUN:_____	TID:_____ LUN:_____
hdisk2					TID:_____ LUN:_____	TID:_____ LUN:_____
hdisk3					TID:_____ LUN:_____	TID:_____ LUN:_____
hdisk4					TID:_____ LUN:_____	TID:_____ LUN:_____
hdisk5					TID:_____ LUN:_____	TID:_____ LUN:_____
hdisk6					TID:_____ LUN:_____	TID:_____ LUN:_____
hdisk7					TID:_____ LUN:_____	TID:_____ LUN:_____
hdisk8					TID:_____ LUN:_____	TID:_____ LUN:_____
hdisk9					TID:_____ LUN:_____	TID:_____ LUN:_____

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Device File Name	Bus No.	TID	LUN	Device Type	Alternate Paths	
and so on…						

Example

Verifying new device recognition on AIX® host

```
# lsdev -C -c disk
hdisk0  Available 10-68-00-0,0 16 Bit SCSI Disk Drive
hdisk1  Available 00-01-00-2,0  Hitachi Disk Array (Fibre)
hdisk2  Available 00-01-00-2,1  Hitachi Disk Array (Fibre)
:
#
```

This example shows the following information:

- The device hdisk1 is TID=2, LUN=0 on bus 1.

- The device hdisk2 is TID=2, LUN=1 on bus 1.

- The device filename is hdisk*x*.

Configuring the new devices on an AIX® host

This section describes how to configure the new disk devices on an AIX® host.

Changing the default device parameters for AIX®

After the storage system is installed and connected and the device files have been created, the AIX® system sets the device parameters to the system default values. If necessary, you can change the read/write time-out, queue type, and queue depth parameters for each new device using the System Management Information Tool (SMIT) or the AIX® command line (see).

📄 **Note:** When you set parameters for the FX devices and SCSI disk devices, use the same settings and device parameters for all storage system devices.

📄 **Note:** If you installed the ODM update, skip this section and go to .

The following table specifies the read/write time-out and queue type requirements for the devices.

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Parameter Name	Default Value	Requirement
Read/write time-out	30	60
Queue type	none	simple

The following table lists the recommended queue depth values for the devices. You can adjust the queue depth as needed to optimize the I/O performance of the devices. For details, see .

Storage system	Recommended queue depth settings
VSP 5000 series	Target ports: ▪ 2,048 per port ▪ 32 per LDEV Bidirectional ports: ▪ 1,024 per port ▪ 32 per LDEV
VSP G1x00, VSP F1500	▪ 2,048 per port ▪ 32 per LDEV
VSP	▪ 2,048 per port ▪ 32 per LDEV
VSP E series	Target ports: ▪ 2,048 per port ▪ 32 per LDEV Universal ports: ▪ 1,024 per port ▪ 32 per LDEV
VSP G130, G/F350, G/F370, G/F700, G/F900	Target ports: ▪ 2,048 per port ▪ 32 per LDEV Universal ports: ▪ 1,024 per port ▪ 32 per LDEV

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Storage system	Recommended queue depth settings
VSP G200, G400, G600, G800, VSP F400, F600, F800	▪ 1,024 per port ▪ 32 per LDEV
HUS VM	▪ 2,048 per port ▪ 32 per LDEV

Changing device parameters from the AIX® command line

You can change the device parameters from the AIX® command line.

Procedure

1. Type the following command at the AIX® command line prompt to display the parameters for the specified device:

   ```
   lsattr -E -l hdiskx
   ```

   hdisk*x* is the device file name, for example, hdisk2. You can also use the `lscfg -vl hdiskx` command, as shown in the following example.

   ```
   #lscfg -vl hdisk1
   DEVICE            LOCATION          DESCRIPTION
   hdisk1            20-58-01          Other FC SCSI Disk Drive
   Manufacturer................HITACHI
   Machine Type and Model......OPEN-3
   ROS Level and ID............30313130
   Serial Number...............04007575
   Device Specific.(Z0)........000002026300003A
   Device Specific.(Z1)........0200 1A
   Device Specific.(Z2)........
   ```

   ▪ Device type: OPEN-3

   ▪ System and serial number (hex): 04007575

   ▪ LCU ID, LDEV ID, port ID: 02, 00, 1A

2. Type the following commands to change the device parameters:

   ```
   cfgmr
   rmdev -l hdisk$i
   chdev -l hdisk$i -a reserve_policy=no_reserve -a queue_depth=x -a
   algorithm=round_robin
   mkdev -l hdisk$i
   ```

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x is used to indicate the desired queue depth within the limits specified in Changing the default device (on page 34).

3. Repeat steps 1 and 2 for each new device.

4. Type the following command to verify that the parameters for all devices were changed:

```
lsattr -E -1 hdiskx
```

Example:

```
#lsattr -E -1 hdisk1
scsi_id        0xef
lun_id         0x0
location
ww_name        0x500490e802757500
pvid           000432871c6bbceb0000000000000000
queue_depth    32
q_type         simple
q_err          yes
clr_q          no
rw_timeout     60
start_timeout  60
reassign_to    120
```

Assigning new devices to volume groups and setting partition sizes for AIX®

After you change the device parameters, assign the new SCSI disk devices to new or existing volume groups, and then set the partition size using SMIT. If SMIT is not installed, see the *IBM® AIX® user guide* for instructions on assigning new devices to volume groups using AIX® commands.

For more details about the partition sizes, see Partition sizes for device types for AIX (on page 38).

📄 **Note:** Do not assign the FX devices (for example, 3390-3A/B/C) to volume groups. If you are configuring storage devices for databases that use a "raw" partition, do not assign those devices to volume groups.

Procedure

1. At the AIX® command line prompt, type the following command to start SMIT and open the System Management panel: `smit`

2. Select **System Storage Management (Physical & Logical Storage)**.

3. On the **System Storage Management** panel, select **Logical Volume Manager**.

4. On the **Logical Volume Manager** panel, select **Volume Groups**.

5. On the **Volume Group** panel, select **Add a Volume Group**.

6. Using the **Add a Volume Group** panel (see the following figure), assign one or more devices (physical volumes) to a new volume group and set the physical partition size:

```
              Add a Volume Group
Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                    [Entry Fields]
  VOLUME GROUP name                 [VSPvg0]
  Physical partition SIZE in megabytes   4
  PHYSICAL VOLUME names             [hdisk1]
  Activate volume group AUTOMATICALLY      yes
    at system restart
  Volume Group MAJOR NUMBER                 []
  Create VG Concurrent Capable?
  Auto-varyon in Concurrent Mode?
F1=Help          F2=Refresh        F3=Cancel          F4=List
F5=Reset         F6=Command        F7=Edit            F8=Image
F9=Shell         F10=Exit          Enter=Do
```

a. Place the cursor in **VOLUME GROUP name**. Enter the name of the new volume group (for example, **VSPvg0**). A volume group can contain multiple hdisk devices, depending on the application.

b. Place the cursor in **Physical partition SIZE in megabytes**, and press the F4 key. When the size menu appears, select the correct partition size for the devices.

c. Place the cursor in **PHYSICAL VOLUME names**. Enter the device file names for the desired devices (for example, hdisk1), or press F4 and select the device file names from the list.

d. Place the cursor in **Activate volume group AUTOMATICALLY**.

e. Type `yes` to activate the volume group automatically at system restart, or type `no` if you are using a PowerHA® or High Availability Cluster Multi-Processing (HACMP™) product.

7. Press the Enter key.

8. When the confirmation panel opens, select **Yes** to assign the specified devices to the specified volume group with the specified partition size.

9. When the **Command Status** panel opens, wait for **OK** to appear on the **Command Status** line (this response ensures that the devices have been assigned to a volume group).

10. To continue creating volume groups, press F3 until the **Add a Volume Group** panel opens.

11. Repeat steps 2 through 10 until all new disk devices are assigned to a volume group.

Partition sizes for device types for AIX®

After assigning the new SCSI disk devices to new or existing volume groups, you need to set the partition sizes. The following tables list the available partition sizes for each device type.

Partition sizes for standard LUs

Device Type	Partition Size
OPEN-V	256 (default size)
OPEN-3	4
OPEN-8	8
OPEN-9	8
OPEN-E	16
OPEN-L	64

Partition sizes for VLL LUSE devices

Device Type	LU Size (MB)	Partition Size (MB)
OPEN-*x**n VLL	35 to 1800	2
	1801 to 2300	4
	2301 to 7000	8
	7001 to 16200	16
	13201 to 32400	32
	32401 to 64800	64
	64801 to 126000	128
	126001 to 259200	256
	259201 to 518400	512
	518401 and higher	1024

Partition sizes for LUSE devices

Device Type	LUSE Configuration	Partition Size (MB)
OPEN-3	OPEN-3	4
	OPEN-3*2, OPEN-3*3	8
	OPEN-3*4 to OPEN-3*6	16
	OPEN-3*7 to OPEN-3*13	32

Device Type	LUSE Configuration	Partition Size (MB)
	OPEN-3*14 to OPEN-3*27	64
	OPEN-3*28 to OPEN-3*36	128
OPEN-8	OPEN-8	8
	OPEN-8*2	16
	OPEN-8*3, OPEN-8*4	32
	OPEN-8*5 to OPEN-8*9	64
	OPEN-8*10 to OPEN-8*18	128
	OPEN-8*19 to OPEN-8*36	256
OPEN-9	OPEN-9	8
	OPEN-9*2	16
	OPEN-9*3, OPEN-9*4	32
	OPEN-9*5 to OPEN-9*9	64
	OPEN-9*10 to OPEN-9*18	128
	OPEN-9*19 to OPEN-9*36	256
OPEN-E	OPEN-E	16
	OPEN-E*2	32
	OPEN-E*3, OPEN-E*4	64
	OPEN-E*5 to OPEN-E*9	128
	OPEN-E*10 to OPEN-E*18	256
OPEN-L	OPEN-L	64
	OPEN-L*2, OPEN-L*3	128
	OPEN-L*4 to OPEN-L*7	256

Creating, mounting, and verifying file systems on AIX®

After you have assigned SCSI disk devices to volume groups and set the partition sizes, you can create and verify the file systems for the new SCSI disk devices.

📄 **Note:** Do not create file systems or mount directories for the FX devices (for example, 3390-3A). These devices are accessed as raw devices and do not require any further configuration after being partitioned and labeled.

Creating the file systems on AIX®

Use the following procedure to create file systems for the newly installed SCSI disk devices.

Procedure

1. At the AIX® command line prompt, type the following command to start SMIT and open the **System Management** panel: `smit`

   📄 **Note:** If SMIT is not installed, see the IBM® AIX® user guide for instructions on creating file systems using AIX® commands.

2. Select **System Storage Management (Physical & Logical Storage)**.
3. On the **System Storage** panel, select **File Systems**.
4. On the **File Systems** panel, select **Add/Change/Show/Delete File Systems**.
5. On the **Add/Change** panel, select **Journaled File Systems**.
6. On the **Journaled File System** panel, select **Add a Standard Journaled File System**.
7. On the **Volume Group Name** panel, click the selected volume group, then press Enter.
8. Select the desired value, then press Enter (see the following figure).

   The **Add a Journaled File System** panel opens.

```
           Add a Journaled File System
Type or select values in entry fields.
Press Enter AFTER making all desired changes.
                                          [Entry Fields]
  Volume group name                        VSPvg0
  SIZE of file system (in 512-byte blocks) [4792320]
  MOUNT POINT                              [/VSPVG00]
  Mount AUTOMATICALLY at system restart?    yes
  PERMISSIONS                               read/write
  Mount OPTIONS                             []
  Start Disk Accounting?                    no
  Fragment Size (bytes)                     4096
  Number of bytes per inode                 4096
  Compression algorithm                     no
  Allocation Group Size (Mbytes)
F1=Help           F2=Refresh        F3=Cancel          F4=List
F5=Reset          F6=Command        F7=Edit            F8=Image
F9=Shell          F10=Exit          Enter=Do
```

9. In **SIZE of file system**, enter the desired file system size (see Journaled file system size for AIX (on page 42)).
10. In **Mount Point**, enter the desired mount point name (for example, `/VSP_VG00`). Record the mount point name and file system size for use later in the configuration process.
11. In **Mount AUTOMATICALLY**, type `yes` to auto-mount the file systems.

    📄 **Note:** If you are using a PowerHA® or HACMP™ product, do not set the file systems to auto-mount.

12. In **Number of bytes per inode**, enter the correct value for the selected device (see [Number of bytes per inode for AIX (on page 43)](#)).

13. Be sure that the file system size, mount point name, auto-mount options, and number of bytes per inode are correct. Press Enter to create the Journaled File System.

14. On the **Command Status** panel, to be sure the Journaled File System has been created, wait for **OK** to be displayed on the **Command Status** line.

```
                            COMMAND STATUS
Command : OK          stdout : yes            stderr : no


    Before command completion, additional instructions may appear below.


Based on the parameters chosen, the new /VSP_VG00 JFS file system
is limited to a maximum size of 134217728 (512 byte blocks)
New Filesystems size is 4792320                  □ 4792320 is displayed for
OPEN-3.


F1=Help            F2=Refresh            F3=Cancel            F6=Command
F8=Image           F9=Shell             F10=Exit             /=Find
```

15. Repeat steps 2 through 14 for each Journaled File System that you want to create. To continue creating Journaled File Systems press the F3 key until you return to the **Add a Journaled File System** panel.

16. To exit SMIT, press F10.

Journaled file system size for AIX®

Use the following table to set the journaled file system size.

Device Type	LU Product Name	Capacity (in 512-Byte Blocks)	Maximum File System Size (see Note 1) (in 512-Byte Blocks)
Standard LU	OPEN-3	4806720	4792320
	OPEN-8	14351040	14319616
	OPEN-9	14423040	14401536
	OPEN-E	28452960	28409856
	OPEN-L	71192160	71041024
	OPEN-V	Max.125827200	Max.125566976
	OPEN-x*n	See the device specifications table in [Logical device types (on page 14)](#)	(see Note 2)

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Device Type	LU Product Name	Capacity (in 512-Byte Blocks)	Maximum File System Size (see Note 1) (in 512-Byte Blocks)
LUSE Device	OPEN-*x**n VLL	See the device specifications table in Logical device types (on page 14)	(see Note 2)
VLL LUSE Device	OPEN-*x**n VLL	See the device specifications table in Logical device types (on page 14)	(see Note 2)

Note 1: When determining SIZE of file system at Add a Journaled File System, AIX® already uses an unspecified amount of disk space. You must determine the remaining space available for physical partitions.

Note 2: Calculate the maximum file system size for these devices as follows:

1. Display the number of free physical partitions (FREE PPs) and physical partition size (PP SIZE) by entering the `lsvg` command, for example:

```
# lsvg VSPvg0
VOLUMEGROUP:   VSPvg0              VG IDENTIFIER:   0083665612e98521
VG STATE:      active              PP SIZE:         64 megabyte(s)
VG PERMISSION: read/write          TOTAL PPs:       733 (46912 megabytes)
MAX LVs:       256                 FREE PPs:        733 (46912 megabytes)
LVs:           0                   USED PPS:        0 (0 megabytes)
OPEN LVs:      0                   QUORUM:          2
TOTAL PVs:     1                   VG DESCRIPTORS:  2
STALE PVs;     0                   STALE PPs        0
ACTIVE PVs     1                   AUTO ON:         yes
Concurrent:    Non-Capable         Auto-Concurrent: Disabled
VG Mode:       Non-Concurrent
```

2. Use the following formula to calculate the maximum file system size:

```
maximum file system size = (FREE PPs – 1) × (PP SIZE) × 2048
```

   For the example shown above: maximum file system size = (733 – 1) × (64) × 2048 = 95944704

Number of bytes per inode for AIX®

The following table specifies the number of bytes per inode for LUSE devices.

Device type	LU product name	Number of bytes per inode
OPEN-3	OPEN-3 OPEN-3*2 to OPEN-3*28	4096
	OPEN-3*29 to OPEN-3*36	8192
OPEN-8	OPEN-8 OPEN-8*2 to OPEN-8*9	4096
	OPEN-8*10 to OPEN-8*18	8192
	OPEN-8*19 to OPEN-8*36	16384
OPEN-9	OPEN-9 OPEN-9*2 to OPEN-9*9	4096
	OPEN-9*10 to OPEN-9*18	8192
	OPEN-9*19 to OPEN-9*36	16384
OPEN-E	OPEN-E OPEN-E*2 to OPEN-E*4	4096
	OPEN-E*5 to OPEN-E*9	8192
	OPEN-E*10 to OPEN-E*18	16384
OPEN-L	OPEN-L	4096
	OPEN-L*2 to OPEN-L*3	8192
	OPEN-L*4 to OPEN-L*7	16384

The following table specifies the number of bytes per inode for VLL devices.

Device type	LU product name	Number of bytes per inode
OPEN-*x* VLL	OPEN-3 VLL, OPEN-8 VLL, OPEN-9 VLL, OPEN-E VLL, OPEN-V VLL	4096
OPEN-V	OPEN-V	4096

The following table specifies the number of bytes per inode for VLL LUSE devices.

Device type	LU size in megabytes	Number of bytes per inode
OPEN-*x**n VLL	35-64800	4096
	64801-126000	8192
	126001 and higher	16384

Mounting and verifying file systems on AIX®

After you have created the Journaled File Systems, you need to mount the file systems and verify that the file systems were created correctly and are functioning properly.

Procedure

1. At the AIX® command line prompt, type the following command:

   ```
   mount <mount_point_name>
   ```

   For example:

   ```
   mount/VSP_VG00
   ```

2. Repeat step 1 for each new file system.
3. Use the **df** command to verify the size of the file systems you created.

   > **Note:** The file system capacity is listed in 512-byte blocks by default. To list capacity in 1024-byte blocks, use the **df -k** command.

4. Verify that the new devices and file systems are fully operational by performing some basic operations (for example, file creation, copying, deletion) on each device .

   Example:

   ```
   # cd /VSPVG00
   # cp /smit.log /VSPVG00/smit.log.back1
   # ls -l VSPVG00
   -rw-rw-rw-   1   root   system      375982 Nov 30 17:25 smit.log.back1
   # cp smit.log.back1 smit.log.back2
   # ls -l
   -rw-rw-rw-   1   root   system      375982 Nov 30 17:25 smit.log.back1
   -rw-rw-rw-   1   root   system      375982 Nov 30 17:28 smit.log.back2
   # rm smit.log.back1
   # rm smit.log.back2
   ```

5. Restart the system and verify that the file systems have successfully auto-mounted by using the **mount** or **df** command to display all mounted file systems. Any file systems that were not auto-mounted can be set to auto-mount using SMIT.

📄 **Note:** If you are using a PowerHA® or HACMP™ product, do not set the file
systems to auto-mount.

Example:

```
# df
File system  512-blocks       free  %Used  Iused  %Iused  Mounted on
/dev/hd4           8192       3176    61%    652     31%  /
/dev/hd2        1024000     551448    46%   6997      5%  /usr
/dev/hd9var        8192       5512    32%     66      6%  /var
/dev/hd3          24576      11608    52%     38      0%  /tmp
/dev/hd1           8192       7840     4%     17      1%  /home
/dev/lv00       4792320    4602128     4%     16      1%  /VSPVG00
/dev/lv01       4792320    4602128     4%     16      1%  /VSPVG01
/dev/lv02      14401536   13949392     4%     16      1%  /VSPVG02
```

Using the Object Data Manager with Hitachi RAID storage for AIX®

This section describes the IBM® AIX® Object Data Manager (ODM) and its relationship with
the storage system.

Overview of ODM for AIX®

The ODM is a repository of system information that includes the basic components of object
classes and characteristics. Information is stored and maintained as objects with associated
characteristics.

System data managed by ODM includes:

- Device configuration information

- Display information for SMIT (menus, selectors, and dialogs)

- Vital product data for installation and update procedures

- Communications configuration information

- System resource information

IBM® provides a predefined set of devices (PdDv) and attributes (PdAt). Hitachi Vantara has
added its own device definitions to the ODM, based on classes defined as objects with
associated characteristics. This allows you to add devices that are recognized when the
system boots or when the configuration manager command (`cfgmgr`) is executed. These
devices have their own set of predefined attributes, which allows you to customize device
definitions easily and automatically, thereby minimizing the amount of work required to define
a device.

IBM® also provides a set of commands to manipulate the ODM and procedures to package ODM updates. For details, see the following references:

- *Device Configuration Database*
  - https://www.ibm.com/support/knowledgecenter/ssw_aix_72/kernelextension/device_config_db_over.html

- *Device Configuration System*
  - https://www.ibm.com/support/knowledgecenter/ssw_aix_72/kernelextension/device_config_subsys.html

- *List of ODM commands and subroutines*
  - https://www.ibm.com/support/knowledgecenter/ssw_aix_72/generalprogramming/odm_cmds_subrs.html

- *IBM Redbook*
  - Certification Study Guide–pSeries®– AIX® System Support, http://www.redbooks.ibm.com/abstracts/sg246199.html?Open

ODM advantages and cautions for AIX®

Advantages

The ODM updates enable the AIX® system to recognize Hitachi disk devices and set the proper attributes. If the attributes for queue type, queue depth, and read/write timeout are not the same for all Hitachi devices, disk errors can be logged both on the storage system and in the AIX® error log.

If the ODM update is installed and a device is discovered, a match will be found in the ODM, and the attributes will be set to the default values recommended by the manufacturer. For disk devices, the default queue depth is 2 (with a range of 1-32) and the default read/write timeout value is 60. If the ODM update is not installed, a system administrator will be required to run a `chdev` (change device) command for every device on the system to change the default attributes.

For details about AIX® ODM for storage, see Hitachi Vantara Support Connect: https://knowledge.hitachivantara.com/Support_Information/Data_Collection/Servers/AIX_ODM_Updates

Cautions

Since the ODM update changes attributes, you might experience problems if you share ports on the storage system with multiple AIX® servers at different ODM update levels (for example, one AIX® host at 5.4.0.0 and one AIX® host at 5.4.0.4). For details about restrictions when sharing ports, contact your Hitachi Vantara representative.

Using ODM for AIX®

This section describes how to use ODM with Hitachi storage.

Chapter 3: AIX® configuration and attachment

AIX® new device discovery

When the system boots and a new device is discovered, the system checks the ODM for a device definition that matches the new device. For a disk device, this is based on the SCSI inquiry command. If a match is found, then a customized definition (`CuDv` and `CuAt`) is built for that device using the default attributes for that device definition. The new device then has the description based in the ODM for that device (for example, 2105 or LVD SCSI disk drive). This customized definition is persistent and will remain until the device is removed from the system. An active device will have an *available* status and is ready for use. A device that was available, but has been physically removed from the system will have a *defined* status and cannot be used.

Device deletion on AIX®

A device's definition remains until it is removed using the `rmdev` command. Some device attributes (such as physical volume identifier, SCSI ID, or Target ID) are unique to a device and remain until the device is removed using the `rmdev` command. A device definition remains in the ODM when an attribute (for example, the WWN) changes. The definitions in the ODM are persistent and remain until a system administrator removes them.

Queue depth and read/write timeout values for AIX®

The default IBM® read/write timeout and queue depth values are different from the recommended and required values for Hitachi disk devices:

- The required value for read/write timeout is 60.

- The default value for the drive queue depth is determined by the adapter family.

> **Note:** If the AIX® host defines a device as *Other FC SCSI Disk Drive*, the queue depth setting for that device is ignored, which can have a negative impact on performance.

The following table lists the recommended queue depth values for the devices. You can adjust the queue depth as needed to optimize the I/O performance of the devices. For details, see Host queue depth (on page 18).

Storage system	Recommended queue depth settings
VSP 5000 series	Target ports: - 2,048 per port - 32 per LDEV Bidirectional ports: - 1,024 per port - 32 per LDEV

Storage system	Recommended queue depth settings
VSP G1x00, VSP F1500	▪ 2,048 per port ▪ 32 per LDEV
VSP	▪ 2,048 per port ▪ 32 per LDEV
VSP E series	Target ports: ▪ 2,048 per port ▪ 32 per LDEV Universal ports: ▪ 1,024 per port ▪ 32 per LDEV
VSP G130, G/F350, G/F370, G/F700, G/F900	Target ports: ▪ 2,048 per port ▪ 32 per LDEV Universal ports: ▪ 1,024 per port ▪ 32 per LDEV
VSP G200, G400, G600, G800, VSP F400, F600, F800	▪ 1,024 per port ▪ 32 per LDEV
HUS VM	▪ 2,048 per port ▪ 32 per LDEV

Installing online devices on AIX®

After the initial installation and configuration of the storage system, you can install or uninstall additional devices online without having to restart the AIX® system. After online installation, the device parameters for new volumes must be changed to match the LUs defined under the same Fibre Channel port (see Changing the default device parameters for AIX (on page 34)).

📄 **Note:** For additional instructions about online installation and reinstallation of LUs, see the *Maintenance Manual* for the storage system.

Before you begin

This procedure should be performed by the system administrator (that is, super-user).

Chapter 3: AIX® configuration and attachment

Procedure

1. Log on to the AIX® system as root.

2. At the AIX® command line prompt, type the following command to start SMIT and open the **System Management** panel: `smit`

   > 📄 **Note:** If SMIT is not installed, see the IBM® AIX® user guide for instructions on assigning new devices to volume groups using AIX® commands.

3. Select **Devices**.

4. On the **Devices** panel, select **Install/Configure Devices Added After IPL**.

5. On the **Install/Configure Devices Added After IPL** panel, select **INPUT device/ directory** for software, then press Enter. The AIX® system scans the buses for new devices.

6. To verify that the new device is installed, type the following command:

   `lsdev -C -c disk`

   > 📄 **Note:**
   >
   > See <u>Verifying new device recognition (on page 32)</u> for complete instructions. Record the device file names for the new devices.

Next steps

Configure the new devices for AIX® operations as described in <u>Configuring the new devices (on page 34)</u> and <u>Using the Object Data Manager with Hitachi RAID storage for AIX (on page 46)</u>.

Online LUSE configuration for AIX®

Online LUSE is LU Expansion that is performed after mounting (2GB => 5GB). Before you begin, verify that the size of corresponding LUN in the storage system can be expanded online.

> 📄 **Note:**
>
> - There is no unmount during this process.
> - Online LUSE is available for AIX® 5.2 and later.

Creating and mounting the file systems on AIX®

Procedure

1. Type the following command to unmount all file systems in the affected volume group:

   `#umount /mnt/h00`

2. Type the following command to vary off the volume group:

   `#varyoff vg_fc00`

3. Expand the size of LU from the storage system.

4. Vary on the volume group:

```
#varyonvg vg_fc00
0516-1434 varyonvg: Following physical volumes appear to be grown in size
Run chvg command to activate the new space.
hdisk1
```

5. Change the volume group:

```
#chvg  -g vg_fc00
0516-1224 chvg: WARNING, once this operation is completed, volume group vg_fc00
cannot be imported into AIX 510 or lower versions. Continue (y/n) ?

y
0516-1164 chvg: Volume group vg_fc04 changed. With given characteristics vg_fc00
can include up to 16 physical volumes with 2032 physical partitions each.
```

6. Type the following command to mount all file systems unmounted in step 1:
#mount /mnt/h00

7. Type the **df-k** command as follows:

```
# df -k
/dev/lv00         2097152   2031276   4%       17    1% /mnt/h00
```

8. Type the **lsvg vg_fc00** command:

```
# lsvg vg_fc00
VOLUME GROUP:   vg_fc00              VG IDENTIFIER:
0007d6dc00004c00000000f3305f5d36
VG STATE:       active               PP SIZE:        128 megabyte(s)
VG PERMISSION:  read/write           TOTAL PPs:      543 (69504 megabytes)
MAX LVs:        256                  FREE PPs:       526 (67328 megabytes)
LVs:            2                    USED PPs:       17 (2176 megabytes)
OPEN LVs:       2                    QUORUM:         2
TOTAL PVs:      1                    VG DESCRIPTORS: 2
STALE PVs:      0                    STALE PPs:      0
ACTIVE PVs:     1                    AUTO ON:        yes
MAX PPs per PV: 1016                 MAX PVs:        32
LTG size:       128 kilobyte(s)      AUTO SYNC:      no
HOT SPARE:      no                   BB POLICY:      relocatable
```

9. Type the **lslv lv00** command:

```
# lslv lv00
LOGICAL VOLUME:    lv00                  VOLUME GROUP:   vg_fc00
LV IDENTIFIER:     0007d6dc00004c00000000f3305f5d36.2 PERMISSION:    read/write
VG STATE:          active/complete       LV STATE:       opened/syncd
TYPE:              jfs                   WRITE VERIFY:   off
MAX LPs:           512                   PP SIZE:        128 megabyte(s)
COPIES:            1                     SCHED POLICY:   parallel
LPs:               16                    PPs:            16
```

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```
STALE PPs:         0                  BB POLICY:      relocatable
INTER-POLICY:      minimum            RELOCATABLE:    yes
INTRA-POLICY:      middle             UPPER BOUND:    32
MOUNT POINT:       /mnt/h00           LABEL:          /mnt/h00
```

Expanding the logical volume for AIX®

Procedure

1. Type the **extendlv lv00 400** command:

```
# extendlv lv00 400

# lsvg vg_fc00
VOLUME GROUP:   vg_fc00            VG IDENTIFIER:
0007d6dc00004c00000000f3305f5d36
VG STATE:       active             PP SIZE:        128 megabyte(s)
VG PERMISSION:  read/write         TOTAL PPs:      543 (69504 megabytes)
MAX LVs:        256                FREE PPs:       126 (16128 megabytes)
LVs:            2                  USED PPs:       417 (53376 megabytes)
OPEN LVs:       2                  QUORUM:         2
TOTAL PVs:      1                  VG DESCRIPTORS: 2
STALE PVs:      0                  STALE PPs:      0
ACTIVE PVs:     1                  AUTO ON:        yes
MAX PPs per PV: 1016               MAX PVs:        32
LTG size:       128 kilobyte(s)    AUTO SYNC:      no
HOT SPARE:      no                 BB POLICY:      relocatable
```

2. Type the **lslv lv00** command:

```
# lslv lv00
LOGICAL VOLUME:     lv00                   VOLUME GROUP:    vg_fc00
LV IDENTIFIER:      0007d6dc00004c00000000f3305f5d36.2 PERMISSION:    read/write
VG STATE:           active/complete        LV STATE:        opened/syncd
TYPE:               jfs                    WRITE VERIFY:    off
MAX LPs:            512                    PP SIZE:         128 megabyte(s)
COPIES:             1                      SCHED POLICY:    parallel
LPs:                416                    PPs:             416
STALE PPs:          0                      BB POLICY:       relocatable
INTER-POLICY:       minimum                RELOCATABLE:     yes
INTRA-POLICY:       middle                 UPPER BOUND:     32
MOUNT POINT:        /mnt/h00               LABEL:           /mnt/h00
MIRROR WRITE CONSISTENCY: on/ACTIVE
EACH LP COPY ON A SEPARATE PV ?: yes
Serialize IO ?:     NO
```

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Next steps

📄 **Note:**

- To determine the parameters for LUSE expansion, see <u>Partition sizes for device types for AIX (on page 38)</u> and <u>Number of bytes per inode for AIX (on page 43)</u>.

- To correspond to the capacity per emulation type, physical partitions such as PPs, LPs, and inodes will need to be adjusted. They cannot be set with the OS default value.

- The number of bytes per inode cannot be changed with online LUSE.

Expanding the file system (up to 3 GB) for AIX®

Procedure

1. Type the **chfs** command to change the size of the file system to 10485760:

```
# chfs -a size=+3G /mnt/h00
```

2. Type the **df-k** command:

```
# df -k
Filesystem      1024-blocks       Free %Used     Iused %Iused Mounted on
/dev/hd4             32768      18496   44%      1474     9% /
/dev/hd2            851968      33396   97%     24029    12% /usr
/dev/hd9var          32768       4712   86%       436     6% /var
/dev/hd3             32768      31620    4%        47     1% /tmp
/dev/hd1             32768      29936    9%        97     2% /home
/proc                    -          -    -         -     -  /proc
/dev/hd10opt         32768      24108   27%       395     5% /opt
/dev/lv00          5242880    5078268    4%        17     1% /mnt/h00
```

Increasing the file system (up to 40 GB) for AIX®

Procedure

1. Type the **chfs** command to change the file system size to 31457280:

```
# chfs -a size=+10G /mnt/h00
```

2. Type the **df-k** command:

```
# df -k
Filesystem      1024-blocks       Free %Used     Iused %Iused Mounted on
/dev/hd4             32768      18496   44%      1474     9% /
/dev/hd2            851968      33396   97%     24029    12% /usr
/dev/hd9var          32768       4584   87%       436     6% /var
/dev/hd3             32768      31620    4%        47     1% /tmp
/dev/hd1             32768      29936    9%        97     2% /home
```

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```
/proc                    -        -     -        -    -  /proc
/dev/hd10opt        32768    24108   27%      395   5%  /opt
/dev/lv00         15728640 15234908   4%       17   1%  /mnt/h00
```

3. Type the `lsvg vg_fc00` command:

```
# lsvg vg_fc00
VOLUME GROUP:   vg_fc00                 VG IDENTIFIER:
0007d6dc00004c00000000f3305f5d36
VG STATE:       active                  PP SIZE:        128 megabyte(s)
VG PERMISSION:  read/write              TOTAL PPs:      543 (69504 megabytes)
MAX LVs:        256                     FREE PPs:       126 (16128 megabytes)
LVs:            2                       USED PPs:       417 (53376 megabytes)
OPEN LVs:       2                       QUORUM:         2
TOTAL PVs:      1                       VG DESCRIPTORS: 2
STALE PVs:      0                       STALE PPs:      0
ACTIVE PVs:     1                       AUTO ON:        yes
MAX PPs per PV: 1016                    MAX PVs:        32
LTG size:       128 kilobyte(s)         AUTO SYNC:      no
HOT SPARE:      no                      BB POLICY:      relocatable
```

4. Type the `chfs` command to change the size of the file system to 94371840:

```
# chfs -a size=+30G /mnt/h00
```

5. Type the `lsvg vg_fc00` command:

```
# lsvg vg_fc00
VOLUME GROUP:   vg_fc00                 VG IDENTIFIER:
0007d6dc00004c00000000f3305f5d36
VG STATE:       active                  PP SIZE:        128 megabyte(s)
VG PERMISSION:  read/write              TOTAL PPs:      543 (69504 megabytes)
MAX LVs:        256                     FREE PPs:       126 (16128 megabytes)
LVs:            2                       USED PPs:       417 (53376 megabytes)
OPEN LVs:       2                       QUORUM:         2
TOTAL PVs:      1                       VG DESCRIPTORS: 2
STALE PVs:      0                       STALE PPs:      0
ACTIVE PVs:     1                       AUTO ON:        yes
MAX PPs per PV: 1016                    MAX PVs:        32
LTG size:       128 kilobyte(s)         AUTO SYNC:      no
HOT SPARE:      no                      BB POLICY:      relocatable
#
```

6. Type the `lslv lv00` command:

```
# lslv lv00
LOGICAL VOLUME:     lv00                    VOLUME GROUP:   vg_fc00
LV IDENTIFIER:      0007d6dc00004c00000000f3305f5d36.2 PERMISSION:    read/write
VG STATE:           active/complete         LV STATE:       opened/syncd
TYPE:               jfs                     WRITE VERIFY:   off
MAX LPs:            512                     PP SIZE:        128 megabyte(s)
```

```
COPIES:                 1                SCHED POLICY:    parallel
LPs:                    416              PPs:             416
STALE PPs:              0                BB POLICY:       relocatable
INTER-POLICY:           minimum          RELOCATABLE:     yes
INTRA-POLICY:           middle           UPPER BOUND:     32
MOUNT POINT:            /mnt/h00         LABEL:           /mnt/h00
MIRROR WRITE CONSISTENCY: on/ACTIVE
EACH LP COPY ON A SEPARATE PV ?: yes
Serialize IO ?:        NO
```

7. Type the **df-k** command to increase the volume size to 47 GB and fully expand the file system size:

```
# df -k
Filesystem     1024-blocks     Free %Used    Iused %Iused Mounted on
/dev/hd4             32768    18496   44%     1474     9% /
/dev/hd2            851968    33396   97%    24029    12% /usr
/dev/hd9var          32768     4584   87%      436     6% /var
/dev/hd3             32768    31620    4%       47     1% /tmp
/dev/hd1             32768    29936    9%       97     2% /home
/proc                    -        -    -        -      - /proc
/dev/hd10opt         32768    24108   27%      395     5% /opt
/dev/lv00         47185920 45704828    4%       17     1% /mnt/h00
```

Troubleshooting for AIX® host attachment

The following table lists potential error conditions that might occur during storage system installation on an AIX® host and provides instructions for resolving the conditions. If you cannot resolve an error condition, contact customer support.

Error Condition	Recommended Action
The logical devices are not recognized by the system.	Make sure that the READY indicator lights on the storage system are ON.
	Run **cfgmgr** to recheck the Fibre Channel for new devices.
	Make sure that LUSE devices are not intermixed with normal LUs or with FX devices on the same Fibre Channel port.
	Verify that LUNs are configured properly for each TID.
The file system is not mounted after rebooting.	Make sure that the system was restarted properly.
	Verify that the values listed under Journaled File System are correct.

Error Condition	Recommended Action
If a new path is added while an existing path is in I/O processing in alternate path configuration, the status of the added path becomes offline.	Run an online operation on the offline path with the Alternate Path software. For details, see the user documentation for the Alternate Path software.

Chapter 4: HP-UX configuration and attachment

This chapter describes how to configure and manage the new disk devices on an HP-UX host. Configuration of the devices should be performed by the HP-UX system administrator. Configuration requires superuser/root access to the host system. If you have questions or concerns, contact your Hitachi Vantara representative.

Storage system configuration for HP-UX operations

The storage system must be fully configured before being attached to the HP-UX host, as described in Configuring the storage system (on page 24).

- Devices types:

  The following devices types are supported for HP-UX operations. For details, see Logical device types (on page 14).

  - OPEN-V
  - OPEN-3/8/9/E/L
  - LUSE (OPEN-*x**n)
  - VLL (OPEN-*x* VLL)
  - VLL LUSE (OPEN-*x**n VLL)
  - Cross-OS File Exchange (FX) (3390-3A/B/C, OPEN-*x* FX oto)

- Host mode:

  The required host mode for HP-UX is 03. Do not select a host mode other than 03 for HP-UX. For a complete list of host modes for the storage system, see Host modes and host mode options (on page 205). For instructions on setting the host modes, see the *Provisioning Guide* for the storage system.

- Host mode options:

  You may also need to set host mode options (HMOs) to meet your operational requirements. For a complete list of HMOs for the storage system, see Host modes and host mode options (on page 205). For instructions on setting the HMOs, see the *Provisioning Guide* for the storage system.

Configuring new devices on HP-UX

Configuration of the new devices requires superuser/root access to the HP-UX host system and should be performed by the HP-UX system administrator. If you have questions or concerns, please contact your Hitachi Vantara representative.

> ❗ **Important:** On HP-UX 11iv3 and later, LUN 0 must be defined as the Command Console LUN (CCL), or pass-through LUN, for the remaining disk devices to be recognized. Do not unmap LUN 0.

Verifying new device recognition for HP-UX

The first step in configuring the new disk devices is to verify that the host system recognizes the new devices. The host system automatically creates a device file for each new device recognized.

The devices should be installed and formatted with the ports configured before the host system is powered on. Type the `cfgmgr` command to force the system to check the buses for new devices.

Procedure

1. Log in to the HP-UX system as root.
2. Use the `ioscan -f` command to display the device data. Verify that the system recognizes the newly installed devices (see the following figure). If desired, use the `-C disk` command option (`ioscan -fnC disk`) to limit the output to disk devices only.

```
# ioscan -fn
Class      I   H/W Path     Driver        S/W State H/W Type   Description
=======================================================================
bc         0                root          CLAIMED    BUS_NEXUS
bc         1   8            bc            CLAIMED    BUS_NEXUS Bus Converter
fc         0   8/12                fcT1   CLAIMED INTERFACE HP Fibre Channel
Mass Storage
fcp        0   8/12.8             fcp    CLAIMED INTERFACE FCP Protocol Adapter
ext_bus    2   8/12.8.0.255.0     fcpdev CLAIMED INTERFACE FCP Device Interface
target     7   8/12.8.0.255.0.6   tgt    CLAIMED DEVICE
disk       3   8/12.8.8.255.0.6.0  sdisk  CLAIMED DEVICE      HITACHI OPEN-9
                          /dev/dsk/c2t6d0   /dev/rdsk/c2t6d0
disk       4   8/12.8.8.255.0.6.1  sdisk  CLAIMED DEVICE      HITACHI OPEN-9
                          /dev/dsk/c2t6d1   /dev/rdsk/c2t6d1
disk       5   8/12.8.8.255.0.8.0  sdisk  CLAIMED DEVICE      HITACHI 3390*3B
                          /dev/dsk/c2t8d0   /dev/rdsk/c2t8d0
:
#
```

This sample screen shows the following new devices recognized:

- HITACHI OPEN-9 device: bus no. = 8/12, bus instance = 2, target ID = 6, LUN = 0, driver = sdisk

- HITACHI OPEN-9 device: bus no. = 8/12, bus instance = 2, target ID = 6, LUN = 1, driver = sdisk

- HITACHI 3390-3B device: bus no. = 8/12, bus instance = 2, target ID = 8, LUN = 0, driver = sdisk

> **Note:**
> - If *UNKNOWN* appears as the Class type, the HP-UX system may not be configured properly. Refer to the HPE documentation or contact HPE technical support.
>
> - If information for unused devices remains in the system, get the system administrator's permission to renew the device information. To renew the device information, delete the `/etc/ioconfig` and `/stand/ioconfig` files (`rm` command), reboot the server, and then issue the `ioinit -c` command. Now issue the `ioscan -f` command to recognize the logical devices again.

3. Make a blank table for recording the device data (see the sample table below). The table must have nine columns for the following data: bus number, bus instance number, disk number, H/W path, driver, device type, target ID, LUN, and device file name. You will need three more columns for entering the major and minor numbers later.

Bus No.	Instance (XX)	Disk No.	H/W Path	Driver	Device Type	TID (Y)	LUN (Z)	Device File	Major # for Char. Files	Major # for Block Files	Minor # 0xXX Y Z 00
8/12	02	3	8/12.8.8.255.0.6.0	sdisk	OPEN-9	6	0	c2t6d0			
8/12	02	4	8/12.8.8.255.0.6.1	sdisk	OPEN-9	6	1	c2t6d1			
8/12	02	5	8/12.8.8.255.0.8.0	sdisk	3390-3B	8	0	c2t8d0			

4. Enter the device data for each device (disk devices and raw/FX devices) in your table including the device file name. The device file name has the following structure:

File name = cXtYdZ

where

- X = bus instance #
- Y = target ID
- Z = LUN

The "c" stands for controller, the "t" stands for target ID, and the "d" stands for device. The SCSI target IDs are hexadecimal (0 through F) and the LUN is decimal (0 through 7).

> **Important:** On HP-UX 11iv3 and later updates, LUN 0 must be defined as the command console LUN (CCL) for the remaining disks to be recognized.

5. Verify that the SCSI TIDs correspond to the assigned port address for all connected ports (SCSI TID Maps for FC adapters (on page 178)). If so, the logical devices are recognized properly. If not:

    a. Check the AL-PA for each port using the LUN Manager software. If the same port address is set for multiple ports on the same loop (AL with HUB), all port addresses except one changed to another value, and the relationship between AL-PA and TID does not correspond to the mapping in SCSI TID Maps for FC adapters. Set a different address for each port, reboot the server, and then verify new device recognition again.

    b. If unused device information remains, the TID-to-AL-PA mapping will not correspond to the mapping in SCSI TID Maps for FC adapters. Renew the device information (see step 2 for instructions) and then verify new device recognition again.

Verifying device files and the driver for HP-UX

The device files for all new devices (SCSI disk and raw/FX) should be created automatically during system startup. Each device should have a block-type device file in the `/dev/dsk` directory and a character-type device file in the `/dev/rdsk` directory. The SCSI disk devices must have both device files. Raw/FX devices only require the character-type device file.

> 📄 **Note:** Some HP-compatible systems do not create the device files automatically. If the device files were not created automatically, follow the instructions in Creating device files manually on HP-UX (on page 62) to create the device files manually.

Procedure

1. Display the block-type device files in the `/dev/dsk` directory using the `ll` command (equivalent to `ls -l`) with the output piped to more. Verify that there is one block-type device file for each device.

```
# ll /dev/dsk | more
total 0
brw-r-----   1 bin    sys     28 0x000000 Oct   4 11:01 c0t0d0
brw-r-----   1 bin    sys     28 0x006000 Dec   6 15:08 c0t6d0
brw-r-----   1 bin    sys     28 0x006100 Dec   6 15:08 c0t6d1
```

2. Use your completed device data table to verify that the block-type device file name for each device is correct.

Bus No.	Instance (XX)	Disk No.	H/W Path	Driver	Device Type	TID (Y)	LUN (Z)	Device File	Major # for Char. Files	Major # for Block Files	Minor # 0xXX Y Z 00
8/12	02	3	8/12.8.8.255.0.6.0	sdisk	OPEN-9	6	0	c2t6d0	188	31	0x026000
8/12	02	4	8/12.8.8.255.0.6.1	sdisk	OPEN-9	6	1	c2t6d1	188	31	0x026100

Bus No.	Instance (XX)	Disk No.	H/W Path	Driver	Device Type	TID (Y)	LUN (Z)	Device File	Major # for Char. Files	Major # for Block Files	Minor # 0xXX Y Z 00
8/12	02	5	8/12.8.8.255.0.8.0	sdisk	3390-3B	8	0	c2t8d0	188	31	0x026800

3. Display the character-type device files in the `/dev/rdsk` directory using the **ll** command with the output piped to more. Verify that there is one character-type device file for each new device.

```
# ll /dev/rdsk | more
total 0
crw-r-----  1 bin   sys   177 0x000000 Oct  4 11:01 c0t0d0
crw-r-----  1 bin   sys   177 0x006000 Dec  6 15:08 c0t6d0
crw-r-----  1 bin   sys   177 0x006100 Dec  6 15:08 c0t6d1
```

4. Use your completed device data table to verify that the character-type device file name for each device is correct.

5. After verifying the block-type and character-type device files, verify the HP-UX driver for the storage system using the **ioscan -fn** command.

```
# ioscan -fn
Class      I   H/W Path          Driver S/W State H/W Type  Description
=======================================================================
bc         0                         root   CLAIMED   BUS_NEXUS
bc         1   8                     bc     CLAIMED    BUS_NEXUS Bus Converter
fc         0   8/12                  fcT1   CLAIMED INTERFACE HP Fibre Channel
Mass Storage
fcp        0   8/12.8                fcp    CLAIMED INTERFACE FCP Protocol Adapter
ext_bus    2   8/12.8.0.255.0        fcpdev CLAIMED INTERFACE FCP Device Interface
target     7   8/12.8.0.255.0.6      tgt    CLAIMED DEVICE
disk       3   8/12.8.8.255.0.6.0  sdisk  CLAIMED DEVICE    HITACHI OPEN-9
                     /dev/dsk/c2t6d0    /dev/rdsk/c2t6d0
disk       4   8/12.8.8.255.0.6.1  sdisk  CLAIMED DEVICE    HITACHI OPEN-9
                     /dev/dsk/c2t6d1    /dev/rdsk/c2t6d1
disk       5   8/12.8.8.255.0.8.0  sdisk  CLAIMED DEVICE    HITACHI 3390*3B
                     /dev/dsk/c2t8d0   /dev/rdsk/c2t8d0
:
#
```

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Creating device files manually on HP-UX

If the device files were not created automatically when the HP-UX system was restarted, issue the `insf -e` command in the `/dev` directory to instruct the HP-UX system to create the device files. After executing this command, repeat the procedure in Verifying new device recognition for HP-UX (on page 58) to verify new device recognition and the device files and driver.

```
# cd /dev
# insf -e
insf: Installing special files for mux2 instance 0 address 8/0/0
          :          :          :          :
          :          :          :          :
#
```

If the device files for the new devices cannot be created automatically, use the following procedure to create the device files manually.

Procedure

1. Obtain your Device Data table on which you recorded the data for the new devices. You should have the following information for all new devices:

   - Bus number

   - Bus instance number

   - Disk number

   - Driver

   - Device type

   - Target ID

   - LUN

Bus No.	Instance (XX)	Disk No.	H/W Path	Driver	Device Type	TID (Y)	LUN (Z)	Device File	Major # for Char. Files	Major # for Block Files	Minor # 0xXX Y Z 00
8/12	02	3	8/12.8.8.255.0.6.0	sdisk	OPEN-9	6	0	c2t6d0	188	31	0x026000
8/12	02	4	8/12.8.8.255.0.6.1	sdisk	OPEN-9	6	1	c2t6d1	188	31	0x026100
8/12	02	5	8/12.8.8.255.0.8.0	sdisk	3390-3B	8	0	c2t8d0	188	31	0x026800

2. Build the device file name for each device, and enter the device file names into your table. Example:

   File name = `cXtYdZ`, where *X* = bus instance #, *Y* = target ID, *Z* = LUN.

3. Build the minor number for each device, and enter the minor numbers into your table. Example:

   $0xXXYZ00$, where *XX* = bus instance #, *Y* = SCSI target ID, and *Z* = LUN.

4. Display the driver information for the system using the **lsdev** command.

```
# lsdev
  Character      Block      Driver      Class
     :             :           :           :
    188           31        sdisk       disk
#
```

This sample screen shows the following system information for the "sdisk" device driver:

- Major number of driver sdisk for character-type files: 188
- Major number of driver sdisk for block-type files: 31

5. Enter the major numbers for the drivers into your table. You should now have all required device and driver information in the Device Data table (as shown in step 4).

6. Create the device files for all new devices (SCSI disk and raw/FX devices) using the **mknod** command. Be sure to create the block-type device files in the /dev/dsk directory and the character-type device files in the /dev/rdsk directory, as shown in the following example:

```
# cd /dev/dsk
# mknod /dev/dsk/c2t6d0 b 31 0x026000            ← Create block-type
file.
         \ File name  \ b = block-type, 31 = major #, 0x026000 =
minor #
 :
# mknod /dev/dsk/c2t8d0 b 31 0x028000
         \ File name  \ b = block-type, 31 = major #, 0x028000 =
minor #
```

```
# cd /dev/dsk
# mknod /dev/dsk/c2t6d0 b 31 0x026000            ← Create block-type
file.
         \ File name  \ b = block-type, 31 = major #, 0x026000 =
minor #
 :
# mknod /dev/dsk/c2t8d0 b 31 0x028000
         \ File name  \ b = block-type, 31 = major #, 0x028000 =
minor #
```

The character-type device file is required for volumes used as raw devices (for example, 3390-3A). The block-type device file is not required for raw devices. If you need to delete a device file, use the **rm -i** command.

Partitioning disk devices for HP-UX

The HP-UX system uses the Logical Volume Manager (LVM) to manage the disk devices on all peripheral storage devices including the storage system. Under LVM disk management, a volume group consisting of multiple disks is formed, and then the volume group is divided into logical partitions and managed as a logical volume. These procedures should be executed for all device files corresponding to the new SCSI disk devices.

> ⚠ **Caution:** Do not partition the raw/FX devices (for example, 3390-3A/B/C). These volumes are not managed by LVM and do not need any further configuration after their character-type device files have been created and verified.

To partition the new SCSI disk devices for LVM operation:

- Create a physical volume for each new SCSI disk device, see Creating physical volumes for new disk drives for HP-UX (on page 64).

- Create new volume groups as desired, see Creating volume groups for the new physical volumes for HP-UX (on page 65) to increase the maximum volume groups (`maxvgs`) setting.

- Create a logical volume for each new SCSI disk device, see Creating logical volumes for new disk devices for HP-UX (on page 68).

This section provides general instructions and basic examples for partitioning the SCSI devices for LVM operations using UNIX commands. These instructions do not explicitly cover all LVM configuration issues. For more information about LVM configuration, see the appropriate user documentation or contact HPE technical support.

> 📄 **Note:** If desired, the HP-UX System Administrator Manager (SAM) can be used instead of UNIX commands to configure the SCSI disk devices.

Creating physical volumes for new disk drives for HP-UX

The first step in partitioning the new devices is to create a physical volume for each new disk device. Once the physical volumes have been created, you will be able to assign these new physical volumes to new or existing volume groups for management by LVM.

> 📄 **Note:** Do not create physical volumes for raw/FX devices (for example, 3390-3A/B/C).

Procedure

1. Use the `pvcreate` command to create the physical volume with the character-type device file as the argument. Specify the `/dev/rdsk` directory for the character file. You can only create one physical volume at a time.

   Example:

```
# pvcreate /dev/rdsk/c2t6d0


Physical volume "/dev/rdsk/c2t6d0" has been successfully created.
# pvcreate /dev/rdsk/c2t6d1
```

```
Physical volume "/dev/rdsk/c2t6d1" has been successfully created.
:
```

> 📄 **Note:** Do not use the `-f` (force) option with the **pvcreate** command. This option creates a new physical volume forcibly and overwrites the existing volume.

2. Repeat step 1 for each new disk device on the storage system.

Creating volume groups for the new physical volumes for HP-UX

After the physical volumes for the disk devices have been created, you can begin creating new volume groups for the new physical volumes as needed. If desired, you can also add any of the new physical volumes on the storage system to existing volume groups using the **vgextend** command. The physical volumes, which make up one volume group, can be in the same disk system or in different disk systems.

> 📄 **Note:**
>
> - Do not assign the raw/FX devices (for example, OPEN-x-FXoto) to volume groups.
>
> - You may need to modify the HP-UX system kernel configuration (*maxvgs* setting) to allow more volume groups to be created (see).

Procedure

1. Use the **ls** command to display the existing volume groups.

```
# ls /dev
vg00
 :
vg05
#
```

2. Use the **mkdir** command to create the directory for the new volume group. Choose a name for the new volume group that is different than all other group names. Do not use an existing volume group name.

```
# mkdir /dev/vg06
```

> 💡 **Tip:** If you need to delete a directory, use the **rmdir** command (for example, `rmdir /dev/vgnn`).

3. Use the **ls** command to verify the new directory.

```
# ls /dev
vg00
 :
```

```
vg06
#
```

4. Use the **ll** command to verify the minor numbers for existing group files with the output piped to **grep** to display only the files containing "group".

```
# ll /dev/vg* | grep group
crw-rw-rw    1 root    root    64 0x000000 Nov 7 08:13
group
:
#
```

In this example, the minor number of the existing group file is 00 ($0x000000$).

5. Choose a minor number for the new group file in sequential order (that is, when existing volume groups are vg00-vg05 and next group name is vg06, use minor number 06 for the vg06 group file). Do not to duplicate any minor numbers.

The minor numbers are hexadecimal (for example, the tenth minor number is 0x0a0000, not 0x100000).

6. Use the **mknod** command to create the group file for the new directory. Specify the correct volume group name, major number, and minor number. The major number for all group files is *64*.

```
# mknod /dev/vg06/group c 64 0x060000
:
#
```

In this example, group name = vg06, major number of group file = 64, and minor number of new group file = 06.

> 💡 **Tip:** If you need to delete a group file, use the **rm -r** command to delete the group file and the directory at the same time (for example, rm – r /dev/vgnn), and start again at step 2.

7. Repeat steps 5 and 6 for each new volume group.
8. Use the **vgcreate** command to create the volume group.

```
# vgcreate /dev/vg06 /dev/dsk/c2t6d0

Volume group "/dev/vg06" has been successfully created.
Volume group configuration for /dev/vg06 has been saved in /etc/1vmconf/vg06.cof.
# vgcreate -s 8 -e 15845 /dev/vg09 /dev/dsk/c2t7d0

Volume group "/dev/vg09" has been successfully created.
Volume Group configuration for /dev/vg09 has been saved in /etc/lvmconf/vg09.cof
```

This example shows the creation of volume group vg06 with device c2t6d0 and the creation of volume group vg09 with LUSE device c2t7d0 (*n* = 18).

For LUSE volumes with more than 17 OPEN-8/9 LDEVs ($n > 18$) or more than 7043 MB (OPEN 8/9*n-CVS), use the `-s` and `-e` physical extent (PE) parameters of **vgcreate**, as shown in the example above (PE Size = `-s 8`, MPE Size = `-e 15845`).

For details about the PE and MPE parameters for LUSE devices, see <u>PE and MPE parameters for LUSE devices for HP-UX (on page 67)</u>.

> 💡 **Tip:**
>
> - To allocate more than one physical volume to the new volume group, add the other physical volumes separated by a space (for example, `vgcreate /dev/vg06 /dev/dsk/c0t6d0 /dev/dsk/c0t6d1`).
>
> - If you need to delete a volume group, use the **vgremove** command (for example, `vgremove /dev/vgnn`). If the **vgremove** command does not work because the volume group is not active, use the **vgexport** command (for example, `vgexport /dev/vgnn`).

9. Use the **vgdisplay** command to verify that the volume group was created correctly. The `-v` option displays the detailed volume group information.

```
# vgdisplay /dev/vg06
--- Volume groups ---
VG Name              /dev/vg06
VG Write Access      read/write
VG Status            available
Max LV               255
Cur LV               0
Open LV              0
Max PV               16
Cur PV               1
Act PV               1
Max PE per PV        1016
VGDA                 2
PE Size (Mbytes)     4
Total PE             586
Alloc PE             0
Free PE              586
Total PVG            0
```

For LUSE devices, verify the values displayed for `Max PE per PV` and `PE Size (Mbytes)`.

PE and MPE parameters for LUSE devices for HP-UX

Device type	Physical Extent Size (PE)	Max Number of Physical Extents (MPE)
OPEN-3/8/9/E	default	default

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Device type		Physical Extent Size (PE)	Max Number of Physical Extents (MPE)
OPEN-3*n (n= 2 to 36) OPEN-3-CVS OPEN-3*n-CVS (n = 2 to 36)			
OPEN-8/9*n	n = 2 to 17	default	default
	n = 18	8	15845
OPEN-E*n	n = 2 to 9	default	default
OPEN-L*n	n= 2 to 3	default	default
OPEN-8/9/E-CVS, OPEN-V		default	default
OPEN-8/9/E*n-CVS, OPEN-V*n (n = 2 to 36)	70-119731(MB) x N1	8	default
	119732- (MB) x N1	8	N2
N1 = [Virtual LVI/LUN volume capacity (in MB)] x n N2 = ceil (N1 / PE) (ceil () means round up to next integer.) *Example*: Volume capacity is 6000 MB for OPEN-9*22-CVS volume: N1 = 6000 x 22 = 132000 N2 = ceil(132000/8) = 16500			

Creating logical volumes for new disk devices for HP-UX

After you have created the new volume groups, create the logical volumes for each new disk device on the storage system.

> **Note:** Do not create logical volumes for raw/FX devices (for example, 3390-3A/B/C).

Procedure

1. Use the `lvcreate -L` command to create the logical volume, and specify the volume size and volume group for the new logical volume.

   For example, to create an OPEN-3 volume (2344 MB):

   ```
   # lvcreate -L 2344 /dev/vg06

   Logical volume "/dev/vg06/lvol1" has been successfully created with character
   device "/dev/vg06/rlvol1".
   Logical volume "/dev/vg06/lvol1" has been successfully extended.
   Volume Group configuration for /dev/vg06 has been saved in /etc/1vmconf/vg06.cof.
   ```

The HP-UX system assigns the logical volume numbers automatically (lvol1, lvol2, lvol3, …). Use the capacity values specified in Logical device types (on page 14) for the size parameter (for example, OPEN-3 = 2344, OPEN-V = 61432 in maximum size).

To calculate S1 for VLL, LUSE, and VLL LUSE volumes, use the `vgdisplay` command to display the physical extent size (PE Size) and usable number of physical extents (Free PE) for the volume. Calculate the maximum size value (in MB) as follows:

```
S1 = ( PE Size) × (Free PE)
```

For example:

```
# vgdisplay /dev/vg01


--- Volume groups ---
VG Name              /dev/vg01
VG Write Access      read/write
VG Status            available
Max LV               255
Cur LV               0
Open LV              0
Max PV               16
Cur PV               1
Act PV               1
Max PE per PV        1016
VGDA                 2
PE Size (Mbytes)     4
Total PE             586
Alloc PE             0
Free PE              586
Total PVG            0
```

This example shows the following information for `/dev/vg01`:

- Physical extent size = 4

- Usable number of physical extents = 586

Therefore, maximum size value = 4 × 586 = 2344

2. Use the `lvdisplay` command to verify that the logical volume was created correctly. If desired, wait until all logical volumes have been created, and then use the * wildcard character with the `lvdisplay` command to verify all volumes at one time (for example, `lvdisplay /dev/vg06/lvol*`).

   Example:

```
# lvdisplay /dev/vg06/lvol1
--- Logical volume ---
LV Name                 /dev/vg06/lvol1
VG Name                 /dev/vg06
LV Permission           read/write
LV Status               available/syncd
Mirror copies           0
Consistency Recovery    MWC
```

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```
Schedule                 parallel
LV Size (Mbytes)         2344        ← (7040 for OPEN-9)
Current LE               586         ← (1760 for OPEN-9)
Allocated PE             586         ← (1760 for OPEN-9)
Stripes                  0
Stripe Size (Kbytes)     0
Bad block                on
Allocation               strict
```

In this example:

- LV Size 2344 = 586 * 4 = OPEN-3

- LE = logical extent

- PE= physical extent

3. Repeat steps 1 and 2 for each logical volume to be created. You can only create one logical volume at a time, but you can verify more than one logical volume at a time.

> **Tip:**
> - If you need to delete a logical volume, use the **lvremove** command (for example, lvremove /dev/vg*nn*/lvol*x*).
>
> - If you need to increase the size of an existing logical volume, use the **lvextend** command (for example, lvextend L *size* /dev/vg*nn*/lvol*x*).
>
> - If you need to decrease the size of an existing logical volume, use the **lvreduce** command (for example, lvreduce L *size* /dev/vg*nn*/lvol*x*).

Creating file systems for HP-UX

After you have created logical volumes, you are ready to create the file system for each new logical volume on the storage system. The default file system type for HP-UX version 11i is *vxfs*.

> **Note:** Do not create file systems for the raw/FX devices (for example, 3390-3A/B/C).

Procedure

1. Use the `newfs` command to create the file system with the logical volume as the argument.

   - Example of creating a file system (default file system, OPEN-3)

   ```
   # newfs /dev/vg06/rlvol1
   newfs: /etc/default/fs is used for determining the file system type
   mkfs (vxfs): Warning -272 sector(s) in the last cylinder are not allocated.
   mkfs (vxfs): /dev/vg06/rlvol1 - 2400256 sectors in 3847 cylinders of 16
   tracks,
   2457.9MB in 241 cyl groups (16 c/g, 10.22Mb/g, 1600 i/g)
   Super block backups (for fsck -b) at:
        16,   10040,   20064,   30038,   40112,   50136,   60160,   70184,   80208,
   90232,
     ...
   2396176
   #
   ```

   - Example of creating a file system (default file system, OPEN-9)

   ```
   # newfs /dev/vg06/rlvol1
   newfs: / etc/default/fs is used for determining the file system type
   mkfs (vxfs): ...
    :
   7188496, 7198520, 7208544
   #
   ```

   - Example of creating a file system (specifying the file system type)

   ```
   # newfs -F vxfs /dev/vg06/rlvol1
    :
   # newfs -F vxfs /dev/vg06/rlvol2
   ```

2. Repeat step 1 for each new logical volume on the storage system.

Setting device parameters for HP-UX

When device files are created, the HP-UX system sets the IO time-out parameter to its default value of 20 seconds and the queue depth parameter to its default value of either 2 or 8. You must change these values for all new disk devices on the storage system.

📄 **Note:** Do not create file systems for the raw/FX devices (for example, 3390-3A/B/C).

Setting the IO time-out parameter for HP-UX

The IO time-out parameter for the disk devices on the storage system must be set to 60 seconds.

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Procedure

1. Use the `pvdisplay` command to verify the current IO time-out value.

```
# pvdisplay /dev/dsk/c0t6d0
--- Physical volumes ---
PV Name                 /dev/dsk/c0t6d0
VG Name                 /dev/vg06
PV Status               available
Allocatable             yes
VGDA                    2
Cur LV                  1
PE Size (Mbytes)        4
Total PE                586
Free PE                 0
Allocated PE            586
Stale PE                0
IO Timeout (Seconds)    default
```

Shown in this example:

- Total PE: 586 indicates OPEN-3, 1760 indicates OPEN-9

- Allocated PE: 586 indicates OPEN-3, 1760 indicates OPEN-9

- IO Timeout: default

2. Use the `pvchange -t` command to change the IO time-out value to 60.

```
# pvchange -t 60 /dev/dsk/c0t6d0
Physical volume "/dev/dsk/c0t6d0" has been successfully changed.
Volume Group configuration for /dev/vg06 has been saved in /etc/lvmconf/vg06.cof
```

3. Use the `pvdisplay` command to verify that the new IO time-out value is 60 seconds.

```
# pvdisplay /dev/dsk/c0t6d0
--- Physical volumes ---
PV Name                 /dev/dsk/c0t6d0
VG Name                 /dev/vg06
PV Status               available
 :
Stale PE                0
IO Timeout (Seconds)    60
```

4. Repeat steps 1 through 3 for each new disk device on the storage system.

Setting the queue depth parameter for HP-UX

The HP-UX system automatically sets the queue depth to a default value of 2 or 8, depending on the installed HPE options and drivers. You must change the queue depth values for all new disk devices on the storage system. The following table lists the recommended queue depth values for the devices. You can adjust the queue depth as needed to optimize the I/O performance of the devices. For details, see Host queue depth (on page 18).

Storage system	Recommended queue depth settings
VSP 5000 series	Target ports: • 2,048 per port • 32 per LDEV Bidirectional ports: • 1,024 per port • 32 per LDEV
VSP G1x00, VSP F1500	• 2,048 per port • 32 per LDEV
VSP	• 2,048 per port • 32 per LDEV
VSP E series	Target ports: • 2,048 per port • 32 per LDEV Universal ports: • 1,024 per port • 32 per LDEV
VSP G130, G/F350, G/F370, G/F700, G/F900	Target ports: • 2,048 per port • 32 per LDEV Universal ports: • 1,024 per port • 32 per LDEV
VSP G200, G400, G600, G800, VSP F400, F600, F800	• 1,024 per port • 32 per LDEV
HUS VM	• 2,048 per port • 32 per LDEV

Using the `scsictl` command, you can view and change the queue depth parameter for each device one volume at a time. However, the queue depth is reset to the default value the next time the system restarts. Therefore, you must create and register a start-up script to set the queue depth for the disk devices each time the system restarts (see).

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> 📄 **Note:** Do not set the queue depth for the raw/FX devices (for example, 3390-3A/B/C).

Procedure

1. If you cannot shut down and restart the system at this time, use the **scsictl** command to set the queue depth for each new device. The **scsictl** commands to set queue depth should be registered as HP-UX start-up script for future reboot.

```
# /usr/sbin/scsictl -m queue_depth=32 -a /dev/rdsk/c0t6d0
# /usr/sbin/scsictl -m queue_depth=32 -a /dev/rdsk/c0t6d1
# /usr/sbin/scsictl -m queue_depth=32 -a /dev/rdsk/c0t6d2
# /usr/sbin/scsictl -m queue_depth=32 -a /dev/rdsk/c0t6d3
 :
 :
# /usr/sbin/scsictl -m queue_depth=32 -a /dev/rdsk/c0t8d0
```

2. Check the `/sbin/init.d` and `/sbin/rc1.d` directories to see whether the script name "queue" is already used (link name Sxxxqueue or Kxxxqueue).

```
# ls /sbin/init.d
OspfMib     clean_ex    dfs         hpether     names       nis.server savecore
swconfig
SnmpHpunix  clean_tmps diagnostic iforls      ncs         pd          sendmail
syncer
 :
clean_adm   ddfa        hparray     mrouted     nis.client rwhod       swcluster
xntpd

# ls /sbin/rc1.d
K230audio      K340xntpd   K420dfs         K475rarpd       K630named
S420set_date
K240auditing   K356vjed    K430dce         K480rdpd        K660net
S440savecore
K250envd       K358egcd    K435OspfMib     K490gated       K700nettl
S500swap_start
K258diagnostic K360kks     K435SnmpHpunix K500inetd       K770ptydaemon
S520syncer
K270cron       K370vt      K435SnmpMib2    K510mrouted     K780syslogd
K278pd         K380xfs     K440SnmpMaster K570nfs.client K900swagentd
K280lp         K390rbootd K450ddfa        K580nis.client S100localmount
K290hparray    K400iforls K460sendmail    K590nis.server S320hostname
K300acct       K410ncs     K470rwhod       K600nfs.core   S400set_prvgrp
```

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Choose a unique name for the start-up script as follows:

- If there is no script named "queue" and no link file named `Sxxxqueue` or `Kxxxqueue`, use the name "queue" for the new script and go to step 3.

- If the script "queue" and the link file `Sxxxqueue` or `Kxxxqueue` exist and the script is used to set the queue depth for other previously installed storage systems, check the script file to see whether the queue depth is set to the desired number and add a line for each new disk device. If necessary, restart the HP-UX system to set the queue depth for the new volumes.

- If the script queue and the link file `Sxxxqueue` or `Kxxxqueue` already exist and the script is not used for setting the queue depth for the storage system, use another name for the new queue-depth script for the storage system (for example, `hitachi_q`) and go to step 3.

  > **Note:** If the link `Sxxxqueue` and/or `Kxxxqueue` exists, but there is no script file named "queue", delete the link files, use the name "queue" for the new script, and go to step 3.

3. Choose a unique 3-digit number for the link name. This number cannot be used in any other links. The link name is derived as follows: `S` stands for "startup script," `K` stands for "kill script," the three-digit number is unique to each link, and the script file name follows the three-digit number (for example, *S890queue* or `S890hitachi_q`).

4. Create and register the new start-up script for the storage system (see Queue depth start-up script for HP-UX (on page 75) for an example).

5. Shut down and restart the HP-UX system, so the new start-up script sets the queue depth for the disk devices to the specified value.

6. After restarting the system or setting the queue depths manually, use the **scsictl** command to verify the queue depth for each disk device.

```
# /usr/sbin/scsictl -a /dev/rdsk/c0t6d0

immediate_report = 0; queue_depth = 32
:
:
# /usr/sbin/scsictl -a /dev/rdsk/c0t8d0
immediate_report = 0; queue_depth = 32
```

Queue depth start-up script for HP-UX

The `queue` (or `hitachi_q`) start-up script sets the queue depth to 8 for all new volumes (SCSI disk devices) on the storage system each time the HP-UX system restarts. If the queue script exists for a previously installed storage system, check the script file to verify that the queue depth value is set to the desired value, and add a line for each new volume. If the script does not exist, create and register the script as shown in the example below. You can use the UNIX `vi` editor or other text editor to create or edit the script.

> 📄 **Note:** For questions about creating and registering the start-up script, refer to the UNIX and HPE user documentation, or ask your Hitachi Vantara representative for assistance.

```
# cp /sbin/init.d/template /sbin/init.d/queue
# vi /sbin/init.d/queue
------------------------file(/sbin/init.d/queue)---------------------
# !/sbin/sh
#
# @(#) $Revision: 78.1 $
#
# NOTE:    This script is not configurable!  Any changes made to this
#          script will be overwritten when you upgrade to the next
#          release of HP-UX.
#
# WARNING: Changing this script in any way may lead to a system that
#          is unbootable.  Do not modify this script.
#
# <Insert comment about your script here>
#
# Allowed exit values:
#    0 = success; causes "OK" to show up in checklist.
#    1 = failure; causes "FAIL" to show up in checklist.
#    2 = skip; causes "N/A" to show up in the checklist.
#          Use this value if execution of this script is overridden
#        by the use of a control variable, or if this script is not
#         appropriate to execute for some other reason.
#        3 = reboot; causes the system to be rebooted after execution.
# Input and output:
#       stdin is redirected from /dev/null
#       stdout and stderr are redirected to the /etc/rc.log file
#       during checklist mode, or to the console in raw mode.

PATH=/usr/sbin:/usr/bin:/sbin
export PATH

# NOTE: If your script executes in run state 0 or state 1,then /usr
#       might not be available.  Do not attempt to access commands or
#       files in /usr unless your script executes in run state 2 or
#       greater.  Other file systems typically not mounted until run
#       state 2 include /var and /opt.

rval=0

# Check the exit value of a command run by this script.  If non-zero,
# the exit code is echoed to the log file and the return value of this
# script is set to indicate failure.
set_return()  {
        x=$?
        if [ $x -ne 0 ]; then
```

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```
                echo "EXIT CODE: $x"
                rval=1 # script FAILed
        fi
}
# Kill the named process(es).
# $1=<search pattern for your process>

killproc()  {
        pid='ps -el | awk '( )$NF ~ /'"$1"'/) && ($4 !=mypid) && ($5 !=
mypid)  ){ print $4 }' mypid=$$ '
        if [ "X$pid" != "X" ]; then
                if kill "$pid"; then
                        echo "$1 stopped"
                else
                        rval=1
                        echo "Unable to stop $1"
                fi
        fi
}


case $1 in
'start_msg')
         # Emit a _short_ message relating to running this script with
         # the "start" argument; this message appears as part of the
         # checklist.
         echo "Setting the queue value"
         ;;
'stop_msg')
        # Emit a _short_ message relating to running this script with
        # the "stop" argument; this message appears as part of the
        # checklist.
        echo "Stopping the <specific> system"
        ;;

'start')
_____
        # source the system configuration variables          |
        if [ -f /etc/rc.config ] ; then                       |
                . /etc/rc.config                              |
        else                                                  |
                echo "ERROR: /etc/rc.config defaults file MISSING"  |
        fi                                                    |
                                                              |
        # Check to see if this script is allowed to run...    |
        if [ "$CONTROL_VARIABLE" != 1 ]; then                 |
                rval=2                                        |
        else                                                  |
                                                              |
        # Execute the commands to stop your system            |
        :                                                     |
        fi                                                    |
```

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```
       /usr/sbin/scsictl -m queue_depth=8 /dev/rdsk/c0t6d0
       /usr/sbin/scsictl -m queue_depth=8 /dev/rdsk/c0t6d1
       /usr/sbin/scsictl -m queue_depth=8 /dev/rdsk/c0t8d0
        :
       ;;
'stop')
       # source the system configuration variables
       if [ -f /etc/rc.config ] ; then
             . /etc/rc.config
       else
             echo "ERROR: /etc/rc.config defaults file MISSING"
       fi

       # Check to see if this script is allowed to run...
       if [ "$CONTROL_VARIABLE" != 1 ]; then
             rval=2
       else
        :
       # Execute the commands to stop your system

       fi
       ;;
*)
       echo "usage: $0 {start|stop|start_msg|stop_msg}"
       rval=1
       ;;
esac
exit $rval
-------------------------end of file(/sbin/init.d/queue)--------------------

# ls /sbin/rc1.d
K230audio       K340xntpd    K420dfs        K475rarpd     K630named
S420set_date
K240auditing    K356vjed     K430dce        K480rdpd      K660net
S440savecore
K250envd        K358egcd     K435OspfMib    K490gated     K700nettl
S500swap_start
K258diagnostic  K360kks      K435SnmpHpunix K500inetd     K770ptydaemon  S520syncer
K270cron        K370vt       K435SnmpMib2   K510mrouted   K780syslogd
K278pd          K380xfs      K440SnmpMaster K570nfs.client K900swagentd
K280lp          K390rbootd   K450ddfa       K580nis.client S100localmount
K290hparray     K400iforls   K460sendmail   K590nis.server S320hostname
K300acct        K410ncs      K470rwhod      K600nfs.core  S400set_prvgrp

# ln -s /sbin/init.d/queue /sbin/rc1.d/S890queue
```

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Creating mount directories for HP-UX

After you create the file systems and set the device parameters, create the mount directory for each volume. Choose a unique name for each mount directory that identifies the logical volume.

Procedure

1. Use the **mkdir** command to create the mount directory with the new mount directory name as the argument.

    ```
    # mkdir /VSP-LU00
    ```

2. Use the **ls -x** command to verify the new mount directory.

    ```
    # ls -x
    VSP-LU00    bin     dev      device    etc       export
    floppy      home    hstsboof kadb      kernel    lib
    #
    ```

    > 💡 **Tip:** If you need to delete a mount directory, use the **rmdir** command.

3. Repeat steps 1 and 2 for each new device on the storage system.

Mounting and verifying file systems for HP-UX

After you have created the mount directories, mount the file system for each new logical volume and verify the file systems.

Procedure

1. Use the **mount** command to mount the file system for the volume.

    ```
    # mount /dev/vg06/lvol1 /VSP-LU00
    ```

    In this example, /dev/vg06/lvol1 is the Block-type lvol name and VSP-LU00 is the mount directory name

2. Repeat step 1 for each new logical volume on the storage system.
3. Use the **bdf** command to verify that the file systems are correct. Be sure the capacity (listed under *Kbytes*) is correct for each device.

    ```
    # bdf
    Filesystem        Kbytes    used    avail   %used  Mounted on
    /dev/vg00/lvol1    59797   59364        0   100%   /
     :
    /dev/vg06/lvol1  2348177       9  2113350    0%    /VSP-LU00
    /dev/vg07/lvol1  2348177       9  2113350    0%    /VSP-LU01
    /dev/vg08/lvol1  7052764       9  6347478    0%    /VSP-LU02
    ```

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4. Perform basic UNIX operations, such as file creation, copying, and deletion, on each logical device to be sure the new devices on the storage system are fully operational.

```
# mount /dev/vg06/lvol1 /VSP-LU00
# cd /VSP-LU00
# cp /bin/vi /VSP-LU00/vi.back1
# ll
drwxr-xr-t   2 root     root         8192 Mar 15 11:35  lost+found
-rwxr-xr-x   1 root     sys        217088 Mar 15 11:41  vi.back1
# cp vi.back1 vi.back2
# ll
drwxr-xr-t   2 root     root         8192 Mar 15 11:35  lost+found
-rwxr-xr-x   1 root     sys        217088 Mar 15 11:41  vi.back1
-rwxr-xr-t   1 root     sys        217088 Mar 15 11:52  vi.back2
# rm vi.back1
# rm vi.back2
```

5. If you want to unmount a file system after it has been mounted and verified, use the **umount** command (for example, umount /VSP-LU00).

Setting and verifying auto-mount parameters for HP-UX

The final step in configuring the storage system volumes for LVM operations is to set up and verify the auto-mount parameters for each new volume. The /etc/fstab file contains the auto-mount parameters for the logical volumes. If you do not plan to auto-mount the new devices, you can skip this section.

Procedure

1. Edit the /etc/fstab file to add a line for each new volume (SCSI disk device) on the storage system.

```
# cp -ip /etc/fstab /etc/fstab.standard        ← Make backup before editing.
# vi /etc/fstab                                    ← Edit the file (vi
shown).
/dev/vg00/lvol1  /              vxfs   rw        0    1   # root
/dev/vg00/lvol2  swap           ignore sw        0    0   # primary swap
  :
/dev/vg06/lvol1  /VSP-LU00   vxfs   defaults 0    2   # VSP-LU00
/dev/vg06/lvol2  /VSP-LU01   vxfs   defaults 0    2   # VSP-LU01
      1                  2      3      4      5    6      7   ← See Auto-mount
Parameters
```

Auto-mount Parameters

Parameter #	Name	Enter:
1	Device to mount	Block-type device file name
2	Mount point	Mount directory name
3	File System	File system type (for example, vxfs)
4	Mount options	Usually "defaults"
5	Enhance	"0"
6	File system check (fsck pass)	Order for performing file system checks
7	Comment	Any comment statement

2. After you finish editing the `/etc/fstab` file, reboot the HP-UX system. If you cannot reboot at this time, issue the **mount -a** command.

3. Use the **bdf** command to verify the device file systems again.

Installing online devices on HP-UX

After initial installation and configuration of the storage system, additional devices can be installed or de-installed online without having to restart the HP-UX system. This procedure should be performed by the system administrator (that is, super-user).

Use the normal disruptive device configuration procedure in the following cases:

- Fibre: If a new Fibre Channel connection is being installed. New Fibre Channel connections can only be installed when the host system is powered off. New devices under existing Fibre Channel ports can be installed and configured non-disruptively.

- Maxvgs: If the `maxvgs` parameter needs to be changed. The procedure for changing the `maxvgs` value in the system kernel requires a system reboot.

Procedure

1. Verify that the new devices on the storage system are ready to be configured. The Hitachi Vantara representative should have completed hardware installation and verified the normal status of the new devices (see Storage system installation (on page 23)).

2. Be sure that you are logged in as root.

3. Enter the **insf -e** command to perform online device recognition.

   The **insf -e** command creates device files for the new devices on the existing fibre busses (see Creating device files manually on HP-UX (on page 62)).

4. Configure the new disk devices for HP-UX operations described in HP-UX configuration and attachment (on page 57). For raw/FX devices, you only need to verify the device files and driver. Do not partition or create a file system on any raw/FX device.

5. Configure the application failover, path failover (that is, `vgextend`), and/or SNMP software on the HP-UX system as needed to recognize the new disk devices. For additional information about online installation and reinstallation of LUs, see the *Maintenance Manual* for the storage system.

Troubleshooting for HP-UX host attachment

The following table lists potential error conditions that might occur during storage system installation on an HP-UX host and provides instructions for resolving the conditions. If you cannot resolve an error condition, contact customer support.

Error condition	Recommended action
The logical devices are not recognized by the system.	Make sure the READY indicator lights on the storage system are ON.
	Make sure the FC cables are correctly installed and firmly connected.
	Make sure that LUSE devices are not intermixed with normal LUs on the same Fibre Channel port.
	Verify that LUNs are configured properly for each TID.
	Run `sr-probe` to recheck the Fibre Channel for new devices.
	For HP-UX 11iv3 and later, verify that LUN 0 is defined as the Command Console LUN (CCL) and mapped to the server.
A physical volume cannot be created (`PVCREATE` command).	Ensure the storage system devices are properly formatted.
	Ensure the character-type device file exists.
	Ensure the correct character-type device file name is used with `pvcreate`.
A volume group cannot be created (`VGCREATE` command).	Ensure the directory for the new volume group exists.
	Ensure the control file exists.
	Ensure the correct major # (64) and minor # are used with `mknod`.
	Ensure the block-type file exists and is entered correctly with `vgcreate`.
	Ensure the physical volume is not already allocated to another volume group.

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Error condition	Recommended action
A logical volume cannot be created (**LVCREATE** command).	Ensure the specified capacity is not greater than 4096 MB.
	Ensure the capacity of the volume group is not less than the capacity of the partitioned logical volume.
File system cannot be created (**newfs**).	Ensure the character-type device file is entered correctly with **newfs**.
The file system is not mounted after rebooting.	Ensure the system was restarted properly.
	Ensure the auto-mount information in the `/etc/fstab` file is correct.
The HP-UX system does not reboot properly after hard shutdown.	If the HP-UX system is powered off without executing the shutdown process, wait *three minutes* before restarting the HP-UX system. This allows the storage system internal time-out process to purge all queued commands so that the storage system is available (not busy) during system startup. If the HP-UX system is restarted too soon, the storage system will continue trying to process the queued commands and the HP-UX system will not reboot successfully.

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Chapter 5: Red Hat Linux configuration and attachment

This chapter describes how to configure the new disk devices on a Red Hat Linux host. Configuration of the devices should be performed by the Linux system administrator. Configuration requires superuser/root access to the host system. If you have questions or concerns, contact your Hitachi Vantara representative.

Storage system configuration for Red Hat Linux operations

The storage system must be fully configured before being attached to the Red Hat Linux host, as described in Configuring the storage system (on page 24).

- *Devices types*

  The following devices types are supported for Red Hat Linux operations. For details, see Logical device types (on page 14).

  - OPEN-V
  - OPEN-3/8/9/E/L
  - LUSE (OPEN-*x**n)
  - VLL (OPEN-*x* VLL)
  - VLL LUSE (OPEN-*x**n VLL)
  - Cross-OS File Exchange(FX) (3390-3A/B/C, OPEN-*x* FX oto)

- *Host mode*

  The required host mode for Red Hat Linux is 00. Do not select a host mode other than 00 for Red Hat Linux. For a complete list of host modes for the storage system, see Host modes and host mode options (on page 205). For instructions on setting the host modes, see the *Provisioning Guide* for the storage system.

- *Host mode options*

  You may also need to set host mode options (HMOs) to meet your operational requirements. For a complete list of HMOs for the storage system, see Host modes and host mode options (on page 205). For instructions on setting the HMOs, see the *Provisioning Guide* for the storage system.

  Veritas Cluster Server: See Note on using Veritas Cluster Server (on page 190) for important information about using Veritas Cluster Server.

Device Mapper (DM) Multipath configuration for Red Hat Linux

The storage systems support DM Multipath operations for Red Hat Enterprise Linux (RHEL) version 5.4 X64 or X32 or later.

📄 **Note:** Refer to the native multipath configuration documentation from the OS vendor for important information about required settings and parameters for DM Multipath operations, including but not limited to:

- Disabling the HBA failover function
- Installing the *kpartx* utility
- Creating the multipath device with the `multipath` command
- Editing the `/etc/modprobe.conf` file
- Editing the `/etc/multipath.conf` file
- Configuring LVM
- Configuring raw devices
- Creating partitions with DM Multipath

📄 **Note:** Specify 10 or more values for the `no_path_retry` parameter in the `/etc/multipath.conf` file when you use Device Mapper Multipath on RHEL8.

After you specify the parameter, execute the following command to enable the setting:

```
# systemctl reload multipathd.service
```

Example of `/etc/multipath.conf`:

If the setting applies to all devices, add the `no_path_retry` parameter to **defaults**.

```
defaults {
        no_path_retry          10
        find_multipaths yes
        user_friendly_names    yes
}
```

If the setting applies to each device, add the `no_path_retry` parameter to **device**.

```
devices {
        device {
                vendor "HITACHI"
                product "^OPEN-"
                path_grouping_policy "multibus"
                no_path_retry 10
        }
}
```

If the `no_path_retry` parameter is not specified, server I/O or the system that booted from SAN might be stopped when failure is detected on the storage controllers.

Verifying new device recognition for Red Hat Linux

The final step before configuring the new disk devices is to verify that the host system recognizes the new devices. The host system automatically creates a device file for each new device recognized.

Procedure

1. Use the **dmesg** command to display the devices.

    ```
    # dmesg | more
    :
    :
    ```

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```
scsi0 : Qlogic QLA2200 PCI to Fibre Channel Host Adapter: 0 device 14 irq 11
        Firmware version:  1.17.26, Driver version  2.11 Beta


scsi : 1 host.
  Vendor: HITACHI        Model: OPEN-3              Rev: 0111
  Type:   Direct-Access                   ANSI SCSI revision: 02
Detected scsi disk sda at scsi0, channel 0, id 0, lun 0



  Vendor: HITACHI        Model: OPEN-9              Rev: 0111
  Type:   Direct-Access                   ANSI SCSI revision: 02
Detected scsi disk sdb at scsi0, channel 0, id 0, lun 1
:
:
```

In this example, the HITACHI OPEN-3 device (TID 0, LUN 0) and the HITACHI OPEN-9 device (TID 0, LUN 1) are recognized by the Red Hat Linux server.

2. Record the device file name for each new device. You will need this information when you partition the devices. The following figure shows a sample SCSI path worksheet.

LDEV (CU:LDEV)	Device Type	LUSE (*n)	VLL (MB)	Device File Name	Path	Alternate Path
0:00					TID:____ LUN:____	TID:____ LUN:____
0:01					TID:____ LUN:____	TID:____ LUN:____
0:02					TID:____ LUN:____	TID:____ LUN:____
0:03					TID:____ LUN:____	TID:____ LUN:____
0:04					TID:____ LUN:____	TID:____ LUN:____
0:05					TID:____ LUN:____	TID:____ LUN:____
0:06					TID:____ LUN:____	TID:____ LUN:____
0:07					TID:____ LUN:____	TID:____ LUN:____

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0:08					TID:____ LUN:____	TID:____ LUN:____
0:09					TID:____ LUN:____	TID:____ LUN:____
0:0A					TID:____ LUN:____	TID:____ LUN:____
0:0B					TID:____ LUN:____	TID:____ LUN:____
0:0C					TID:____ LUN:____	TID:____ LUN:____
0:0D					TID:____ LUN:____	TID:____ LUN:____
0:0E					TID:____ LUN:____	TID:____ LUN:____
0:0F					TID:____ LUN:____	TID:____ LUN:____

3. The device files are created under the `/dev` directory. Verify that a device file was created for each new disk device.

```
# ls -l /dev | more
:
brw-rw----   1 root    disk   8,  0 May  6  1998 sda
```

In this example, the device file is `sda`.

Configuring the new devices on Red Hat Linux

This section describes how to configure the new disk devices on the Red Hat Linux system host.

Setting the number of logical units for Red Hat Linux

Use this procedure to set the number of logical units (LUs).

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Procedure

1. Edit the `/etc/modules.conf` file to add the following line:

   ```
   options scsi_mod max_scsi_luns=xx
   ```

   where *xx* is the maximum number of LUs supported by your Linux OS. Check your host adapter documentation and Linux system documentation to determine the total number of devices that can be supported.

2. To set the Emulex Driver, add the following line to the `/etc/modules.conf` file:

   ```
   Alias scsi_hostadapter lpfcdd
   ```

3. To activate the above modification, make an image file for booting. Example:

   ```
   # mkinitrd /boot/initrd-2.4.x.scsiluns.img 'uname -r'
   ```

4. Use one of the following methods to change the setting of Bootloader:

   - *When LILO is used as Bootloader:* Edit the `lilo.conf` file, and then issue the **lilo** command to activate the `lilo.conf` setting with selecting the label. Example:

     ```
     image=/boot/vmlinuz-qla2x00
             label=Linux-qla2x00
             append="max_scsi_luns=16"
             # initrd=/boot/initrd-2.4.x.img
             initrd=/boot/initrd-2.4.x.scsiluns.img
      root=/dev/sda7
      read-only
     #sbin/lilo
     ```

     As shown in this example, the `initrd=/boot/initrd-2.4.x.img` line is commented out, and the `initrd=/boot/initrd-2.4.x.scsiluns.img` line is added.

   - *When Grand Unified Bootloader (GRUB) is used as Bootloader:* Edit the `/boot/grub/grub.conf` file. Example:

     ```
     kernel /boot/vmlinuz-2.4.x ro root=/dev/hda1
     # initrd /boot/initrd-2.4.x.img
     initrd /boot/initrd-2.4.x.scsiluns.img
     ```

5. Reboot the system.

Partitioning the new disk devices for Red Hat Linux

After the setting the number of logical units, you need to create the partitions on the new disk devices.

📄 **Note:** For important information about required settings and parameters for DM Multipath operations, refer to the native multipath configuration documentation from the OS vendor.

Chapter 5: Red Hat Linux configuration and attachment

Procedure

1. Enter `fdisk/dev/<device_name>`, for example:

```
fdisk/dev/sda
```

where

- `dev/sda` is the device file name.

2. Select `p` to display the present partitions.

3. Select `n` to make a new partition. You can make up to four primary partitions (1-4) or one extended partition. The extended partition can be organized into 11 logical partitions, which can be assigned partition numbers from 5 to 15.

   💡 **Tip:** Other useful commands include `d` to remove partitions and `q` to stop a change.

4. Select `w` to write the partition information to disk and complete the **fdisk** command.

5. Repeat steps 1 through 4 for each new disk device.

Creating, mounting, and verifying the file systems on Red Hat Linux

Creating the file systems for Red Hat Linux

After you have partitioned the disk devices, you need to create the file system. Be sure the file system is appropriate for the primary and/or extended partition for each logical unit.

Procedure

1. Issue the **mkfs** command, for example:

```
# mkfs /dev/sda1
```

where

- `/dev/sda1` is device file of primary partition number 1.

Creating the mount directories for Red Hat Linux

Procedure

1. Issue the **mkdir** command, for example:

```
# mkdir /VSP-LU00
```

Mounting the new file systems for Red Hat Linux

Procedure

1. Use the **mount** command to mount each new file system, for example:

```
# mount /dev/sda1 /VSP-LU00
```

   The first parameter of the **mount** command is the device file name (`/dev/sda1`), and the second parameter is the mount directory (VSP-LU00).

Verifying the file systems for Red Hat Linux

After mounting the file systems, you need to verify the file systems, for example:

Procedure

1. Issue the **df -h** command.

```
# df -h
Filesystem        Size    Used    Avail    Used%    Mounted on
/dev/sda1         1.8G    890M    866M     51%      /
/dev/sdb1         1.9G    1.0G    803M     57%      /usr
/dev/sdc1         2.2G     13k    2.1G      0%      /VSP-LU00
#
```

Setting the auto-mount parameters for Red Hat Linux

Procedure

1. Make a backup of the `/etc/fstab` file, for example:

```
# cp -ip /etc/fstab /etc/fstab.standard
```

2. Edit the `/etc/fstab` file to add the new devices, for example:

```
# vi /etc/fstab
:
/dev/sda1         /VSP-LU00 ext2    defaults   0   2
```

Troubleshooting for Red Hat Linux host attachment

The following table lists potential error conditions that might occur during storage system installation on a Red Hat Linux host and provides instructions for resolving the conditions. If you cannot resolve an error condition, contact customer support.

Error Condition	Recommended Action
The logical devices are not recognized by the system.	Be sure that the READY indicator lights on the storage system are ON. Be sure that the LUNs are properly configured. The LUNs for each target ID must start at 0 and continue sequentially without skipping any numbers.
The file system cannot be created.	Be sure that the device name is entered correctly with `mkfs`. Be sure that the LU is properly connected and partitioned.
The file system is not mounted after rebooting.	Be sure that the system was restarted properly. Be sure that the auto-mount information in the `/etc/fstab` file is correct.

Chapter 5: Red Hat Linux configuration and attachment

Chapter 6: Solaris configuration and attachment

This chapter describes how to configure the new disk devices on a Solaris host. Configuration of the devices should be performed by the Solaris system administrator. Configuration requires superuser/root access to the host system. If you have questions or concerns, contact your Hitachi Vantara representative.

Storage system configuration for Solaris operations

The storage system must be fully configured before being attached to the Solaris host, as described in Configuring the storage system (on page 24).

- *Devices types*: The following devices types are supported for Solaris operations. For details, see Logical device types (on page 14).

  - OPEN-V

  - OPEN-3/8/9/E/L

  - LUSE (OPEN-*x**n)

  - VLL (OPEN-*x* VLL)

  - VLL LUSE (OPEN-*x**n VLL)

  - Cross-OS File Exchange(FX) (3390-3A/B/C, OPEN-*x* FX oto)

- *Host mode*: The required host mode for Solaris is *09*. Do not select a host mode other than *09* for Solaris. For a complete list of host modes for the storage system, see Host modes and host mode options (on page 205). For instructions on setting the host modes, see the *Provisioning Guide* for the storage system.

  > 📄 **Note:** You must set *HOST MODE=09* before installing Sun Cluster, or the Quorum Device will not be assigned to the storage system.

- *Host mode options*: You may also need to set host mode options (HMOs) to meet your operational requirements. For a complete list of HMOs for the storage system, see Host modes and host mode options (on page 205). For instructions on setting the HMOs, see the *Provisioning Guide* for the storage system.

  Veritas Cluster Server: See Note on using Veritas Cluster Server (on page 190) for important information about using Veritas Cluster Server.

FCA configuration for Solaris

This section describes how to configure the Fibre Channel adapters (FCAs) that will be attached to the Solaris host.

Verifying FCA installation for Solaris

Before configuring the Fibre Channel HBAs, verify the HBA installation and recognition of the Fibre Channel HBA and driver.

Procedure

1. Log in to the Solaris system as root, and confirm that all existing devices are powered on and properly connected to the Solaris system.

2. Display the host configuration using the `dmesg` command. The fibre information includes the recognition of the *Fibre Channel adapter*, *SCSI bus characteristics*, *worldwide name*, and *FCA driver*. Ensure the host recognizes these four classes. If this information is not displayed or if error messages are displayed, the host environment may not be configured properly.

```
# dmesg

Nov  9 23:14
ems, Inc.
mem = 65536K (0x4000000)
avail mem = 60129280
Ethernet address = 8:0:20:92:32:48
root nexus = Sun Ultra 1 SBus (UltraSPARC 167MHz)
sbus0 at root: UPA 0x1f 0x0 ...
espdma0 at sbus0: SBus0 slot 0xe offset 0x8400000
esp0:   esp-options=0x46
esp0 at espdma0: SBus0 slot 0xe offset 0x8800000 Onboard device sparc9 ipl 4
sd0 at esp0: target 0 lun 0
sd0 is /sbus@1f,0/espdma@e,8400000/esp@e,8800000/sd@0,0
        <SUN2.1G cyl 2733 alt 2 hd 19 sec 80>
sd6 at esp0: target 6 lun 0
sd6 is /sbus@1f,0/espdma@e,8400000/esp@e,8800000/sd@6,0
fca0: JNI Fibre Channel Adapter (1062 MB/sec), model FC              ←
Verify that
fca0:   SBus 1: IRQ 4: FCODE Version 11.0.9 [1a6384]: SCSI ID 125: AL_PA 01  ←
these items
fca0:   Fibre Channel WWN: 100000e0690000d5                          ←
are listed.
fca0:   FCA Driver Version 2.2.HIT.03, Oct 09, 1999 Solaris 2.5, 2.6

fca0:   All Rights Reserved.
fca0:   < Total IOPB space used: 1125824 bytes >
fca0:   < Total DMA space used: 565277 bytes >
root on /sbus@1f,0/espdma@e,8400000/esp@e,8800000/sd@0,0:a fstype ufs
zs0 at sbus0: SBus0 slot 0xf offset 0x1100000 Onboard device sparc9 ipl 12
zs0 is /sbus@1f,0/zs@f,1100000
zs1 at sbus0: SBus0 slot 0xf offset 0x1000000 Onboard device sparc9 ipl 12
zs1 is /sbus@1f,0/zs@f,1000000
keyboard is </sbus@1f,0/zs@f,1000000> major <29> minor <2>
mouse is </sbus@1f,0/zs@f,1000000:b> major <29> minor <3>
```

```
stdin is </sbus@1f,0/zs@f,1000000> major <29> minor <2>
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
```

Setting the disk and device parameters for Solaris

The queue depth for the storage system devices (*max_throttle*, *max_pending* for Solaris ZFS) must be set as specified in the following table. You can adjust the queue depth for the devices later as needed to optimize the I/O performance. For details about queue depth, see .

Storage system	Recommended queue depth settings
VSP 5000 series	Target ports: ▪ 2,048 per port ▪ 32 per LDEV Bidirectional ports: ▪ 1,024 per port ▪ 32 per LDEV
VSP G1x00, VSP F1500	▪ 2,048 per port ▪ 32 per LDEV
VSP	▪ 2,048 per port ▪ 32 per LDEV
VSP E series	Target ports: ▪ 2,048 per port ▪ 32 per LDEV Universal ports: ▪ 1,024 per port ▪ 32 per LDEV
VSP G130, G/F350, G/F370, G/F700, G/F900	Target ports: ▪ 2,048 per port ▪ 32 per LDEV Universal ports: ▪ 1,024 per port ▪ 32 per LDEV
VSP G200, G400, G600, G800, VSP F400, F600, F800	▪ 1,024 per port ▪ 32 per LDEV

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Storage system	Recommended queue depth settings
HUS VM	▪ 2,048 per port ▪ 32 per LDEV

⚠️ **Caution:** Inappropriate settings, including *max_pending/throttle* and number of LUNs per ZFS pool, can significantly impact the SAN environment (for example, C3 discards). If you have any questions or concerns, contact your Hitachi Vantara representative for important information about these settings.

The required I/O time-out value (TOV) for storage system devices is 60 seconds (default TOV=60). If the I/O TOV has been changed from the default, change it back to 60 seconds by editing the `sd_io_time` or `ssd_io_time` parameter in the `/etc/system` file.

Several other parameters (for example, FC fibre support) may also need to be set. See the user documentation for the HBA to determine whether other options are required to meet your operational requirements.

Use the same settings and device parameters for all storage system devices. For Fibre Channel, the settings in the system file apply to the entire system, not to just the HBAs.

Procedure

1. Make a backup of the `/etc/system` file, for example:

   ```
   cp /etc/system /etc/system.old
   ```

2. Edit the `/etc/system` file as follows:

   a. To set the TOV, add the following to the `/etc/system` file: set `sd:sd_io_time=0x3c`.

      For Sun generic HBA: `set ssd:ssd_io_time=0x3c`

      ```
      *ident   "@(#)system     1.18    97/06/27 SMI" /* SVR4 1.5 */
      *
      * SYSTEM SPECIFICATION FILE
      *
      :
      *       To set a variable named 'debug' in the module named 'test_module'
      *
      *               set test_module:debug=0x13
                      set sd:sd_io_time=0x3c
                      set ssd:ssd_io_time=0x3c
      ```

   b. To set the queue depth, add the following to the `/etc/system` file: set `sd:sd_max_throttle=`*x*

      For Sun generic HBA: `set ssd:ssd_max_throttle=`*x*

      For Solaris ZFS: `set zfs:zfs_vdev_max_pending=`*x*

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where

- *x* = queue depth value

```
:
*    To set a variable named 'debug' in the module named 'test_module'
*
*          set test_module:debug=0x13

                set sd:sd_max_throttle=32
                set ssd:ssd_max_throttle=32
                set vdev:vdev_max_pending=32
```

3. Save your changes, and exit the text editor.
4. Shut down and reboot to apply the I/O TOV setting.

Configuring new devices on Solaris

This section describes how to configure the new disk devices that you attached to the Solaris system.

Setting and recognizing the LUs on Solaris

Once the storage system is installed and connected, set and recognize the new LUs by adding the logical devices to the `sd.conf` file (`/kernel/drv/sd.conf`). The `sd.conf` file includes the SCSI TID and LUN for all LDEVs connected to the Solaris system. After editing the `sd.conf` file, you will halt the system and reboot.

Procedure

1. Log in as *root*, and make a backup copy of the `/kernel/drv/sd.conf` file.

   ```
   cp -ip /kernel/drv/sd.conf /kernel/drv/sd.conf.standard
   ```

2. Edit the `/kernel/drv/sd.conf` file as shown in the following figure. Be sure to make an entry (SCSI TID and LUN) for each new device being added to the Solaris system. If the LUs have already been added to the `sd.conf` file, verify each new LU.

   ```
   # cp -ip /kernel/drv/sd.conf /kernel/drv/sd/conf/standard     ← Make backup of
   file.
   #
   # vi /kernel/drv/sd.conf                                       ← Edit the file
   (vi shown).
   #ident   "@(#)sd.conf   1.8    93/05/03 SMI"
   name="sd" class="scsi"                                        ← The SCSI class
   type name
          target=0 lun=0;                                            is used
   because the SCSI

                                                                   driver is used

   for fibre
   ```

```
name="sd" class="scsi"                                               channel.
        target=1 lun=0;


name="sd" class="scsi"
        target=2 lun=0;


name="sd" class="scsi"                                  ← Add this
information for
        target=2 lun=1;                                all new target
IDs
                                                       and LUNs.
name="sd" class="scsi"
        target=3 lun=0;


name="sd" class="scsi"
        target=4 lun=0;
#
# halt                                                 ← Enter halt.
Jan 11 10:10:09 sunss20 halt:halted by root
Jan 11 10:10:09 sunss20 syslogd:going down on signal 15
Syncing file systems... done
Halted


Program terminated
Type help for more information
OK


volume management starting.
The system is ready.


host console login: root                               ← Log in as root.
Password:                                              ← Password is not
displayed.
Oct 11 15:28:13 host login: ROOT LOGIN /dev/console
Last login:Tue Oct 11 15:25:12 on console
Sun Microsystems inc.  SunOS 5.5      Generic September 1993
#
#
#
```

> 📄 **Note:** If the FX volumes (for example, 3390-3A/B/C) are customized, their block number may be lower than the number displayed in this example.

3. Exit the vi editor.

```
ESC + :wq
```

4. Halt the Solaris system.

```
halt
```

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5. Reboot the Solaris system.

```
boot -r
```

6. Log in to the system as root, and verify that the system recognizes the storage system as shown in the following figure.

```
# dmesg | more
   :
sbus0 at root: UPA 0x1f 0x0 ...
fas0:  rev 2.2 FEPS chip

SUNW,fas0 at sbus0: SBus0 slot 0xe offset 0x8800000 and slot 0xe offset
0x8810000 Onboard device sparc9 ipl 4
SUNW,fas0 is /sbus@1f,0/SUNW,fas@e,8800000
sd0 at SUNW,fas0: target 0 lun 0
sd0 is /sbus@1f,0/SUNW,fas@e,8800000/sd@0,0
     <SUN2.1G cyl 2733 alt 2 hd 19 sec 80>
sd6 at SUNW,fas0: target 6 lun 0
sd6 is /sbus@1f,0/SUNW,fas@e,8800000/sd@6,0
WARNING: fca0: fmle: sc1: 000e0000  sc2: 00000000
fca0: JNI Fibre Channel Adapter (1062 MB/sec), model FC
fca0:  SBus 1 / IRQ 4 / FCODE Version 10 [20148b] / SCSI ID 125 / AL_PA 0x1
fca0:  Fibre Channel WWN: 100000e0690002b7
fca0:  FCA Driver Version 2.1+, June 24, 1998 Solaris 2.5, 2.6
fca0:  All Rights Reserved.
fca0:  < Total IOPB space used: 1100624 bytes >
fca0:  < Total DMA space used: 532644 bytes >
fca0: <HITACHI :OPEN-3        :5235> target 2 (alpa 0xe4) lun 0 online
sd192 at fca: target 2 lun 0
                         ↘  LUN = 0
                 ↘  target ID = 2
sd192 is /sbus@1f,0/fca@1,0/sd@2,0

WARNING: /sbus@1f,0/fca@1,0/sd@2,0 (sd192)
       corrupt label - wrong magic number                          ← Not yet
labeled.
        Vendor 'HITACHI', product 'OPEN-3', 4806720 512 byte blocks
               ↘  Vendor name            ↘   Number of blocks
                                    ↘  Product name
fca0: <HITACHI :OPEN-3        :5235> target 2 (alpa 0xdc) lun 2 online
sd193 at fca: target 2 lun 1          (LUN=1, target ID=2)
sd193 is /sbus@1f,0/fca@1,0/sd@2,1
WARNING: /sbus@1f,0/fca@1,0/sd@2,1 (sd193)
       corrupt label - wrong magic number
       Vendor 'HITACHI', product 'OPEN-3', 4806720 512 byte blocks
fca0: <HITACHI :OPEN-9        :5235> target 6 (alpa 0xdc) lun 0 online
sd.. at fca: target  lun 0    (LUN=0, target ID=6)
sd.. is /sbus@1f,0/fca@1,0/sd@4,0
WARNING: /sbus@1f,0/fca@1,0/sd@4,0 (sd..)
       corrupt label - wrong magic number                          ← Not yet
```

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```
labeled.
        Vendor 'HITACHI', product 'OPEN-9', 14423040 512 byte blocks
sd.. at fca: target 6 lun 0                                    ← Verify
target ID.
        corrupt label - wrong magic number                    ← Not yet
labeled.
        Vendor 'HITACHI', product 'OPEN-9', 14423040 512 byte blocks
sd.. is /sbus@1f,0/fca@1,0/sd@5,0
WARNING: /sbus@1f,0/fca@1,0/sd@5,0 (sd..)
        corrupt label - wrong magic number                    ← Not yet
labeled.
        Vendor 'HITACHI', product '3390-3B', 5822040 512 byte blocks
sd.. is /sbus@1f,0/fca@1,0/sd@6,0
WARNING: /sbus@1f,0/fca@1,0/sd@6,0 (sd..)
        corrupt label - wrong magic number                    ← Not yet
labeled.
        Vendor 'HITACHI', product '3390-3A', 5825520 512 byte blocks
sd.. is /sbus@1f,0/fca@1,0/sd@8,0
```

7. Verify that the vendor name, product name, and number of blocks match the values shown in the figure in step 6.

Verification of new device recognition on Solaris

After system start-up, log in as root and use the **dmesg | more** command to verify that the Solaris system recognizes the storage system. Confirm that the displayed vendor names, product names, and number of blocks match the values in the following figure. If the results are different from the intended system configuration, the path definition or fibre cabling might be wrong.

📄 **Note:** When the Solaris system accesses the multiplatform devices, the message `Request sense couldn't get sense data` might be displayed. You can disregard this message.

```
# dmesg | more
 :
sbus0 at root: UPA 0x1f 0x0 ...
fas0:  rev 2.2 FEPS chip

SUNW,fas0 at sbus0: SBus0 slot 0xe offset 0x8800000 and slot 0xe offset 0x8810000
Onboard device sparc9 ipl 4
SUNW,fas0 is /sbus@1f,0/SUNW,fas@e,8800000
sd0 at SUNW,fas0: target 0 lun 0
sd0 is /sbus@1f,0/SUNW,fas@e,8800000/sd@0,0
     <SUN2.1G cyl 2733 alt 2 hd 19 sec 80>
sd6 at SUNW,fas0: target 6 lun 0
sd6 is /sbus@1f,0/SUNW,fas@e,8800000/sd@6,0
WARNING: fca0: fmle: sc1: 000e0000  sc2: 00000000
fca0: JNI Fibre Channel Adapter (1062 MB/sec), model FC
fca0: SBus 1 / IRQ 4 / FCODE Version 10 [20148b] / SCSI ID 125 / AL_PA 0x1
```

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```
fca0: Fibre Channel WWN: 100000e0690002b7
fca0: FCA Driver Version 2.1+, June 24, 1998 Solaris 2.5, 2.6
fca0: All Rights Reserved.
fca0: < Total IOPB space used: 1100624 bytes >
fca0: < Total DMA space used: 532644 bytes >
fca0: <HITACHI :OPEN-3          :5235> target 2 (alpa 0xe4) lun 0 online
sd192 at fca: target 2 lun 0
                      ╲          ╲ LUN = 0
                        target ID = 2
sd192 is /sbus@1f,0/fca@1,0/sd@2,0
WARNING: /sbus@1f,0/fca@1,0/sd@2,0 (sd192)
        corrupt label - wrong magic number                              ← Not
yet labeled.
        Vendor 'HITACHI', product 'OPEN-3',    4806720 512 byte blocks
                  ╲ Vendor name     ╲ Product name   ╲ Number of blocks
fca0: <HITACHI :OPEN-3          :5235> target 2 (alpa 0xdc) lun 1 online
sd193 at fca: target 2 lun 1          (LUN=1, target ID=2)
sd193 is /sbus@1f,0/fca@1,0/sd@2,1
WARNING: /sbus@1f,0/fca@1,0/sd@2,1 (sd193)
        corrupt label - wrong magic number
        Vendor 'HITACHI', product 'OPEN-3', 4806720 512 byte blocks
```

This example shows two new disks on fca@1: target ID is 2, LUNs are 0 and 1, vendor name is "HITACHI", product name is "OPEN-3", and number of blocks is 4806720. LUNs 0 and 1 are assigned as device names sd192 and sd193, respectively. Details for other disks:

▪ vendor name "HITACHI", product name "OPEN-9" and 14423040 512-byte blocks

▪ vendor name "HITACHI", product name "3390-3B" and 5822040 512-byte blocks

▪ vendor name "HITACHI", product name "3390-3A" and 5825520 512-byte blocks

Partitioning and labeling the new devices on Solaris

After the Solaris system recognizes the new devices, partition and label the devices. All new devices, including all SCSI disk devices format and FX devices, must be partitioned and labeled using the format utility (see Caution below).

▪ Each SCSI disk device (for example, OPEN-*x*) can have more than one partition.

▪ Each FX device (for example, 3390-3A) must have one partition of fixed size.

The disk partitioning and labeling procedure involves the following tasks:

1. Defining and setting the disk type.
2. Setting the partitions.
3. Labeling the disk (required for devices to be managed by HDLM).
4. Verifying the disk label.

A good way to partition and label the disks is to partition and label all devices of one type (for example, OPEN-3), then all devices of the next type (for example, OPEN-9), and so on until you partition and label all new devices. You will enter this information into the Solaris system during the disk partitioning and labeling procedure.

> ⚠ **Caution:** Be extremely careful when using the Solaris format utility. Do not use any `format` commands not described in this document. The format utility is designed for Sun disks. Some `format` commands are not compatible with the storage system and can overwrite the data on the disk. The storage system will not respond to the `format` command (devices are formatted using the SVP or management software), and will not report any defect data in response to the `defect` command.

Procedure

1. Enter `format` at the `root` prompt to start the **format** utility.

```
# format                                               ← Start format
utility.
Searching for disks...done

c1t2d0: configured with capacity of 2.29GB   (OPEN-3)  ← These devices are not
yet labeled.
c1t2d1: configured with capacity of 2.29GB   (OPEN-3)  ←
c2t4d0: configured with capacity of 6.88GB   (OPEN-9)  ←
c2t5d0: configured with capacity of 2.77GB   (3390-3B) ←
c2t6d0: configured with capacity of 2.78GB   (3390-3A) ←
  ⬚ These character-type device file names are used later to create the file
systems.

AVAILABLE DISK SELECTIONS:

       0. c0t1d0 <SUN1.05 cyl 2036 alt 2 hd 14 sec 72>           ← Already
labeled.
          /iommu@f,e0000000/sbus@f,e0001000/espdma@f,400000/esp@f,800000/sd@1,0
       1. c0t3d0 <SUN1.05 cyl 2036 alt 2 hd 14 sec 72>           ← Already
labeled.
          /iommu@f,e0000000/sbus@f,e0001000/espdma@f,400000/esp@f,800000/sd@3,0
       2. c1t2d0 <HITACHI-OPEN-3-52-34                           ← Not yet
labeled:
                 ↘ LUN                ↘ Product version
                     ↘ Vendor   ↘ Product ID
               ↘ Target Id
           ↘ Logical Controller ID
          /iommu@f,e0000000/sbus@f,e0001000/....,isp@1,10000/sd@2,0   OPEN-3,
TID=2, LUN=0
       3. c1t2d1 <HITACHI-OPEN-3-52-34                           ← Not
yet labeled:
          /iommu@f,e0000000/sbus@f,e0001000/....,isp@1,10000/sd@2,1   OPEN-3,
TID=2, LUN=1
       4. c1t4d0 <HITACHI-OPEN-9-52-34                           ← Not
yet labeled:
          /iommu@f,e0000000/sbus@f,e0001000/....,isp@1,10000/sd@4,0   OPEN-9,
TID=4, LUN=0
       5. c1t5d0 <HITACHI-3390-3B-52-34                          ← Not
```

```
yet labeled:
        /iommu@f,e0000000/sbus@f,e0001000/....,isp@1,10000/sd@5,0   3390-3B,
TID=5, LUN=0
     6. c1t6d0 <HITACHI-3390-3A-52-34                              ← Not
yet labeled:
        /iommu@f,e0000000/sbus@f,e0001000/....,isp@1,10000/sd@6,0   3390-3A,
TID=6, LUN=0
Specify disk (enter its number): 2                                  ←
Select device.
selecting c1t2d0
[disk formatted]
Disk not labeled.  Label it now ? n                                 ←
Enter "n" for no.
:
#
```

    a. Verify that all new devices are displayed. If not, exit the **format** utility (`quit` or `Ctrl d`), and then be sure the SCSI/fibre-to-LDEV paths were defined for all devices and that all new devices were added to the driver configuration file). For troubleshooting information see <u>Troubleshooting for Solaris host attachment (on page 126)</u>.

    b. Write down the character-type device file names (for example, c1t2d0) for all of the new devices. You will need this information later to create the file systems.

2. When prompted to specify the disk, enter the number (from the list) for the device to be partitioned and labeled. Remember the device type of this device (for example, OPEN-3).

3. When prompted to label the disk, enter `y` for "yes" and enter the desired label. Devices that will be managed by HDLM require a label. If you are sure that the device will not need a label, you can enter `n` for "no".

4. When the **format** menu appears, enter `type` to display the disk types. The disk types are listed in the device specifications table in <u>Logical device types (on page 14)</u> (vendor name + product name, for example, HITACHI OPEN-3).

5. If the disk type for the selected device is already defined, enter the number for that disk type and skip to step 7.

> **Note:**
> - Do not use HITACHI-OPEN-x-0315, HITACHI-3390-3A/B-0315. These disk types are created automatically by the Solaris system and cannot be used for the storage system devices.
> - LU capacity must be less than 1 TB. In case of selecting other type, the disk type parameters described below cannot be set for an LU larger than 32,767 data cylinders.

6. If the disk type for the selected device is not already defined, enter the number for `other` to define a new disk type.

7. Enter the disk type parameters for the selected device using the data provided above. Be sure to enter the parameters exactly as shown in the following figure.

```
FORMAT MENU:
        disk      - select a disk
        type      - select (define) a disk type
        partition - select (define) a partition table
        current   - describe the current disk
        format    - format and analyze the disk
        repair    - repair a defective sector
        label     - write label to the disk
        analyze   - surface analysis
        defect    - defect list management
        backup    - search for backup labels
        verify    - read and display labels
        save      - save new disk/partition definitions
        inquiry   - show vendor, product and revision
        volume    - set 8-character volume name
        quit


# format> type                                        ← Enter type.
:
AVAILABLE DRIVE TYPES
        0. Auto configure
            :
        14. SUN2.1G
        15. HITACHI-OPEN-3-0315                        ← Do not select this disk
type.
        16. other                                        (Note 3)
Specify disk type (enter its number):16              ← Enter number for "other"
to define.
Enter number of data cylinders:3336                  ← See Note 1 and Note 5
Enter number of alternate cylinders[2]:2             ← See Note 5
Enter number of physical cylinders[3338]:               (press Enter for default)
Enter number of heads:15                             ← See Note 6
Enter number of physical sectors/track[defaults]:       (press Enter for default)
Enter rpm of drive [3600]:10000                      ← See Note 2 and Note 5)
Enter format time[defaults]:                            (press Enter for default)
Enter cylinder skew[defaults]:                          (press Enter for default)
Enter track skew[defaults]:                             (press Enter for default)
Enter track per zone[defaults]:                         (press Enter for default)
Enter alternate tracks[defaults]:                       (press Enter for default)
Enter alternate sectors[defaults]:                      (press Enter for default)
Enter cache control[defaults]:                          (press Enter for default)
Enter prefetch threshold[defaults]:                     (press Enter for default)
Enter minimum prefetch[defaults]:                       (press Enter for default)
Enter maximum prefetch[defaults]:                       (press Enter for default)
Enter disk type name(remember quotes):"HITACHI OPEN-3"   ← See Note 7
selecting c1t2d0
[disk formatted]
No defined partition tables.
```

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```
Disk not labeled.  Label it now ? n                      ← Enter "n" for no.
format>
```

Figure notes

1. The number of cylinders for the 3390-3B is 3346, and the storage system returns '3346 cylinder' to the `Mode Sense` command, and '5822040 blocks' (Maximum LBA 5822039) to the `Read capacity` command. When 3390-3B is not labeled yet, Solaris displays 3344 data cylinders and 2 alternate cylinders. When 3390-3B is labeled by the Solaris format type subcommand, use 3340 for data cylinder and 2 for alternate cylinder. This is similar to the 3390-3B VLL.

2. The storage system reports the RPM of the physical disk drive in response to the `type` subcommand parameter.

3. It is also possible to follow the procedure using type => "0. Auto configure" => label the drive without calculating detail values such as Cylinder, Header, Blocks/Tracks.

4. Setting host mode 16 affects the geometry parameter reported by the storage system (see Device geometry parameter tables for Solaris (on page 109)) as follows:

- Setting host mode option 16 to ON increases the number of cylinders by 4 and reduces the number of blocks per track by ¼.

- Setting host mode option 16 to OFF lowers the number of cylinders by ¼ and increases the number of blocks per track by 4. Therefore, if you use host mode option 16, please account for these differences. For example, if you change the host mode option 16 from OFF to ON, you may want to make either of the following changes in the **Format** menu:

  - Increase the number of block setting per track by ¼ and the number of heads by 4.

  - Increase the number of blocks per track to ¼, the number of cylinders by 2, and the number of heads by 2.

  If the number of cylinders entered exceeds 65,533, the total LU block number equals or is less than 65,533. Use the **Format** Menu to specify the numbers of cylinders, heads, and blocks per track.

5. Enter values from Device Geometry Parameters table (see Device geometry parameter tables for Solaris (on page 109)).

6. Enter values from Geometry parameters for OPEN-3*n LUSE devices table (see Device geometry parameter tables for Solaris (on page 109)).

7. Enter values from Device specifications table (see Logical device types (on page 14)) .

8. When prompted to label the disk, enter n for "no".

9. When the **format** menu appears, enter `partition` to display the **partition** menu.

10. Enter the desired partition number and the partition parameters shown in the following example and in the tables in Device geometry parameter tables for Solaris (on page 109).

```
format> disk
```

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```
AVAILABLE DISK SELECTIONS
        0. c0t1d0 <SUN1.05 cyl 2036 alt 2 hd 14 sec 72>
           /iommu@f,e0000000/sbus@f,e0001000/espdma@f,400000/esp@f,800000/sd@1,0
        1. c0t3d0 <SUN1.05 cyl 2036 alt 2 hd 14 sec 72>
           /iommu@f,e0000000/sbus@f,e0001000/espdma@f,400000/esp@f,800000/sd@3,0
        2. c1t2d0 <HITACHI OPEN-3 cyl 3336 alt 2 hd 15 sec 96> ← already labeled
           /iommu@f,e0000000/sbus@f,e0001000/....,isp@0,10000/sd@2,0
        3. c1t2d1 <HITACHI-OPEN-3-52-34 .....>                 ← not yet labeled
           /iommu@f,e0000000/sbus@f,e0001000/....,isp@0,10000/sd@2,1
        4. c1t4d0 <HITACHI-OPEN-9-52-34 .....>                 ← not yet labeled
           /iommu@f,e0000000/sbus@f,e0001000/....,isp@1,10000/sd@4,0
        5. c1t5d0 <HITACHI-3390-3B-52-34 ....>                 ← not yet labeled
           /iommu@f,e0000000/sbus@f,e0001000/....,isp@1,10000/sd@5,0
        6. c1t6d0 <HITACHI-3390-3A-52-34 ....>                 ← not yet labeled
           /iommu@f,e0000000/sbus@f,e0001000/....,isp@1,10000/sd@6,0


Specify disk (enter its number): 3


FORMAT MENU:
        disk      - select a disk
        type      - select (define) a disk type
        partition - select (define) a partition table
        current   - describe the current disk
        format    - format and analyze the disk
        repair    - repair a defective sector
        label     - write label to the disk
        analyze   - surface analysis
        defect    - defect list management
        backup    - search for backup labels
        verify    - read and display labels
        save      - save new disk/partition definitions
        inquiry   - show vendor, product and revision
        volume    - set 8-character volume name
        quit
format> type


AVAILABLE DRIVE TYPES
        0.Auto configure
           :
        13. SUN1.3G
        14. SUN2.1G
        15. HITACHI-OPEN-3-52-34
        16. HITACHI OPEN-3
        17. other
Specify disk type (enter its number):16
:


selecting c0t2d0
[disk formatted]
No defined partition tables.
Disk not labeled.  Label it now ? n
```

```
format>
FORMAT MENU:
        disk      - select a disk
        type      - select (define) a disk type
        partition - select (define) a partition table
        current   - describe the current disk
        format    - format and analyze the disk
        repair    - repair a defective sector
        label     - write label to the disk
        analyze   - surface analysis
        defect    - defect list management
        backup    - search for backup labels
        verify    - read and display labels
        save      - save new disk/partition definitions
        inquiry   - show vendor, product and revision
        volname   - set 8-character volume name
        <cmd>     - execute <cmd>, then return
        quit
format> partition


PARTITION MENU
        0       - change '0' partition
        1       - change '1' partition
        2       - change '2' partition
        3       - change '3' partition
        4       - change '4' partition
        5       - change '5' partition
        6       - change '6' partition
        7       - change '7' partition
        select - select a predefined table
        modify - modify a predefined partition table
        name   - name the current table
        print  - display the current table
        label  - write partition map and label to the disk
        quit
partition> 0
Part       Tag     Flag    Cylinders      Size       Blocks
  0   unassigned    wm        0 -           0         (0/0/0)


Enter partition id tag [root]:
Enter partition permission flags [wm]:
Enter new starting cyl [0]:
Enter partition size [0b, 0c, 0.00mb]:3336c
partition> print                               ← (see Note,
below)
:
Current partition table (unnamed)
Part        Tag    Flag    Cylinders     Size               Blocks
  0        root     wm       0 -           0         (0/0/0)         0
  1        swap     wm       0 -           0         (0/0/0)         0
  2       backup    wu       0 - 3335    2.29 GB   (3336/0/0)   4803840
```

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```
3   unassigned   wu     0 -           0          (0/0/0)       0
4   unassigned   wm     0 -           0          (0/0/0)       0
5   unassigned   wm     0 -           0          (0/0/0)        0
6          usr   wm   336 - 3335    204 GB    (2970/0/0)    4276800
7   unassigned   wm     0 -           0          (0/0/0)       0
```

> **Note:** The Solaris system displays the following warnings when an FX device (for example, 3390-3A) is labeled. You can ignore these warnings:
>
> ```
> Warning: error warning VTOC.
> ```
>
> ```
> Warning: no backup labels. Label failed.
> ```

11. At the `partition>` prompt, enter print to display the current partition table.

12. Repeat steps 9 and 10 as needed to set the desired partitions for the selected device.

> **Note:** This step does not apply to the multiplatform devices (for example, 3390-3A/B/C), because these devices can only have one partition of fixed size.

13. After setting the partitions for the selected device, enter `label` at the `partition>` prompt, and enter `y` to label the device (see the following figure).

```
PARTITION MENU
      0       - change '0' partition
      1       - change '1' partition
      2       - change '2' partition
      3       - change '3' partition
      4       - change '4' partition
      5       - change '5' partition
      6       - change '6' partition
      7       - change '7' partition
      select - select a predefined table
      modify - modify a predefined partition table
      name   - name the current table
      print  - display the current table
      label  - write partition map and label to the disk
      quit
partition> label                                              ← Label
the disk.
Ready to label disk, continue? Y                              ← Enter Y
for yes.
  * (see Note, below)
partition> quit                                               ← Return
to format.
format> disk                                                  ← Display
disks.

AVAILABLE DISK SELECTIONS
      0. c0t1d0 <SUN1.05 cyl 2036 alt 2 hd 14 sec 72>
         /iommu@f,e0000000/sbus@f,e0001000/espdma@f,400000/esp@f,800000/sd@1,0
      1. c0t3d0 <SUN1.05 cyl 2036 alt 2 hd 14 sec 72>
```

```
                /iommu@f,e0000000/sbus@f,e0001000/espdma@f,400000/esp@f,800000/sd@3,0
        2. c1t2d0 <HITACHI OPEN-3 cyl 3336 alt 2 hd 15 sec 96>          ← Verify
disk label.
                                                        ╲ Track size.
                                                      ╲  Number of heads.
                                                   ╲  Number of alternate cylinders.
                                                 ╲  Number of data cylinders.
                        □  Disk type name.
           /iommu@f,e0000000/sbus@f,e0001000/....,isp@0,10000/sd@2,0
        3. c1t2d1 <HITACHI-OPEN-3-0315 ..................... >          ← Not
yet labeled.
           /iommu@f,e0000000/sbus@f,e0001000/....,isp@0,10000/sd@2,1
        4. c1t4d0 <HITACHI-OPEN-9-0315 .................... >          ← Not
yet labeled.
           /iommu@f,e0000000/sbus@f,e0001000/....,isp@1,10000/sd@4,0
        5. c1t5d0 <HITACHI-3390-3B-0315 ................... >          ← Not
yet labeled.
           /iommu@f,e0000000/sbus@f,e0001000/....,isp@1,10000/sd@5,0
        6. c1t6d0 <HITACHI-3390-3A-0315 ................... >          ← Not
yet labeled.
           /iommu@f,e0000000/sbus@f,e0001000/....,isp@1,10000/sd@6,0

Specify disk (enter its number): 3                 ← Enter number for next disk
to label,
                                                   or press Ctrl-d to quit.
```

> 📄 **Note:**
>
> The Solaris system displays the following warnings when an FX device (for example, 3390-3A/B/C) is labeled. You can ignore these warnings.
>
> `Warning: error warning VTOC.`
>
> `Warning: no backup labels.`
>
> `Label failed.`

14. Enter `quit` to exit the **partition** utility and return to the **format** utility.

15. At the `format>` prompt, enter `disk` to display the available disks. Verify that the disk you just labeled is displayed with the proper disk type name and parameters.

16. Repeat steps 2 through 15 for each new device to be partitioned and labeled. After a device type is defined (for example, HITACHI OPEN-3), you can label all devices of that same type without having to enter the parameters (skipping steps 6 and 7). For this reason, you may want to label the devices by type (for example, labeling all OPEN-3 devices, then all OPEN-9 devices, and so on) until all new devices have been partitioned and labeled.

17. When you finish partitioning and labeling the disks and verifying the disk labels, exit the **format** utility by entering `quit` or `Ctrl-d`.

Device geometry parameter tables for Solaris

The following tables provide the device geometry parameters.

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Device geometry parameters

Device Type	# of Data Cylinders	# of Alternate Cylinders	RPM	Partition Size (sample)
OPEN-3	3336	2	10,000	3336c
OPEN-8	9964	2	10,000	9964c
OPEN-9	10014	2	10,000	10014c
OPEN-E	19757	2	10,000	19757c
OPEN-L	19013	2	10,000	19013c
OPEN-3*n	N1*	2	10,000	N4*
OPEN-8*n	N26*	2	10,000	N29*
OPEN-9*n	N5*	2	10,000	N8*
OPEN-E*n	N30*	2	10,000	N33*
OPEN-L*n	N34	2	10,000	N37
OPEN-x VLL	See the device specifications table in Logical device types (on page 14).	2	10,000	See the device specifications table in Logical device types (on page 14).
OPEN-3*n VLL	N22*	2	10,000	N25*
OPEN-8*n VLL	N22*	2	10,000	N25*
OPEN-9*n VLL	N22*	2	10,000	N25*
OPEN-E*n VLL	N22*	2	10,000	N25*
OPEN-V*n VLL	N22*	2	10,000	N25*
3390-3A	3346	2	10,000	3346c
3390-3B	3340	2	10,000	3340c
3390-3C	3346	2	10,000	3346c
FX OPEN-3	3336	2	10,000	3336c
3390-3A VLL	See the device specifications table in Logical device types (on page 14).	2	10,000	See the device specifications table in Logical device types (on page 14).

Device Type	# of Data Cylinders	# of Alternate Cylinders	RPM	Partition Size (sample)
3390-3B VLL	See the device specifications table in Logical device types (on page 14).	2	10,000	See the device specifications table in Logical device types (on page 14).
3390-3C VLL	See the device specifications table in Logical device types (on page 14).	2	10,000	See the device specifications table in Logical device types (on page 14).
FX OPEN-3 VLL	See the device specifications table in Logical device types (on page 14).	2	10,000	See the device specifications table in Logical device types (on page 14).
Note: For the values indicated by N*xx* (for example, N15, N22), see all the tables for geometry parameters listed below.				

Geometry parameters for OPEN-3*n LUSE devices

n	Data Cylinders-N1 Partition Size-N4	Heads-N2	Blocks/Track-N3	Usable Blocks (N1+2)*N2*N3	Provided Blocks=3338*15*96*n	Diff.
2	6674	15	96	9613440	9613440	0
3	10012	15	96	14420160	14420160	0
4	13350	15	96	19226880	19226880	0
5	16688	15	96	24033600	24033600	0
6	20026	15	96	28840320	28840320	0
7	23364	15	96	33647040	33647040	0
8	26702	15	96	38453760	38453760	0
9	30040	15	96	43260480	43260480	0
10	16688	30	96	48067200	48067200	0
11	20026	33	80	52873920	52873920	0
12	20026	30	96	57680640	57680640	0

n	Data Cylinders-N1 Partition Size-N4	Heads-N2	Blocks/ Track-N3	Usable Blocks (N1+2)*N2*N3	Provided Blocks=3338*15* 96*n	Diff.
13	20026	39	80	62487360	62487360	0
14	23364	30	96	67294080	67294080	0
15	16688	45	96	72100800	72100800	0
16	26702	30	96	76907520	76907520	0
17	30040	34	80	81714240	81714240	0
18	30040	30	96	86520960	86520960	0
19	30040	38	80	91327680	91327680	0
20	16688	60	96	96134400	96134400	0
21	23364	45	96	100941120	100941120	0
22	30040	55	64	105747840	105747840	0
23	30040	46	80	110554560	110554560	0
24	20026	60	96	115361280	115361280	0
25	16688	45	160	120168000	120168000	0
26	20026	39	160	124974720	124974720	0
27	30040	45	96	129781440	129781440	0
28	23364	60	96	134588160	134588160	0
29	30040	58	80	139394880	139394880	0
30	16688	45	192	144201600	144201600	0
31	30040	62	80	149008320	149008320	0
32	26702	60	96	153815040	153815040	0
33	30040	55	96	158621760	158621760	0
34	30040	64	85	163428480	163428480	0
35	30040	56	100	168235200	168235200	0
36	30040	60	96	173041920	173041920	0

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n	Data Cylinders-N1 Partition Size-N4	Heads-N2	Blocks/ Track-N3	Usable Blocks (N1+2)*N2*N3	Provided Blocks=3338*15* 96*n	Diff.
Notes:						
N1, N2, N3: Use values from the Device geometry parameters table.						
N4: Use same value as N1. Specify as *NNNN*c, where *NNNN* = # of cylinders and c = cylinder (for example, enter 6674c for OPEN-3*2).						

Geometry parameters for OPEN-8*n LUSE devices

n	Data Cylinders-N26 Partition Size-N29	Heads-N27	Blocks/ Track-N28	Usable Blocks (N26+2)*N27*N28	Provided Blocks =9966*15*96*n	Diff.
2	19930	15	96	28702080	28702080	0
3	29896	15	96	43053120	43053120	0
4	29896	20	96	57404160	57404160	0
5	29896	25	96	71755200	71755200	0
6	29896	30	96	86106240	86106240	0
7	29896	35	96	100457280	100457280	0
8	29896	40	96	114808320	114808320	0
9	29896	45	96	129159360	129159360	0
10	29896	50	96	143510400	143510400	0
11	29896	55	96	157861440	157861440	0
12	29896	60	96	172212480	172212480	0
13	29896	52	120	186563520	186563520	0
14	29896	56	120	200914560	200914560	0
15	29896	60	120	215265600	215265600	0
16	29896	64	120	229616640	229616640	0
17	29896	34	240	243967680	243967680	0
18	29896	36	240	258318720	258318720	0

n	Data Cylinders-N26 Partition Size-N29	Heads-N27	Blocks/ Track-N28	Usable Blocks (N26+2)*N27*N28	Provided Blocks =9966*15*96*n	Diff.
19	29896	38	240	272669760	272669760	0
20	29896	40	240	287020800	287020800	0
21	29896	42	240	301371840	301371840	0
22	29896	44	240	315722880	315722880	0
23	29896	46	240	330073920	330073920	0
24	29896	48	240	344424960	344424960	0
25	29896	50	240	358776000	358776000	0
26	29896	52	240	373127040	373127040	0
27	29896	54	240	387478080	387478080	0
28	29896	56	240	401829120	401829120	0
29	29896	58	240	416180160	416180160	0
30	29896	60	240	430531200	430531200	0
31	29896	62	240	444882240	444882240	0
32	29896	64	240	459233280	459233280	0
33	32614	60	242	473584320	473584320	0
34	29896	64	255	487935360	487935360	0
35	30655	64	256	502284288	502286400	2112
36	31531	64	256	516636672	516637440	768

Notes:

N26, N27, N28: Use values from the device specifications table in Logical device types (on page 14).

N29: Use same value as N26. Specify as *NNNN*c, where *NNNN* = # of cylinders and c = cylinder (for example, enter 19930c for OPEN-8*2).

📄 **Note:** Data cylinders must be less than or equal to *32767*, heads must be less than or equal to *64*, blocks per track must be less than or equal to *256* when these values are specified as parameters of Solaris format type subcommand. The whole data blocks of OPEN-3*2 ~ OPEN-3*36 can be used by above parameters.

Geometry parameters for OPEN-9*n LUSE devices

n	Data Cylinders-N5 Partition Size-N8	Heads-N6	Blocks/ Track-N7	Usable Blocks (N5+2)*N6*N7	Provided Blocks =10016*15*96*n	Diff.
2	20030	15	96	28846080	28846080	0
3	30046	15	96	43269120	43269120	0
4	30046	20	96	57692160	57692160	0
5	30046	25	96	72115200	72115200	0
6	30046	30	96	86538240	86538240	0
7	30046	35	96	100961280	100961280	0
8	30046	40	96	115384320	115384320	0
9	30046	45	96	129807360	129807360	0
10	30046	50	96	144230400	144230400	0
11	30046	55	96	158653440	158653440	0
12	30046	60	96	173076480	173076480	0
13	30046	52	120	187499520	187499520	0
14	30046	56	120	201922560	201922560	0
15	30046	60	120	216345600	216345600	0
16	30046	64	120	230768640	230768640	0
17	30046	34	240	245191680	245191680	0
18	30046	36	240	259614720	259614720	0
19	30046	38	240	274037760	274037760	0
20	30046	40	240	288460800	288460800	0
21	30046	42	240	302883840	302883840	0
22	30046	44	240	317306880	317306880	0
23	30046	46	240	331729920	331729920	0
24	30046	48	240	346152960	346152960	0
25	30046	50	240	360576000	360576000	0
26	30046	52	240	374999040	374999040	0

n	Data Cylinders-N5 Partition Size-N8	Heads-N6	Blocks/ Track-N7	Usable Blocks (N5+2)*N6*N7	Provided Blocks =10016*15*96*n	Diff.
27	30046	54	240	389422080	389422080	0
28	30046	56	240	403845120	403845120	0
29	30046	58	240	418268160	418268160	0
30	30046	60	240	432691200	432691200	0
31	30046	62	240	447114240	447114240	0
32	30046	64	240	461537280	461537280	0
33	30985	64	240	475960320	475960320	0
34	31924	64	240	490383360	490383360	0
35	31298	63	256	504806400	504806400	0
36	31689	64	256	519225344	519229440	4096

Notes:

N5, N6, N7: Use values from Device geometry parameters table and Geometry parameters for OPEN-3*n LUSE devices table.

N8: Use same value as N5. Specify as *NNNN*c, where *NNNN* = # of cylinders and c = cylinder (for example, enter 20030c for OPEN-9*2).

Geometry parameters for OPEN-E*n LUSE devices

n	Data Cylinders-N30 Partition Size-N33	Heads-N31	Blocks/ Track-N32	Usable Blocks (N30+2)*N31*N32	Provided Blocks =9966*15*96*n	Diff.
2	19757	30	96	56905920	56905920	0
3	19757	45	96	85358880	85358880	0
4	19757	60	96	113811840	113811840	0
5	19757	30	240	142264800	142264800	0
6	19757	45	192	170717760	170717760	0
7	19757	60	168	199170720	199170720	0

n	Data Cylinders-N30 Partition Size-N33	Heads-N31	Blocks/ Track-N32	Usable Blocks (N30+2)*N31*N32	Provided Blocks =9966*15*96*n	Diff.
8	19757	60	192	227623680	227623680	0
9	19757	60	216	256076640	256076640	0
10	19757	60	240	284529600	284529600	0
11	27166	60	192	312975360	312982560	7200
12	29636	60	192	341429760	341435520	5760
13	32106	60	192	369884160	369888480	4320
14	27660	60	240	398332800	398341440	8640
15	29636	60	240	426787200	426794400	7200
16	31612	60	240	455241600	455247360	5760
17	31612	60	255	483694200	483700320	6120
18	31257	64	256	512147456	512153280	5824

Notes:

N30, N31, N32: Use values from Device geometry parameters table.

N33: Use same value as N30. Specify as *NNNNc*, where *NNNN* = # of cylinders and c = cylinder (for example, enter 19757c for OPEN-E*2).

Note: Data cylinders must be less than or equal to *32767*, heads must be less than or equal to *64*, blocks per track must be less than or equal to *256* when these values are specified as parameters of Solaris format type subcommand. The whole data blocks of OPEN-E*2☐OPEN-E*10 can be used by above parameters. About OPEN-E*11~OPEN-E*18, some blocks must become unusable.

Geometry parameters for OPEN-L*n LUSE devices

n	Data Cylinders-N34 Partition Size-N37	Heads-N35	Blocks/ Track-N36	Usable Blocks (N34+2)*N35*N36	Provided Blocks =49439*15*96*n	Diff.
2	19013	64	117	142384320	142384320	0
3	30422	36	195	213576480	213576480	0
4	30422	45	208	284768640	284768640	0
5	30422	60	195	355960800	355960800	0
6	30422	60	234	427152960	427152960	0
7	30897	63	256	498339072	498345120	6048

Notes:

N34, N35, N36: Use values from Device geometry parameters table.

N37: Use same value as N34. Specify as *NNNN*c, where *NNNN* = # of cylinders and c = cylinder (for example, enter19013c for OPEN-L*2).

📄 **Note:** Data cylinders must be less than or equal to *32767*, heads must be less than or equal to *64*, blocks per track must be less than or equal to *256* when these values are specified as parameters of Solaris format type subcommand. The whole data blocks of OPEN-L*2☐OPEN-L*6 can be used by above parameters. About OPEN-L*7, some blocks must become unusable.

Geometry parameters for OPEN-x*n VLL-LUSE devices (example)

Data Cylinders-N22 Partition Size-N25	Heads-N23	Blocks/ Track-N24	Usable Blocks (N22+2)*N23*N24	Provided Blocks-N21	Diff.
98	15	96	144000	35MB*2 volumes ceil (35*1024/720)*2 =100 100*15*96=144000	0
2590	15	96	3732480	50MB*36 volumes ceil (50*1024/720)*36=2592 2592*15*96=3732480	0

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Data Cylinders-N22 Partition Size-N25	Heads-N23	Blocks/ Track-N24	Usable Blocks (N22+2)*N23*N24	Provided Blocks-N21	Diff.
284	15	96	411840	100MB*2 volumes ceil (100*1024/720)*2=286 286*15*96=411840	0
5694	15	96	8202240	500MB*8 volumes ceil (500*1024/720)*8=5696 5696*15*96=8202240	0
22758	30	96	65548800	2000MB*2 volumes ceil (2000*1024/720)*16=45520 45520*15*96=65548800	0
27455	40	188	206476640	2800MB*36 volumes ceil (2800*1024/720)*36=143388 143388*15*96=206478720	2080

Notes:

N21 # of blocks of LUSE composed by VLL volumes are calculated by:

N21 = N20 x (# of heads) x (# of sectors per track).

N22: N20 – 2, Use total cylinder – 2.

N23, **N24**: Use values from Device geometry parameters table and Geometry parameters for OPEN-3*n LUSE devices table.

N25: Use same value as N22.

Geometry parameters for OPEN-V*n VLL-LUSE devices (example)

Data Cylinders-N22 Partition Size-N25	Heads-N23	Blocks/ Track-N24	Usable Blocks (N22+2)*N23*N 24	Provided Blocks-N21	Diff.
48	15	128	92160	45 MB volumes ceil (45 * 16/15) = 48 48 * 15 * 128 = 92160	0
27305	30	128	104858880	50 GB volumes ceil (50 * 1024 * 16/15) = 54614 54614 * 15 * 128 = 104858880	0
10921	150	128	209721600	10 GB * 10 volumes ceil (10 * 1024 * 16/15) * 10 = 109230 109230 * 15 * 128 = 209721600	0
32767	100	128	419443200	20 GB * 10 volumes ceil (20 * 1024 * 16/15) * 10 = 218460 218460 * 15 * 128 = 419443200	0

Notes:

N21 # of blocks of LUSE composed by VLL volumes are calculated by:

N21 = N20 x (# of heads) x (# of sectors per track).

N22: N20 – 2, Use total cylinder – 2.

N23, **N24**: Use values from Device geometry parameters table and Geometry parameters for OPEN-3*n LUSE devices table.

N25: Use same value as N22.

- For OPEN-V, because the capacity is not fixed, AutoConfig is recommended for the geometry setting.

- The geometry setting is also available manually as needed. In this case, the OPEN-V geometry of X GB can be calculated according to the equations in Example 1 and Example 2 using the values of N22, N23, and N24.

Example 1

N22(Cyl)×N23(Head)×N24(Block/Trk)×512(Byte) ≤ X GB (=×1024×1024×1024 Byte) is as follows:

```
16000(Cyl)×256(Head)×256(Block)×512(Byte)＝ 536870912000Byte ＝ 500GB
32000(Cyl)×128(Head)×256(Block)×512(Byte)＝ 536870912000Byte ＝ 500GB
```

Example 2

22(Cyl)×N23(Head)×N24(Block/Trk) ≤ X GB （=×1024×1024×1024 Byte） / 512 (Byte) = Usable Blocks is as follows:

```
15000(Cyl)×256(Head)×256(Block)×512(Byte)＝ 536870912000Byte ＝ 468.75GB ＜ 500GB
```

Creating and mounting the file systems on Solaris

After you partition and label all new disks, you can create and mount the file systems for the SCSI disk devices.

> **Note:** Do not create file systems or mount directories for the FX devices (for example, 3390-3A). These devices are accessed as raw devices and do not require any further configuration after being partitioned and labeled.

Creating the file systems for Solaris

Use the following procedure to create file systems for the newly installed SCSI disk devices.

Procedure

1. Create the file system using the **`newfs -C <maxcontig>`** command.

```
# newfs -C 6 /dev/rdsk/c1t2d0s0
newfs:construct a new file system /dev/rdsk/c1t2d0s0:(y/n) y
/dev/rdsk/c1t2d0s0: 4803840 sectors in 3336 cylinders of 15 tracks, 96 sectors
    2345.6MB in 209 cyl groups (16 c/g, 11.25MB/g, 5440 i/g)
super-block backups (for fsck -F ufs -o b=#) at:
 32, 23168, 46304, 69440, 92576, 115712, 138848, 161984, 185120, 208256,
  :
4747616, 4770752, 4792352,
# newfs -C 6 /dev/rdsk/c1t2d1s0
```

   a. Use 6 or one of the following multiples of 6 as the `maxcontig` value for all SCSI disk devices on the storage system: 12, 18, 24, or 30. If 6 is used, the Solaris system will access 48 KB as a unit (6 * 8 KB), which matches the track size of the OPEN-x devices. These `maxcontig` values (6, 12, 18, 24, 30) optimize the I/O performance by keeping the I/O data range on one track. The `maxcontig` value that you choose depends on your applications, and you can always change the `maxcontig` parameter to a different value at any time.

    b. Use the character-type device file as the argument.

      For example: `/dev/rdsk/c1t2d0s0`

2. When the confirmation appears, verify that the device file name is correct. If so, enter `y` for yes. If not, enter `n` for no, and then repeat step (1) using the correct device file name.

3. Repeat steps (1) and (2) for each new SCSI disk device on the storage system. Be sure to use the same `maxcontig` value for all storage system devices.

Creating and verifying the mount directories for Solaris

After you have created the file systems, you can create and verify the mount directories for the new SCSI disk devices. Each logical partition requires a unique mount directory, and the mount directory name should identify the logical volume and the partition.

Procedure

1. Go to the root directory, and display the current directory.

```
# cd
# pwd
/
```

2. Use the **mkdir** command to create the mount directory. Choose a name for the mount directory that identifies both the logical volume and the partition. For example, to create a mount directory named VSP_LU00, enter: `mkdir /VSP_LU00`

```
# mkdir /VSP_LU00
```

> 💡 **Tip:** If you need to delete a mount directory, use the **rmdir** command (for example, `rmdir /VSP_LU00`).

3. Use the **ls -x** command to verify the new mount directory.

```
# ls -x
VSP_LU00  bin     dev       device    etc      export correctly
floppy      home    hstsboof kadb      kernel   lib
#
```

4. Repeat steps 2 to 4 for each logical partition on each new SCSI disk

Mounting and verifying the file systems for Solaris

After you have created the mount directories, you can mount and verify the file systems for the new SCSI disk devices. The file system for each logical partition should be mounted and verified to ensure that all new logical units are fully operational.

The following figure illustrates the steps in this procedure.

```
# mount /dev/dsk/c1t2d0s0 /VSP_LU00                          ← Mount file system.
                 ←   Block-type device file name
# mount /dev/dsk/c1t2d1s0 /VSP_LU01                          ← Mount next file
```

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```
system.
                              ↖ Mount directory name
# mount /dev/dsk/c1t2d2s0 /VSP_LU02                        ← Mount next file
system.
 :
 :
#
# df -k                                                    ← Display file
systems.
File system        Kbytes    used    avail  capacity   Mounted on
/dev/dsk/c0t3d0s0    28775   27706        0    100%     /
/dev/dsk/c0t3d0s6   269191  234897     7384     97%     /usr
/proc                    0       0        0      0%     /proc
fd                       0       0        0      0%     /dev/fd
/dev/dsk/c0t3d0s4s   57567   29515    22302     57%     /var
swap                142204      20   142184      0%     /tmp
/dev/dsk/c0t3d0s7   462119  206000   209909     50%     /export/home
/dev/dsk/c0t3d0s5    47975   42059     1126     97%     /opt
/dev/dsk/c1t2d0s0  2256436       9  2030787      0%     /VSP_LU00  ← Verify file
systems.
/dev/dsk/c1t2d1s0  2256436       9  2030787      0%     /VSP_LU01  ← OPEN-3
device.
/dev/dsk/c1t2d2s0  6774358       9  6548709      0%     /VSP_LU02  ← OPEN-9 device.
:
# mount /dev/dsk/c1t2d0s0 /VSP_LU00                            ← Mount file system.
# cd /VSP_LU00                                                 ← Go to mount
directory.
# cp /bin/vi /VSP_LU00/vi.back1                           ← Copy a file.
# ls -l                                                   ← Verify the file
copy.
drwxr-xr-t   2 root     root       8192 Mar 15 11:35  lost+found
-rwxr-xr-x   1 root     sys     2617344 Mar 15 11:41  vi.back1
# cp vi.back1 vi.back2                                        ← Copy file again.
# ls -l                                                       ← Verify file copy
again.
drwxr-xr-t   2 root     root       8192 Mar 15 11:35  lost+found
-rwxr-xr-x   1 root     sys     2617344 Mar 15 11:41  vi.back1
-rwxr-xr-t   1 root     sys     2617344 Mar 15 11:52  vi.back2
# rm vi.back1                                             ←  Remove test files.
# rm vi.back2                                             ←  Remove test files.
```

Procedure

1. Mount the file system using the `mount` command. Be sure to use the correct block-type device file name and mount directory for the device/partition. For example, to mount the file /dev/dsk/c1t2d0s0 with the mount directory /VSP_LU00, enter:

   ```
   mount /dev/dsk/c1t2d0s0 /VSP_LU00
   ```

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> **Note:** If you already set the auto-mount parameters (see <u>Setting and verifying auto-mount parameters for Solaris (on page 124)</u>), you do not need to specify the block-type device file, only the mount directory.

> **Tip:** To unmount a file system, use the **`umount`** command (for example, `umount /VSP_LU00`).

2. Repeat step 1 for each partition of each newly installed SCSI disk device.

3. Display the mounted devices using the **`df -k`** command, and verify that all new SCSI disk devices are displayed correctly. OPEN-x devices will be displayed as OPEN-3, OPEN-9, OPEN-E, OPEN-L devices.

4. As a final verification, perform some basic UNIX operations (for example, file creation, copying, and deletion) on each logical unit to ensure the new file systems are fully operational.

Setting and verifying auto-mount parameters for Solaris

You can add any or all of the new SCSI disk devices to the `/etc/vfstab` file to specify the auto-mount parameters for each device. Once a device is added to this file, you can mount the device without having to specify its block-type device file name (for example, `mount / VSP_LU00`), since the `/etc/vfstab` file associates the device with its mount directory.

The following table describes the auto-mount parameters for Solaris.

Parameter #	Name	Enter:
1	Device to mount	Block-type device file name
2	Device to fsck	Character-type device file name
3	Mount point	Mount directory name
4	FS type	File system type (for example, ufs)
5	Fsck pass	Order for performing file system checks
6	Mount at boot	Yes = auto-mounted at boot/mountall No = not auto-mounted at boot/mountall
7	Mount options	Desired mount options: ▪ no options (typical) ▪ ro read-only access (for example, for 3390-3B devices)

Procedure

1. Make a backup copy of the `/etc/vfstab` file, and then edit the `/etc/vfstab` file to add one line for each device to be auto-mounted.

```
# cp -ip /etc/vfstab /etc/vfstab.standard              ← Make backup
before editing.
# vi /etc/vfstab                                              ← Edit
the file.
#device          device          mount      FS     fsck  mount   mount
#to mount        to fsck         point      type   pass  at boot options
    1               2               3         4      5     6        7  ←
Auto mount

/proc            -                /proc      procfs  -    no      -
fd               -                /dev/fd    fd      -    no      -
swap             -                /tmp       tmpfs   -    yes     -
/dev/dsk/c0t3d0s0  /dev/rdsk/c0t3d0s0  /      ufs    1    no      -
/dev/dsk/c0t3d0s6  /dev/rdsk/c0t3d0s6  /usr   ufs    2    no      -
/dev/dsk/c0t3d0s7  /dev/rdsk/c0t3d0s7  /export ufs   3    yes     -
/dev/dsk/c0t3d0s5  /dev/rdsk/c0t3d0s5  /opt   ufs    4    yes     -
/dev/dsk/c0t3d0s1  -                   -      swapfs  -   no      -
/dev/dsk/c1t2d0s0  /dev/rdsk/c1t2d0s0  /VSP_LU00 ufs  5   yes     - ← Add
one line
/dev/dsk/c1t2d1s0  /dev/rdsk/c1t2d1s0  /VSP_LU01 ufs  5   yes     -    for
each LUN.
```

> 💡 **Tip:** If you make a mistake while editing, exit the **vi** editor without saving the file, and then begin editing again.

2. Reboot the Solaris system after you are finished editing the `/etc/vfstab` file.

3. Use the `df -k` command to display the mounted devices, and verify that the desired devices were auto-mounted.

ALUA support on Solaris

ALUA is supported on Solaris systems with the following two restrictions:

- You must modify the `/etc/driver/drv/scsi_vhci.conf` file (shown below) and then reboot the system.

- You must have ALUA enabled for all LUNs.

> 📄 **Note:**
>
> - LUNs that do not have ALUA enabled are not visible after you enable ALUA support. If you plan to migrate non-ALUA LUNs, perform the migration first and then enable ALUA after the migration.
>
> - This information applies to Solaris versions 10.x and 11.x.

Define the following in `/etc/driver/drv/scsi_vhci.conf`:

```
scsi-vhci-failover-override =
"HITACHI OPEN", "f_tpgs";
and "scsi_vhci_f_sym_hds" and "scsi_vhci_f_tpgs" defined in ddi-forceload.
ddi-forceload =
"misc/scsi_vhci/scsi_vhci_f_asym_sun",
"misc/scsi_vhci/scsi_vhci_f_asym_lsi",
"misc/scsi_vhci/scsi_vhci_f_asym_emc",
"misc/scsi_vhci/scsi_vhci_f_sym_emc",
"misc/scsi_vhci/scsi_vhci_f_sym_hds",
"misc/scsi_vhci/scsi_vhci_f_sym",
# "misc/scsi_vhci/scsi_vhci_f_sym_enc",
# "misc/scsi_vhci/scsi_vhci_f_tpgs_tape",
# "misc/scsi_vhci/scsi_vhci_f_tape",
"misc/scsi_vhci/scsi_vhci_f_tpgs";
```

Troubleshooting for Solaris host attachment

The following table lists potential error conditions that might occur during storage system installation on a Solaris host and provides instructions for resolving the conditions. If you cannot resolve an error condition, contact customer support.

Error Condition	Recommended Action
The logical devices are not recognized by the system.	Ensure the READY indicator lights on the storage system are ON.
	Ensure the Fibre Channel cables are correctly installed and firmly connected.
	Run **dmesg** to recheck the fibre buses for new devices.
	Verify the contents of `/kernel/drv/sd.conf` file.
File system cannot be created (**newfs** command)	Ensure the character-type device file is specified for **newfs** command.
	Verify that logical unit is correctly labeled by UNIX **format** command.
The file system is not mounted after rebooting.	Ensure the system was restarted properly.
	Ensure the file system attributes are correct.
	Ensure the `/etc/vfstab` file is correctly edited.

Error Condition	Recommended Action
The Solaris system does not reboot properly after hard shutdown.	If the Solaris system is powered off without executing the shutdown process, wait three minutes before restarting the Solaris system. This allows the storage system's internal time-out process to purge all queued commands so that the storage system is available (not busy) during system startup. If the Solaris system is restarted too soon, the storage system will continue trying to process the queued commands, and the Solaris system will not reboot successfully.
The storage system performed a self-reboot because the system was busy or it logged a panic message.	Reboot the Solaris system.
The storage system responds Not Ready, or displays Not Ready and timed itself out.	Contact Hitachi Vantara customer support.
The system detects a parity error.	Ensure the HBA is installed properly. Reboot the Solaris system.

Verbose mode troubleshooting on Solaris

One way to troubleshoot Solaris operations involves the "verbose" mode for the HBA configuration file. This topic provides examples of error messages that may occur. A possible debugging method is to select the device and turn on verbose mode, then attempt the boot process again. Verbose error messages provide information that help isolate the problem.

Turning on the verbose flag

To turn on the verbose flag, use these commands:

```
ok   " /sbus/fca" select-dev
ok    true to fca-verbose
ok    boot fcadisk
```

Examples of error messages

```
Error message:
Cannot Assemble drivers for /sbus@1f,0/fcaw@1,0/sd@0,0:a
Cannot Mount root on  /sbus@1f,0/fcaw@1,0/sd@0,0:a
Problem:
The process of copying the OS to the fibre channels was not complete, or the drive
```

```
specified on the boot
command is not the same as the one the OS was constructed on.
```

```
Error message:
Can't open boot device
Problem:
The wwn specified with the set-bootn0-wwn does not correspond to the wwn of the
device.  Could also be a
cable problem - the adapter cannot initialize.
```

```
Error message:
The file just loaded does not appear to be bootable
Problem:
The bootblk was not installed on the target.
```

```
Error message:
mount: /dev/dsk/c0t0d0s0 - not of this fs type
Problem:
At this point the process hangs. This happens if the /etc/vfstab
File has not been updated on the fibrechannel boot drive to reflect the new target.
```

```
Error message:
Get PortID request rejected by nameserver
Problem:
The wwn of the target is not correct. Select the adapter and perform set-bootn0-wwn.
If this is correct,
 check the switch to see that target is properly connected.
```

```
Error message:
Can't read disk label
Problem:
The selected target is not a Solaris filesystem.
Error message:
Nport init failed -
Problem:
Card is connected to an arbitrated loop device, but wants to initialize as an NPORT.
The bootn0-wwn
property has probably been set to a valid WWN.
```

```
Error message:
Panic dump not saved
Problem:
After the system is successfully booted to Solaris from the fibrechannel and a panic
occurs the
panic does not get saved to the swap device.
This can be the result not properly defined the swap partition.
```

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```
Use the format command to view the slices on the fibre channel drive.
Take the partition option, then the print option.
The swap partition should look something like this:
     1      swap      wm      68-459      298.36MB      (402/0/0)      611040
Sizes and cylinders will probably be different on your system. Make sure that the
flag is wm and that
 the sizes are defined (not 0). Then use the label option from partition to write the
label to the drive.
 After this the panic should be saved to the swap partition. If the partition needs
to be changed chose
the partition option, and enter 1 to select slice 1.
```

Installing online devices for Solaris

After initial installation and configuration of the storage system, additional devices can be installed or de-installed online without having to restart the Solaris system. After online installation, the device parameters for new volumes must be changed to match the LUs defined under the same Fibre Channel port (see <u>Verification of new device recognition on Solaris (on page 100)</u>).

📄 **Note:** For additional instructions about online installation and deinstallation of LUs, see the *Maintenance Manual*.

This task describes how to install a Sun Fibre Channel HBA.

Before you begin

This procedure should be performed by the system administrator (that is, super-user).

Procedure

1. Set up the Solaris server:
   a. Confirm that the Sun Fibre Channel HBAs are installed.
   b. Confirm that Sun StorEdge SAN Foundation Software version 4.2 or later is installed.
2. Set up the storage system:
   a. Ensure the latest microcode is loaded. Non-disruptive version-up requires alternate path.
   b. Install the front-end directors and LDEVs, and connect fibre cable if necessary.
   c. Execute online LU installation from the service processor (SVP) or the Device Manager - Storage Navigator software.
   d. Verify the SCSI path configuration.
3. Execute the `Format` command. Solaris will recognize the new volumes.
4. If new volumes are not recognized, the following operation is not needed. Refer to the Solaris documentation as needed.
   a. Disconnect and reconnect the fibre cable connected to the paths on which you are adding LUs.

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    b. Use the following command to display available paths to the HBAs: `luxadm –e port`

    c. With the path from the output, issue the following command: `luxadm –e forcelip path`

    d. Use the following command to display devices: `cfgadm –al`

    e. Bring fabric devices back onto the system.

    f. Execute the `Format` command.

Using MPxIO path failover software on Solaris

The storage systems are compatible with the Solaris Operating Environment Multi-path I/O (MPxIO) multi-pathing driver that offers hardware transparency and multi-pathing capabilities. MPxIO is fully integrated within the Solaris operating system (beginning with Solaris 8) and enables I/O devices to be accessed through multiple host controller interfaces from a single instance of the I/O device.

MPxIO enables you to more effectively to represent and manage devices that are accessible through multiple I/O controller interfaces within a single instance of the Solaris operating system. The MPxIO architecture:

- Helps protect against I/O outages due to I/O controller failures. Should one I/O controller fail, MPxIO automatically switches to an alternate controller.

- Increases I/O performance by load balancing across multiple I/O channels.

You can use the following procedure for the storage systems to work with MPxIO.

Procedure

1. Configure the storage system to use host mode *09* (see <u>Setting the host modes and host mode options (on page 25)</u>).

2. Modify the configuration file `/kernel/drv/scsi_vhci.conf` to enable MPxIO to manage the path failover:

```
mpxio-disable="no";
```

> 📄 **Note:** You do not have to edit `/kernel/drv/sd.conf`.

3. Connect the storage system to the Solaris system.

4. Reboot the server.

5. After reboot, login to the system and issue the following command: `cfgadm -la`.

   The following information appears:

```
bigc2 > cfgadm -la
Ap_Id                   Type         Receptacle   Occupant     Condition
ac0:bank0               memory       connected    configured   ok
ac0:bank1               memory       connected    configured   ok
ac1:bank0               memory       connected    configured   ok
ac1:bank1               memory       connected    configured   ok
```

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```
ac2:bank0              memory        connected     configured    ok
ac2:bank1              memory        connected     configured    ok
ac3:bank0              memory        connected     configured    ok
ac3:bank1              memory        connected     configured    ok
c0                     scsi-bus      connected     configured    unknown
c0::dsk/c0t2d0         disk          connected     configured    unknown
c0::dsk/c0t3d0         disk          connected     configured    unknown
c0::dsk/c0t6d0         CD-ROM        connected     configured    unknown
c0::rmt/0              tape          connected     configured    unknown
c5                     fc-fabric     connected     configured    unknown
c5::20000001730037eb   unavailable   connected     unconfigured  failed
c5::200000017380a45b   unknown       connected     unconfigured  unknown
c5::210000e08b042791   unknown       connected     unconfigured  unknown
c5::210000e08b049755   unknown       connected     unconfigured  unknown
c5::210100e08b276f6d   unknown       connected     unconfigured  unknown
c5::500060e8029eb604   disk          connected     configured    unknown
c5::50060e80034e5a05   disk          connected     configured    unknown
c5::50060e8004272f01   disk          connected     configured    unknown
c6                     fc-fabric     connected     configured    unknown
c6::200000017300380d   unavailable   connected     unconfigured  failed
c6::200000017300a45b   unknown       connected     unconfigured  unknown
c6::210000e08b076f6d   unknown       connected     unconfigured  unknown
c6::210100e08b242791   unknown       connected     unconfigured  unknown
c6::500060e8029eb614   disk          connected     unconfigured  unknown
c6::50060e80034e5a15   disk          connected     unconfigured  unknown
c6::50060e8004272f11   disk          connected     configured    unknown
```

6. Check for the target not configured (in red). Then issue the following command to see the unconfigured LUNs:

```
cfgadm -c configure c6::500060e8029eb614   c6::50060e80034e5a15
```

Chapter 7: SUSE Linux configuration and attachment

This chapter describes how to configure the new disk devices on a SUSE Linux host. Configuration of the devices should be performed by the Linux system administrator. Configuration requires superuser/root access to the host system. If you have questions or concerns, contact your Hitachi Vantara representative.

Storage system configuration for SUSE Linux operations

The storage system must be fully configured before being attached to the SUSE Linux host, as described in Configuring the storage system (on page 24).

- *Devices types*

  The following devices types are supported for SUSE Linux operations. For details, see Logical device types (on page 14).

  - OPEN-V
  - OPEN-3/8/9/E/L
  - LUSE (OPEN-*x**n)
  - VLL (OPEN-*x* VLL)
  - VLL LUSE (OPEN-*x**n VLL)

- *Host mode*

  The required host mode for SUSE Linux is 00. Do not select a host mode other than 00 for SUSE Linux. For a complete list of host modes for the storage system, see Host modes and host mode options (on page 205). For instructions on setting the host modes, see the *Provisioning Guide* for the storage system.

- *Host mode options*

  You may also need to set host mode options (HMOs) to meet your operational requirements. For a complete list of HMOs for the storage system, see Host modes and host mode options (on page 205). For instructions on setting the HMOs, see the *Provisioning Guide* for the storage system.

  Veritas Cluster Server: See Note on using Veritas Cluster Server (on page 190) for important information about using Veritas Cluster Server.

Device Mapper (DM) Multipath configuration for SUSE Linux

The storage systems support DM Multipath operations.

> 📄 **Note:** Refer to the native multipath configuration documentation from the OS vendor for important information about required settings and parameters for DM Multipath operations, including but not limited to:
>
> - Disabling the HBA failover function
> - Installing kpartx utility
> - Creating the multipath device with the `multipath` command
> - Editing the `/etc/modprobe.conf` file
> - Editing the `/etc/multipath.conf` file
> - Configuring LVM
> - Configuring raw devices
> - Creating partitions with DM Multipath

Verifying new device recognition for SUSE Linux

Before configuring the new disk devices, use the following procedure to verify that the host system recognizes the new devices. The host system automatically creates a device file for each new device recognized.

Procedure

1. Display the devices using the `dmesg` command.

```
# dmesg | more
:
:
scsi0 : Qlogic QLA2200 PCI to Fibre Channel Host Adapter: 0 device 14 irq 11
       Firmware version:  1.17.26, Driver version  2.11 Beta

scsi : 1 host.
  Vendor: HITACHI       Model: OPEN-V           Rev: 0111
  Type:   Direct-Access                    ANSI SCSI revision: 02
Detected scsi disk sda at scsi0, channel 0, id 0, lun 0


  Vendor: HITACHI       Model: OPEN-V           Rev: 0111
  Type:   Direct-Access                    ANSI SCSI revision: 02
Detected scsi disk sdb at scsi0, channel 0, id 0, lun 1
:
:
```

Chapter 7: SUSE Linux configuration and attachment

In this example, the HITACHI OPEN-V device (device file /dev/sda, TID 0, LUN 0) and the HITACHI OPEN-V device (device file /dev/sdb, TID 0, LUN 1) are recognized by the SUSE Linux server.

2. Record the device file name for each new device. You will need this information when you partition the devices (see Partitioning the new disk devices for Red Hat Linux (on page 89)).

Sample SCSI path worksheet:

LDEV (CU:LDEV)	Device Type	LUSE (*n)	VLL (MB)	Device File Name	Path	Alternate Path
0:00					TID:____ LUN:____	TID:____ LUN:____
0:01					TID:____ LUN:____	TID:____ LUN:____
0:02					TID:____ LUN:____	TID:____ LUN:____
0:03					TID:____ LUN:____	TID:____ LUN:____
0:04					TID:____ LUN:____	TID:____ LUN:____
0:05					TID:____ LUN:____	TID:____ LUN:____
0:06					TID:____ LUN:____	TID:____ LUN:____
0:07					TID:____ LUN:____	TID:____ LUN:____
0:08					TID:____ LUN:____	TID:____ LUN:____
0:09					TID:____ LUN:____	TID:____ LUN:____
0:0A					TID:____ LUN:____	TID:____ LUN:____
0:0B					TID:____	TID:____

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LDEV (CU:LDEV)	Device Type	LUSE (*n)	VLL (MB)	Device File Name	Path	Alternate Path
					LUN:____	LUN:____
0:0C					TID:____ LUN:____	TID:____ LUN:____
0:0D					TID:____ LUN:____	TID:____ LUN:____
0:0E					TID:____ LUN:____	TID:____ LUN:____
0:0F					TID:____ LUN:____	TID:____ LUN:____

3. The device files are created under the `/dev` directory. Verify that a device file (`sda` in the following example) was created for each new disk device.

```
# ls -l /dev | more
:
brw-rw----  1 root   disk   8,  0 May  6  1998 sda
```

Configuring the new devices for SUSE Linux

This section describes how to configure the newly attached disk devices.

Setting the number of logical units for SUSE Linux

Procedure

1. Edit the `/etc/modules.conf` file to add the following line, for example:

```
options scsi_mod max_scsi_luns=xx
```

where xx = the maximum number of LUs supported by your Linux operating system. Check your adapter documentation and your Linux documentation to determine the total number of devices that can be supported.

2. To set the Emulex driver, add the following line to the `/etc/modules.conf` file:

```
Alias scsi_hostadapter lpfcdd
```

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3. To activate the above modification, make an image file for booting, for example:

    ```
    # mkinitrd /boot/initrd-2.4.x.scsiluns.img 'uname -r'
    ```

4. Use one of the following methods to change the setting of Bootloader:

    - LILO used as Bootloader: You need to edit the `lilo.conf` file and then execute the **`lilo`** command to activate the `lilo.conf` setting with selecting the label. For example: `# lilo`

    ```
    image=/boot/vmlinuz-qla2x00
            label=Linux-qla2x00
            append="max_scsi_luns=16"
            initrd=/boot/initrd-2.4.x.img
            root=/dev/sda7
     read-only
    #sbin/lilo
    ```

    - GRUB (Grand Unified Bootloader) used as Bootloader: You need to edit the `/boot/grub/grub.conf` file to add "lpfcdd" in `/etc/rc.config`.

    ```
    Initrd_modules = "lpfcdd"
    ```

5. Reboot the system.

Partitioning new disk devices for SUSE Linux

After the setting the number of logical units, you can set the partitions for the new disk devices.

📄 **Note:** For important information about creating partitions with DM Multipath, refer to the native multipath configuration documentation from the OS vendor.

Procedure

1. Enter `fdisk/dev/<device_name>` (for example, `fdisk/dev/sda`, where `/dev/sda` is the device file name).
2. Select `p` to display the present partitions.
3. Select `n` to make a new partition. You can make up to four primary partitions (1-4) or as an alternative, you can make one extended partition. The extended partition can be divided into a maximum of 11 logical partitions, which can be assigned partition numbers from 5 to 15.
4. Select `w` to write the partition information to disk and complete the **`fdisk`** command.

    Other commands that you might want to use include:

    - To remove partitions, select `d`.

    - To stop a change, select `q`.

5. Repeat the above steps for each new disk device.

Creating, mounting, and verifying file systems for SUSE Linux

Creating file systems for SUSE Linux

After you have partitioned the devices, you can create the file systems, making sure that they are appropriate for the primary and/or extended partition for each logical unit.

Procedure

1. Execute the **mkfs** command:

```
# mkfs /dev/sda1
```

where /dev/sda1 is device file of primary partition number 1.

Creating mount directories for SUSE Linux

Use the following procedure to create mount directories after creating the file systems.

Procedure

1. Execute the **mkdir** command.

```
# mkdir /VSP-LU00
```

Mounting new file systems for SUSE Linux

Procedure

1. Use the **mount** command to mount each new file system.

```
# mount /dev/sda1 /VSP-LU00
```

The first parameter of the **mount** command is the device file name (/dev/sda1), and the second parameter is the mount directory.

Verifying file systems for SUSE Linux

After mounting the file systems, you should verify the file systems.

Procedure

1. Execute the **df -h** command.

```
# df -h
Filesystem          Size    Used    Avail    Used%    Mounted on
/dev/sda1           1.8G    890M    866M     51%       /
/dev/sdb1           1.9G    1.0G    803M     57%       /usr
/dev/sdc1           2.2G     13k    2.1G      0%       /VSP-LU00
#
```

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Setting auto-mount parameters for SUSE Linux

Procedure

1. Make a backup of the `/etc/fstab` file.

   ```
   # cp -ip /etc/fstab /etc/fstab.standard
   ```

2. Edit the `/etc/fstab` file to add the new devices, for example:

   ```
   # vi /etc/fstab
   :
   /dev/sda1          /VSP-LU00 ext2    defaults   0   2
   ```

Troubleshooting for SUSE Linux host attachment

The following table lists potential error conditions that might occur during installation of new storage and provides instructions for resolving the conditions. If you cannot resolve an error condition, contact customer support.

Error Condition	Recommended Action
The logical devices are not recognized by the system.	Be sure that the READY indicator lights on the storage system are ON. Be sure that the LUNs are properly configured. The LUNs for each target ID must start at 0 and continue sequentially without skipping any numbers.
The file system cannot be created.	Be sure that the device name is entered correctly with **mkfs**. Be sure that the LU is properly connected and partitioned.
The file system is not mounted after rebooting.	Be sure that the system was restarted properly. Be sure that the auto-mount information in the `/etc/fstab` file is correct.

Chapter 8: VMware configuration and attachment

This chapter describes how to configure the new disk devices on a VMware host. Configuration of the devices should be performed by the VMware system administrator. Configuration requires superuser/root access to the host system. If you have questions or concerns, contact your Hitachi Vantara representative.

Storage system configuration for VMware operations

The storage system must be fully configured before being attached to the VMware host, as described in Configuring the storage system (on page 24).

Devices types: The following devices types are supported for VMware operations. For details, see Logical device types (on page 14).

- OPEN-V
- OPEN-3/8/9/E/L
- LUSE (OPEN-*x**n)
- VLL (OPEN-*x* VLL)
- VLL LUSE (OPEN-*x**n VLL)

Host mode: The required host mode for VMware is *21*. Do not select a host mode other than *21* for VMware. For a complete list of host modes for the storage system, see Host modes and host mode options (on page 205). For instructions on setting the host modes, see the *Provisioning Guide* for the storage system.

> 📄 **Note:** For VMware, host groups are created per VMware cluster or per ESX host on the ports on each storage cluster that the VMware cluster or ESX hosts can access.

Host mode options: You may also need to set host mode options (HMOs) to meet your operational requirements. For a complete list of HMOs for the storage system, see Host modes and host mode options (on page 205). For instructions on setting the HMOs, see the *Provisioning Guide* for the storage system.

VMware host configuration for storage system

This section provides reference information to help you implement VMware software with the storage systems.

SAN configuration on VMware

For vSphere 5.5 and earlier, a SAN is required to connect the storage system to the VMware ESX Server host as VMware does not support FC-AL and direct-connect connections to storage systems.

For vSphere 6.x, direct-connect connection to the storage system is supported with 8G FC using FC-AL or with 16G FC using point-to-point. For information about setting up storage arrays for VMware ESX Server, see the VMware user documentation.

For details about supported switches, topology, and firmware versions for SAN configurations, see the Hitachi Product Compatibility Guide: https://compatibility.hitachivantara.com

VMware vSphere API operations

The storage systems support the VMware vSphere API for Array Integration (VAAI). VAAI enables the offload of specific storage operations from the VMware ESX host to the storage system for improved performance and efficiency. These APIs, available in VMware vSphere 4.1 and later, provide integration with the advanced features and capabilities of the storage systems such as thin provisioning, Dynamic Tiering, and storage virtualization. For details, see the following sites:

- https://www.hitachivantara.com/en-us/solutions/application-ecosystem/vmware-solutions.html

- https://docs.vmware.com/en/VMware-vSphere/6.7/vsphere-esxi-vcenter-server-671-storage-guide.pdf

VMware ESX 4.1 or later is required for VAAI operations.

VMware ESX Server and VirtualCenter compatibility

VMware recommends that you install VirtualCenter with the ESX Server software. VirtualCenter lets you provision virtual machines and monitor performance of physical servers and virtual machines, monitor performance and utilization of physical servers and the virtual machines they are running, and export VirtualCenter data to HTML and Excel formats for integration with other reporting tools.

Make sure that your VMware ESX server and VirtualCenter versions are compatible. For details, refer to your VMware Release Notes and the VMware website at http://www.vmware.com.

VMware installation and configuration

You must verify that your server, I/O, storage, guest operating system, management agent, and backup software are all compatible before you install and configure VMware.

Consult the following documents for information about VMware ESX Server installation, configuration, and compatibility:

- *Installing and Configuring VMware ESX Server* Refer to the VMware documentation when installing and configuring VMware ESX Server. Follow the configuration steps for licensing, networking, and security.

- *Upgrading an ESX Server and VirtualCenter Environment* Refer to the VMware documentation when upgrading an ESX Server and VirtualCenter environment.

Creation and management of VMware infrastructure components

After VMware ESX Server installation has been completed, including all major components of the VMware Infrastructure, you can perform the following tasks to manage your VMware infrastructure components:

- Use the VI client to manage your ESX Server hosts either as a group through VirtualCenter or individually by connecting directly to the host.

- Set up a datacenter to bring one or more ESX Server hosts under VirtualCenter management, create virtual machines, and determine how you want to organize virtual machines and manage resources.

- Create a Virtual Machine manually, from templates, or by cloning existing virtual machines.

- Configure permissions and roles for users to allocate access to VirtualCenter, its administrative functions, and its resources.

- Use resource pools to partition available CPU and memory resources hierarchically.

- Configure network connections to ensure that virtual machine traffic does not share a network adapter with the service console for security purposes.

- Install a guest operating system in a virtual machine.

- Manage virtual machines to learn how to power them on and off.

- Monitor the status of your virtual infrastructure using tasks and events.

- Schedule automated tasks to perform actions at designated times.

- Configure alarm notification messages to be sent when selected events occur to or on hosts or virtual machines.

FCA configuration for VMware

The Fibre Channel adapters (FCAs) on the VMware host must be fully configured before being attached to the storage system, as described in Installing and configuring the host adapters (on page 27). This section provides recommended settings for QLogic and Emulex host adapters for storage attached to a VMware host.

Settings for QLogic adapters for VMware

The following table lists the recommended QLogic adapter settings for storage attached to a VMware host. Use the setup utility for the adapter to set the required options for your operational environment. For details and instructions, see the user documentation for the adapter.

For the latest information about supported adapters, see the Hitachi Vantara Product Compatibility Guide: https://compatibility.hitachivantara.com

Parameter	Setting
Host Adapter BIOS	Disabled
Number of LUNs per target	Determined by the number of LUNs in your configuration. Multiple LUN support is typically for RAID arrays that use LUNs to map drives. The default is 8. If you do not need multiple LUN support, set the number of LUNs to 0.
Enable LIP reset	No
Enable LIP full login	Yes
Enable target reset	Yes
Connection option	Point-to-point only

Settings for Emulex adapters for VMware

The following table lists the recommended Emulex adapter settings for storage attached to a VMware host. Use the setup utility for the adapter to set the required options for your operational environment. For details and instructions, see the user documentation for the adapter.

For the latest information about supported adapters, see the Hitachi Vantara Product Compatibility Guide: https://compatibility.hitachivantara.com

Parameter	Setting
Host Adapter BIOS	Disabled
Topology	Fabric Point-to-Point

Configuring new devices for VMware

This section provides information about configuring the new storage devices on the storage system for operation with the VMware host.

VMFS datastores creation

Use the software on the VMware host (for example, vSphere Client) to create the VMFS datastores on the new storage devices in the storage system. Make sure to create only one VMFS datastore for each storage device. For details about configuring new storage devices (for example, supported file and block sizes), see the VMware user documentation.

Use the following settings when creating a VMFS datastore on a storage device:

- LUN properties

  - Path policy: Round robin.

  - Preference: Preferred. Always route traffic over this port when possible.

  - State: Enabled. Make this path available for load balancing and failover.

- VMFS properties

  - Storage type: disk/LUN

  - Maximum file size: 256 GB, block size 1 MB

  - Capacity: Maximum capacity

> **Tip:** : You do not need to create the VMFS datastores again on other hosts that may need access to the new storage devices. Use the storage refresh and rescan operations to update the datastore lists and storage information on the other hosts.

Addition of a hard disk to a virtual machine on VMware

Use the following settings when adding a hard disk to a virtual machine for storage devices:

- When creating a new virtual disk:

  - Disk capacity (can be changed later)

  - Location: on the same datastore as the virtual machine files, or specify a datastore

- When adding an existing virtual disk: browse for the disk file path.

- When adding a mapped SAN LUN:

  - Datastore: Virtual Machine

  - Compatibility mode: physical

  - Store LUN mapping file on the same datastore as the virtual machine files

- Virtual device node: Select a node that is local to the virtual machine.

- Virtual disk mode options: Independent mode (persistent or nonpersistent)

Chapter 8: VMware configuration and attachment

Troubleshooting for VMware host attachment

The following table lists potential error conditions that may occur during installation of new storage and provides instructions for resolving the conditions. If you cannot resolve an error condition, contact customer support.

Error condition	Recommended action
Virtual Machine adapter does not see Lun8 and greater.	Verify cabling, storage LUN, switch and storage security and LUN masking. Verify that the `Disk.MaxLUN` parameter in the Advance Settings (VMware Management Interface) is set to more than 7.
Guest OS virtual machine booting up but not installing the OS.	It is possible that there is an existing corrupted `vmdk` file (due to an incomplete installation). Delete the `vmdk` file from the File Manager and remove it from the Guest OS. Add a new device for the Guest OS and recreate a new `vmdk` image file.
Cannot add Meta Data File for raw device.	The Meta Data File for the raw device may have existed. Selected the existing Meta Data File or delete the old Meta Data File and create a new one.
Guest OS virtual machine boots up, but does not install the operating system.	There may be a corrupt `vmdk` file (usually because of previous incomplete installation). Delete the `vmdk` file from the File Manager and remove it from the Guest OS. Add a new device for the Guest OS and recreate a new `vmdk` image file.
Cannot add Meta Data File for raw device.	The Meta Data File for the raw device may have existed. Select the existing Meta Data File or delete the old Meta Data File and create a new one.
Volume label is not successful.	Limit the number of characters to 30.
Cannot delete a VMFS file.	It is possible that there is an active swap file on the same extended partition. Manually turn off the swap device (using **vmkfstools** command) from the service console and try again. Relocate the swap file to another disk.
Guest OS cannot communicate with the server or outside network.	Make sure a virtual switch is created and bound to a connected network adapter.

Error condition	Recommended action
`vmkfstools s` does not add LUN online.	Delete the LUN. Select and add another LUN and retry the process again. Repeat the command or perform the Rescan SAN function in the Storage Management of the VMware Management Interface and display again.
Service console discovers online LUN addition, but the disks and LUNs do not.	Rescan SAN and refresh.
VMware ESX Server crashes while booting up.	Check for the error message on the screen. It could be because of mixing different types of adapters in the server.

Chapter 8: VMware configuration and attachment

Chapter 9: Windows configuration and attachment

This chapter describes how to configure the new disk devices on a Microsoft® Windows® host. Configuration of the devices should be performed by the Windows system administrator. Configuration requires superuser/root access to the host system. If you have questions or concerns, contact your Hitachi Vantara representative.

> ⚠ **Caution:** Changes made to the Registry without the direct assistance of Hitachi Vantara might jeopardize the proper operation of your Windows system and are the sole responsibility of the user.

Storage system configuration for Windows operations

The storage system must be fully configured before being attached to the Windows host, as described in Configuring the storage system (on page 24).

Devices types: The following devices types are supported for Windows operations. For details, see Logical device types (on page 14).

- OPEN-V
- OPEN-3/8/9/E/L
- LUSE (OPEN-*x**n)
- VLL (OPEN-*x* VLL)
- VLL LUSE (OPEN-*x**n VLL)

Host mode: The required host mode for Windows is 2C. Do not select a host mode other than 2C for Windows. For a complete list of host modes for the storage system, see Host modes and host mode options (on page 205). For instructions on setting the host modes, see the *Provisioning Guide* for the storage system.

Host mode options: You may also need to set host mode options (HMOs) to meet your operational requirements. For a complete list of HMOs for the storage system, see Host modes and host mode options (on page 205). For instructions on setting the HMOs, see the *Provisioning Guide* for the storage system.

Verifying disk and device parameters for Windows

Before you configure the new disk devices, verify the disk I/O timeout value, queue depth, and other required parameters such as fabric support. If you need to change any settings, reboot the Windows system, and use the setup utility for the adapter to change the settings.

Verifying the disk I/O timeout value (TOV) for Windows

The disk I/O TOV parameter, which applies to all SCSI disk devices attached to the Windows system, must be set to 60 seconds. The default setting is hexadecimal 0x3c (decimal 60). Use the following procedure to verify the disk I/O TOV using Registry Editor.

Before you begin

> ⚠️ **Caution:** The following procedure is intended for the system administrator with the assistance of the Hitachi Vantara representative. *Use the Registry Editor with extreme caution*. Do not change the system registry without the direct assistance of Hitachi Vantara. For information and instructions about the registry, refer to the online help for the Registry Editor.

Procedure

1. Start the Windows Registry Editor: click **Start** > **Run**, and enter `regedt32` in the **Run** dialog box.

2. Go to **HKEY_LOCAL_MACHINE** > **SYSTEM** > **CurrentControlSet** > **Services** > **Disk**.

3. In the list of disk parameters, verify that the **TimeOutValue** disk parameter is set to 60 seconds (0x3c), as shown below.
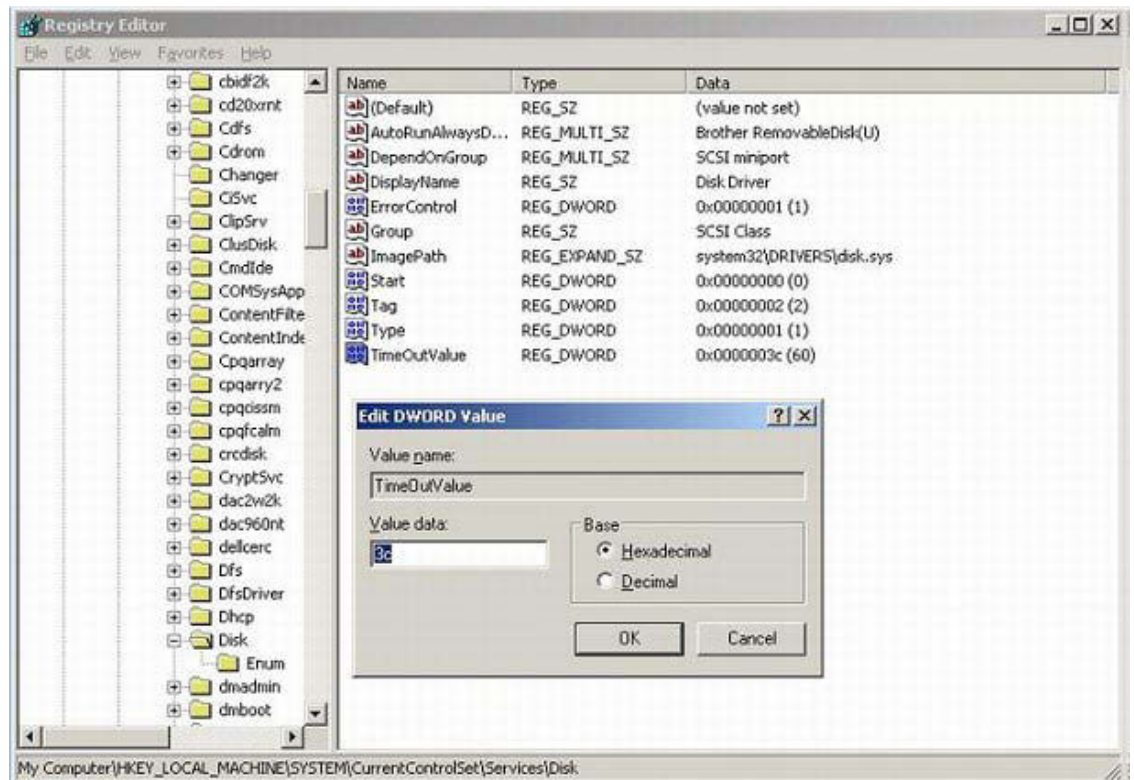
4. Verify other required settings for your operational environment (for example, FC fabric support). Refer to the user documentation for the adapter as needed.

5. Exit the Registry Editor.

6. If you need to change any settings, reboot the Windows system, and use the setup utility for the adapter to change the settings. If you are not able to change the settings using the setup utility, ask your Hitachi Vantara representative for assistance.

Verifying the queue depth for Windows

The following sample instructions describe how to verify the queue depth for a QLogic HBA using the Registry Editor.

Before you begin

> ⚠ **Caution:** The following procedure is intended for the system administrator with the assistance of the Hitachi Vantara representative. Use the Registry Editor with extreme caution. Do not change the system registry without the direct assistance of Hitachi Vantara. For information and instructions about the registry, refer to the online help for the Registry Editor.

Procedure

1. Start the Windows Registry Editor: click **Start** > **Run**, and enter `regedt32` in the **Run** dialog box.

2. Go to **HKEY_LOCAL_MACHINE** > **SYSTEM** > **CurrentControlSet** > **Services** > **ql2200 (or 2300)** > **Parameters** > **Device** to display the device parameters for the QLogic HBA.

3. In the parameter list, verify that the queue depth value in **DriverParameter** meets the requirements for the storage system.
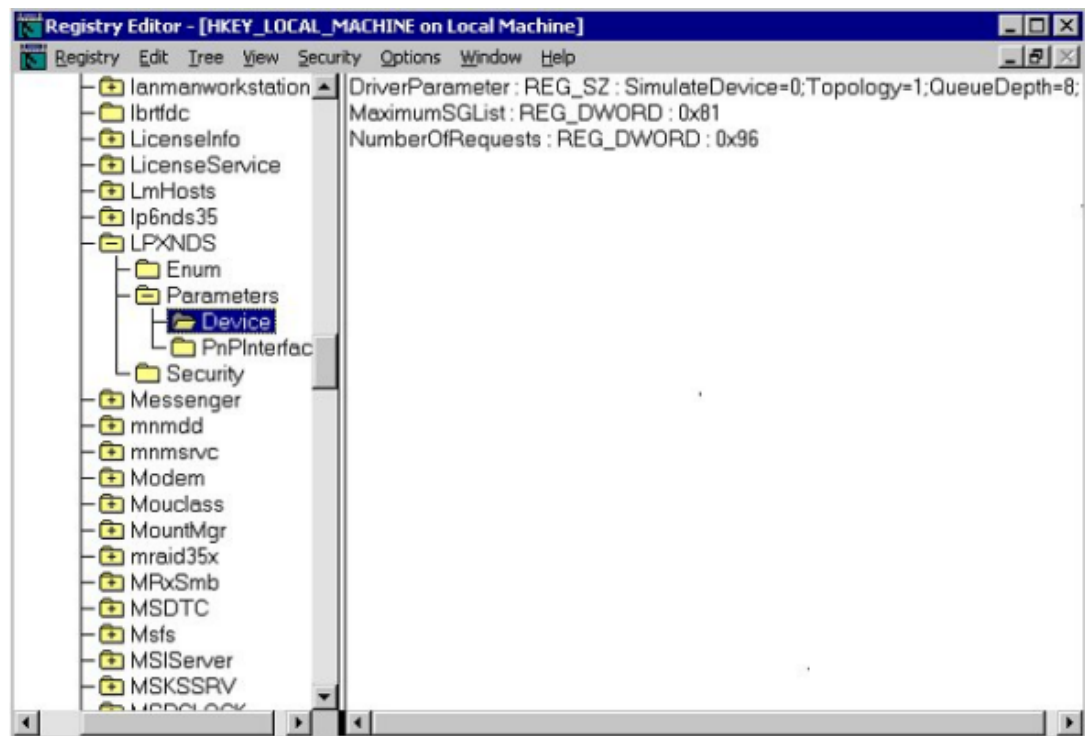
The following table lists the recommended queue depth (MAXTAGS) values for the devices. You can adjust the queue depth later as needed to optimize the I/O performance of the devices. For details about queue depth, see Host queue depth (on page 18).

Storage system	Recommended queue depth settings
VSP 5000 series	Target ports: ■ 2,048 per port ■ 32 per LDEV Bidirectional ports: ■ 1,024 per port ■ 32 per LDEV
VSP G1x00, VSP F1500	■ 2,048 per port ■ 32 per LDEV
VSP	■ 2,048 per port ■ 32 per LDEV
VSP E series	Target ports: ■ 2,048 per port ■ 32 per LDEV Universal ports: ■ 1,024 per port ■ 32 per LDEV
VSP G130, G/F350, G/F370, G/F700, G/F900	Target ports: ■ 2,048 per port ■ 32 per LDEV Universal ports: ■ 1,024 per port ■ 32 per LDEV
VSP G200, G400, G600, G800, VSP F400, F600, F800	■ 1,024 per port ■ 32 per LDEV
HUS VM	■ 2,048 per port ■ 32 per LDEV

4. If connected to a fabric switch, make sure **FabricSupported=1** is displayed in **DriverParameter**.

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5. Verify other required settings for your environment (for example, support for more than eight LUNs per target ID). Refer to the HBA documentation as needed.

6. Make sure the device parameters are the same for all devices on the storage system.

7. Exit the Registry Editor.

8. If you need to change any settings, reboot the Windows system, and use the HBA setup utility to change the settings. If you are not able to change the settings using the HBA utility, ask your Hitachi Vantara representative for assistance.

Verification of new device recognition for Windows

When the adapter connected to the storage system shows the new devices (see the figure below), pause the screen and record the disk number for each new device on your SCSI Device worksheet (see the figure for worksheet below). You will need this information when you write signatures on the devices (see).

Disk number assignments

The Windows system assigns the disk numbers sequentially starting with the local disks and then by adapter, and by TID/LUN. If the storage system is attached to the first adapter (displayed first during system start up), the disk numbers for the new devices will start at 1 (the local disk is 0). If the storage system is not attached to the first adapter, the disk numbers for the new devices will start at the next available disk number. For example, if 40 disks are attached to the first adapter (disks 1–40) and the storage system is attached to the second adapter, the disk numbers for the storage system will start at 41.

> 📄 **Note:** When disk devices are added to or removed from the Windows system, the disk numbers are reassigned automatically. For the FX devices, be sure to update your FX volume definition file (`datasetmount.dat`) with the new disk numbers.

```
Adaptec AHA 2944 Ultra/Ultra W Bios v1.32.1
 1997 Adaptec, Inc.  All Rights Reserved
 <<<Press <CTRL><A> for SCSISelect™ Utility>>>

   SCSI ID:0
        LUN: 0  HITACHI OPEN 9          Hard Disk 0    ← Disk numbers may not start
at 0.
        LUN: 1  HITACHI OPEN 9          Hard Disk 1
        LUN: 2  HITACHI OPEN 3          Hard Disk 2
        LUN: 3  HITACHI OPEN 3          Hard Disk 3
        LUN: 4  HITACHI OPEN 3          Hard Disk 4
        LUN: 5  HITACHI OPEN 9          Hard Disk 5
        LUN: 6  HITACHI 3390 3A         Hard Disk 6
        LUN: 7  HITACHI 3390 3A         Hard Disk 7
   SCSI ID:1
        LUN: 0  HITACHI OPEN 3          Hard Disk 8
        LUN: 1  HITACHI OPEN 3          Hard Disk 9
        LUN: 2  HITACHI OPEN 3          Hard Disk 10
```

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:
:

LDEV (CU:LDEV)	LU Type	VLL (MB)	Device Number	Bus Number	Path 1	Alternate Paths	
0:00					TID:____ LUN:____	TID:____ LUN:____	TID:____ LUN:____
0:01					TID:____ LUN:____	TID:____ LUN:____	TID:____ LUN:____
0:02					TID:____ LUN:____	TID:____ LUN:____	TID:____ LUN:____
0:03					TID:____ LUN:____	TID:____ LUN:____	TID:____ LUN:____
0:04					TID:____ LUN:____	TID:____ LUN:____	TID:____ LUN:____
0:05					TID:____ LUN:____	TID:____ LUN:____	TID:____ LUN:____
0:06					TID:____ LUN:____	TID:____ LUN:____	TID:____ LUN:____
0:07					TID:____ LUN:____	TID:____ LUN:____	TID:____ LUN:____
0:08					TID:____ LUN:____	TID:____ LUN:____	TID:____ LUN:____
0:09					TID:____ LUN:____	TID:____ LUN:____	TID:____ LUN:____
0:0a					TID:____ LUN:____	TID:____ LUN:____	TID:____ LUN:____
0:0b					TID:____ LUN:____	TID:____ LUN:____	TID:____ LUN:____
0:0c					TID:____ LUN:____	TID:____ LUN:____	TID:____ LUN:____

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0:0d					TID:____ LUN:____	TID:____ LUN:____	TID:____ LUN:____
0:0e					TID:____ LUN:____	TID:____ LUN:____	TID:____ LUN:____
0:0f					TID:____ LUN:____	TID:____ LUN:____	TID:____ LUN:____
0:10					TID:____ LUN:____	TID:____ LUN:____	TID:____ LUN:____
and so on…							

Configuring the new disk devices for Windows

This section describes how to configure the new disk devices on the Windows host.

> **Note:**
>
> - Do not create partitions on the FX devices. If the FX devices will be used in the MSCS environment, you must write a signature on each FX device. If not, do not write a signature.
>
> - For information about the FC AL PA to SCSI TID mapping, see SCSI TID Maps for FC adapters (on page 178).
>
> - Online LUSE expansion: data migration is not needed for OPEN V (required for other LU types). A host reboot is not required for Windows. For more information, contact your Hitachi Vantara representative.

Writing the signatures for Windows

The first step when configuring new devices is to write a signature on each device using the Windows Disk Management. You must write a signature on each SCSI disk device to enable the Windows system to vary the device online. For MSCS environments, you must also write signatures on the FX and other raw devices. The 32-bit signature identifies the disk to the Windows system. If the disk's TID or LUN is changed, or if the disk is moved to a different controller, the Disk Management and Windows fault tolerant driver will continue to recognize it.

📄 **Note:** Microsoft Windows assigns disk numbers sequentially, starting with the local disks and then by adapter, and by TID/LUN. If the storage system is attached to the first adapter (displayed first during system start up), the disk numbers for the new devices start at 1 (the local disk is 0). If the storage system is not attached to the first adapter, the disk numbers for the new devices start at the next available disk number. For example, if 40 disks are attached to the first adapter (disks 1–40) and the storage system is attached to the second adapter, the disk numbers for the storage system start at 41.

Procedure

1. Click the **Start** button, point to **Programs**, point to **Administrative Tools** (**Computer Management**), and click **Disk Management** to start the Disk Manager. Initialization takes a few seconds.

2. When the **Disk Management** window notifies you that one or more disks have been added, click **OK** to allow the system configuration to be updated. The **Disk Management** window also notifies you if any disks were removed.
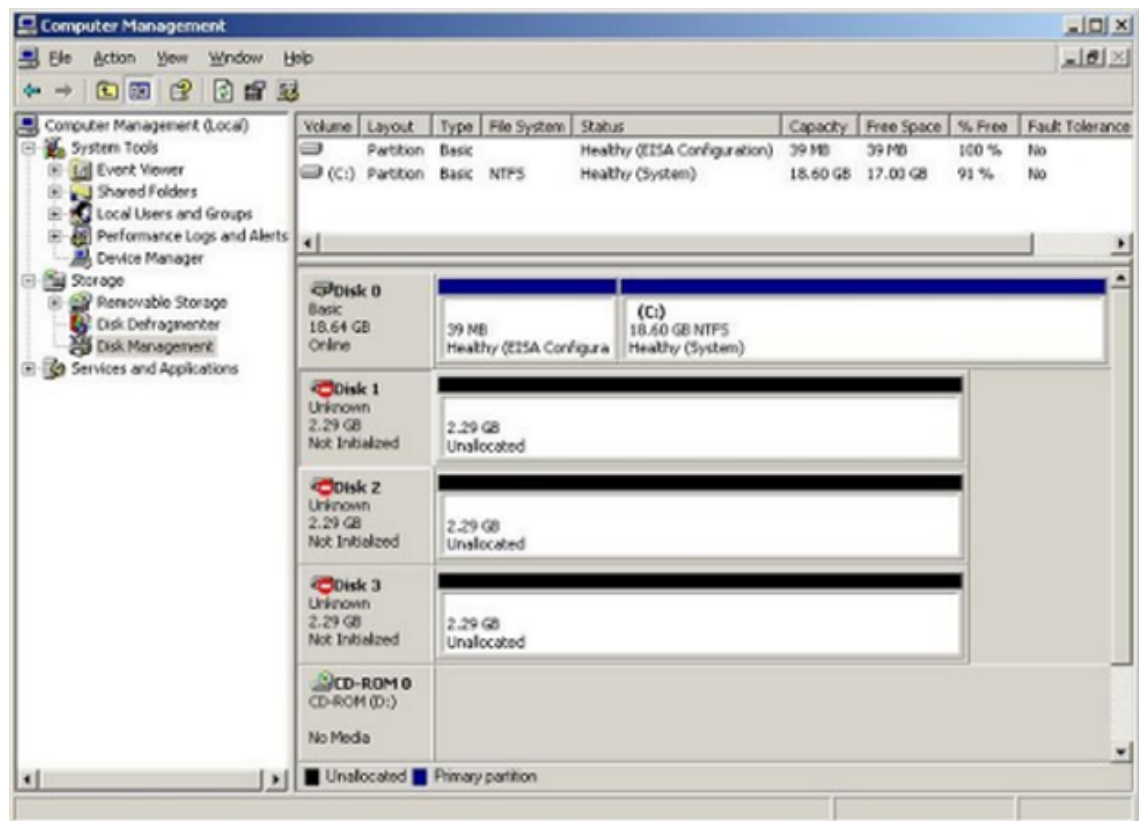
📄 **Note:** In this example, disk 0 is the local disk, disk 1 is an OPEN-3 device, disk 2 is an OPEN-3 device, and disk 3 is an OPEN-3 device.

3. Each new device is displayed by disk number, and you are prompted about whether you want to write a signature on the disk. You may only write a signature once on each device. Refer to your completed SCSI Path Worksheet (see <u>Verification of new device recognition for Windows (on page 150)</u> to verify the device type for each disk number.
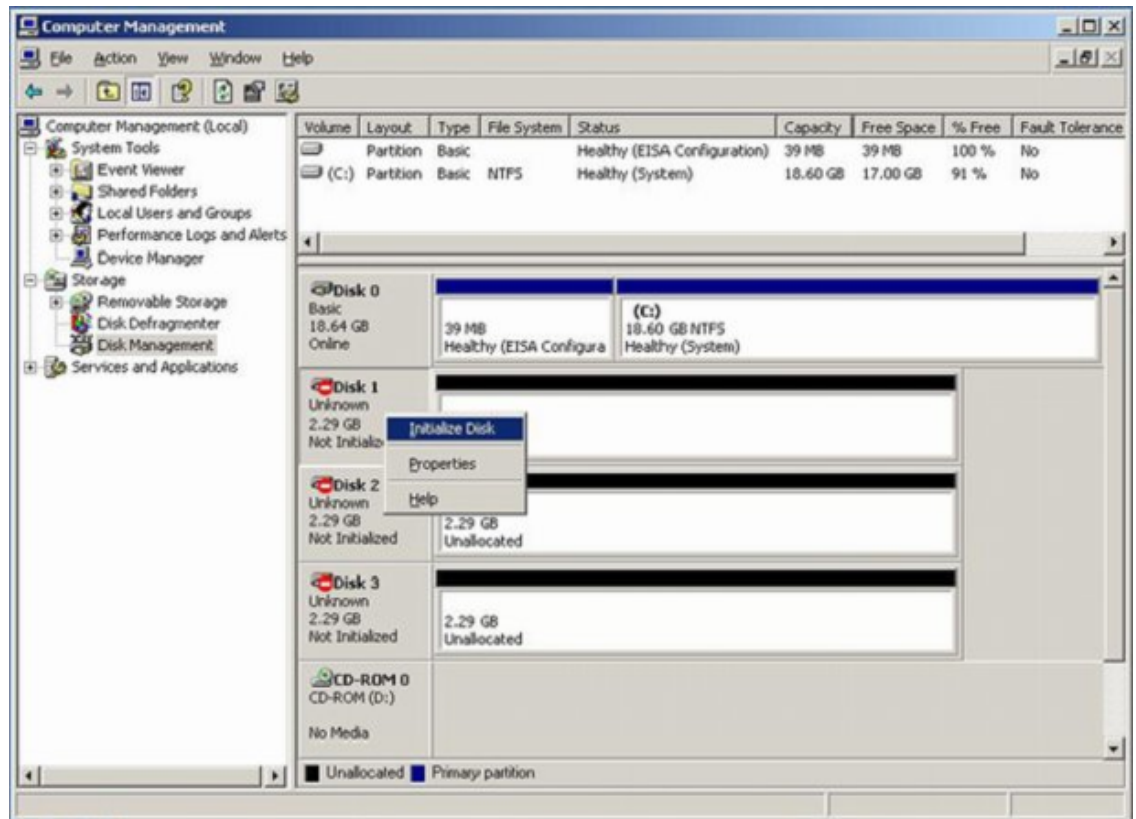
- For all SCSI disk devices, click **OK** to write a signature.

- For FX devices without MSCS, click **No**.

- For FX devices with MSCS, click **Yes** and observe this warning:

> ⚠ **Caution:** After a signature has been written on an FX device, there is no way to distinguish the FX device from a SCSI disk device. Use extreme caution to not accidentally partition and format an FX device. This will overwrite any data on the FX device and prevent the FX software from accessing the device.

4. After you write or decline to write a signature on each new device, the devices are displayed by disk number in the **Disk Management** window. The total capacity and free space are displayed for each disk device with a signature. `Configuration information not available` indicates no signature. For directions on creating partitions on the new SCSI disk devices, see Creating and formatting the partitions for Windows (on page 154) .

Creating and formatting the partitions for Windows

After writing signatures on the new devices, you can create and format the partitions on the new disk devices. Use your completed SCSI Device Worksheet (see Verification of new device recognition for Windows (on page 150)) to verify disk numbers and device types.

Dynamic Disk is supported with no restrictions for the storage system connected to the Windows operating system. For more information, refer to the Microsoft Windows online help.

Note: Do not partition or create a file system on a device that will be used as a raw device. All FX devices are raw devices.

Procedure

1. On the **Disk Management** window, select the unallocated area for the SCSI disk you want to partition, click the **Action** menu, and then click **Create Partition**.

2. In the **New Partition Wizard**, in the **Select Partition Type** dialog box, select the desired type of partition, and then click **Next**.

Note: The storage systems do not support Stripe Set Volume with parity.
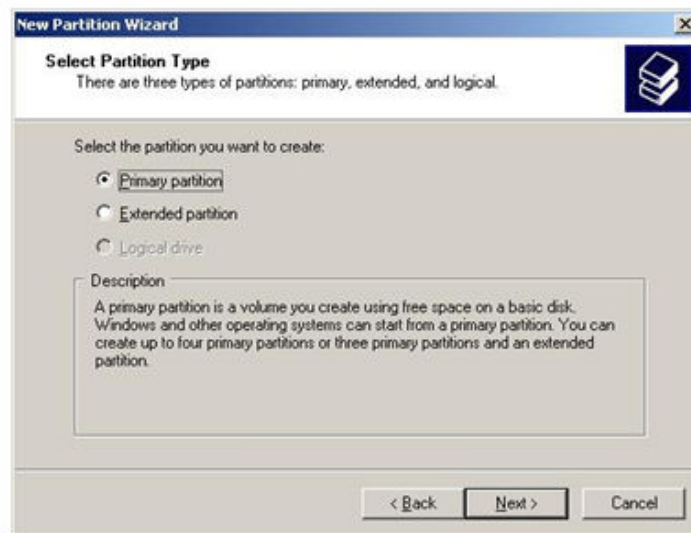
3. In the **Specify Partition Size** dialog box, specify the desired partition size. If the size is greater than 1024 MB, you will be asked to confirm the new partition. Click **Next**.
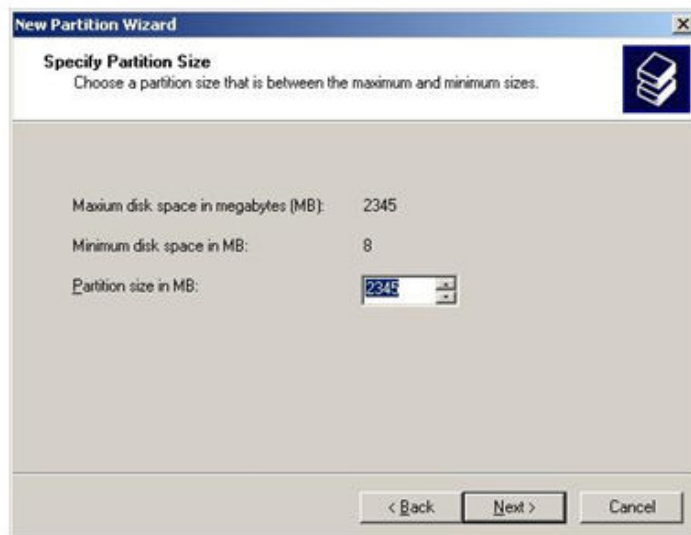
4. In the **Assign Drive Letter** or **Path dialog** box, select a drive letter or path, or specify no drive letter or drive path. Click **Next**.

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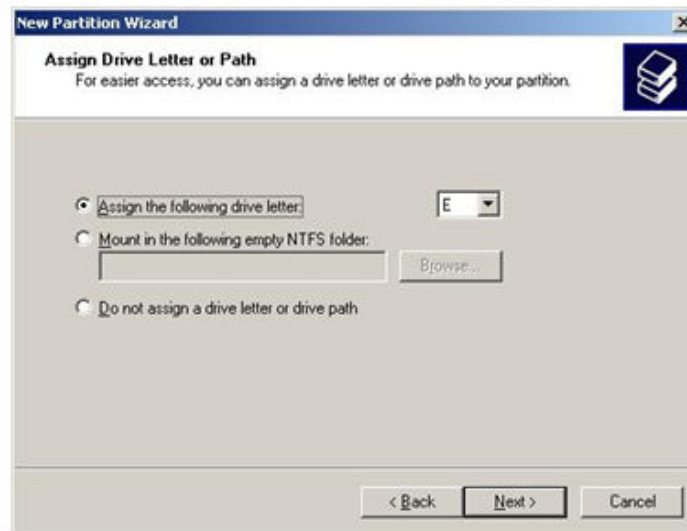
5. In the **Format Partition** dialog box, click **Format this partition with the following settings** and select the following options:

    ■ **File System:** Select **NTFS** (enables the Windows system to write to the disk).

    ■ **Allocation unit size: Default**. Do not change this entry.

    ■ **Volume label:** Enter a volume label, or leave blank for no label.

    ■ **Format Options:** Select **Perform a Quick Format** to decrease the time required to format the partition. Select **Enable file and folder compression** only if you want to enable compression.
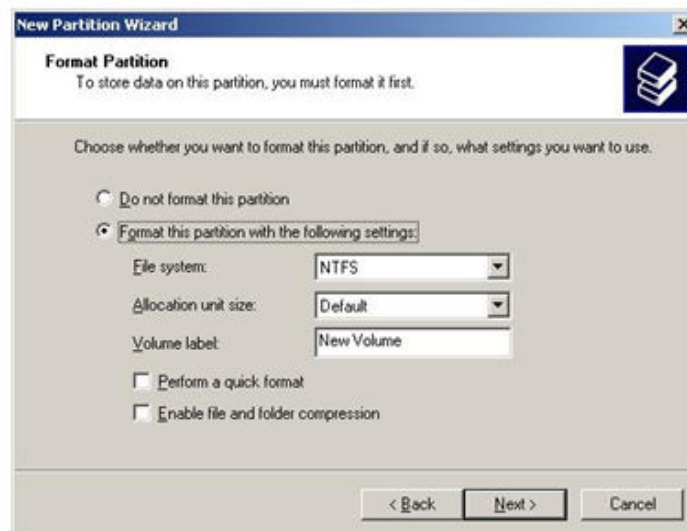
6. Click **Next** to format the partition as specified. When the format warning appears (`This new format will erase all existing data on disk`), click **OK** to continue. The **Format dialog** box shows the progress of the format partition operation.

7. When the format operation is complete, click **OK**. The new partition is displayed in the **New Partition Wizard** (see the figure below). Click **Finish** to close the **New Partition Wizard**.

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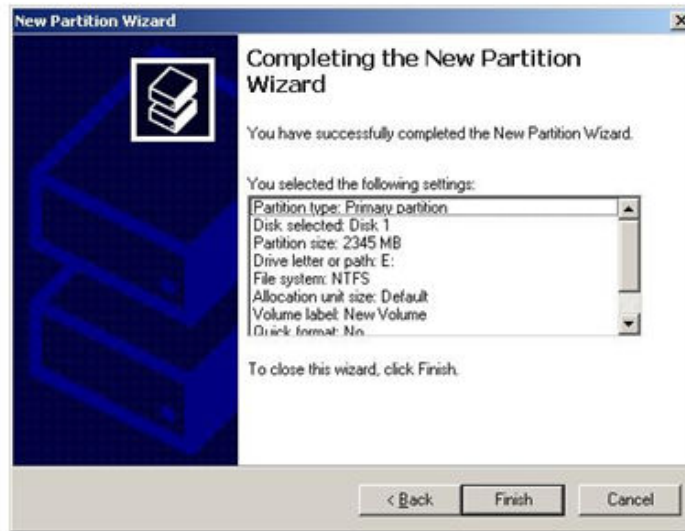
8. Verify that the correct file system (NTFS) for the formatted partition is displayed in the **Disk Management** window (see the figure below). The word **Healthy** indicates that the partition has been created and formatted successfully.
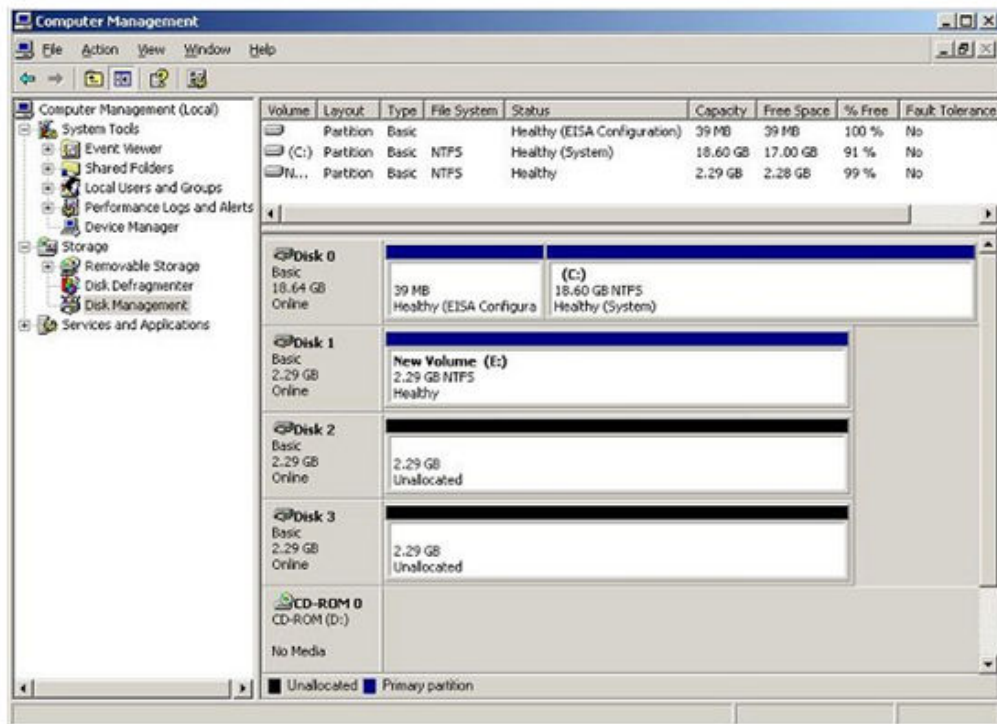
9. Repeat steps 1-8 for each new SCSI disk device. When you finish creating and formatting partitions, exit the **Disk Management** window. When the disk configuration change message appears, click **Yes** to save your changes.

📄 **Note:** Be sure to make your new Emergency Repair Disk.

Verifying file system operations on SCSI disk device for Windows

After you create and format the partitions, verify that the file system is operating properly on each new SCSI disk device. The file system enables the Windows host to access the devices. You can verify file system operation easily by copying a file onto each new device. If the file is copied successfully, this verifies that the file system is operating properly and that Windows can access the new device.

> **Note:** Do not perform this procedure for FX and other raw devices. Instead, use the FX File Conversion Utility (FCU) or File Access Library (FAL) to access the FX devices.

Procedure

1. From the Windows desktop, double-click My Computer to display all connected devices. All newly partitioned disks appear in this window.

   In the following example, (E:) and (F:) are the new devices.
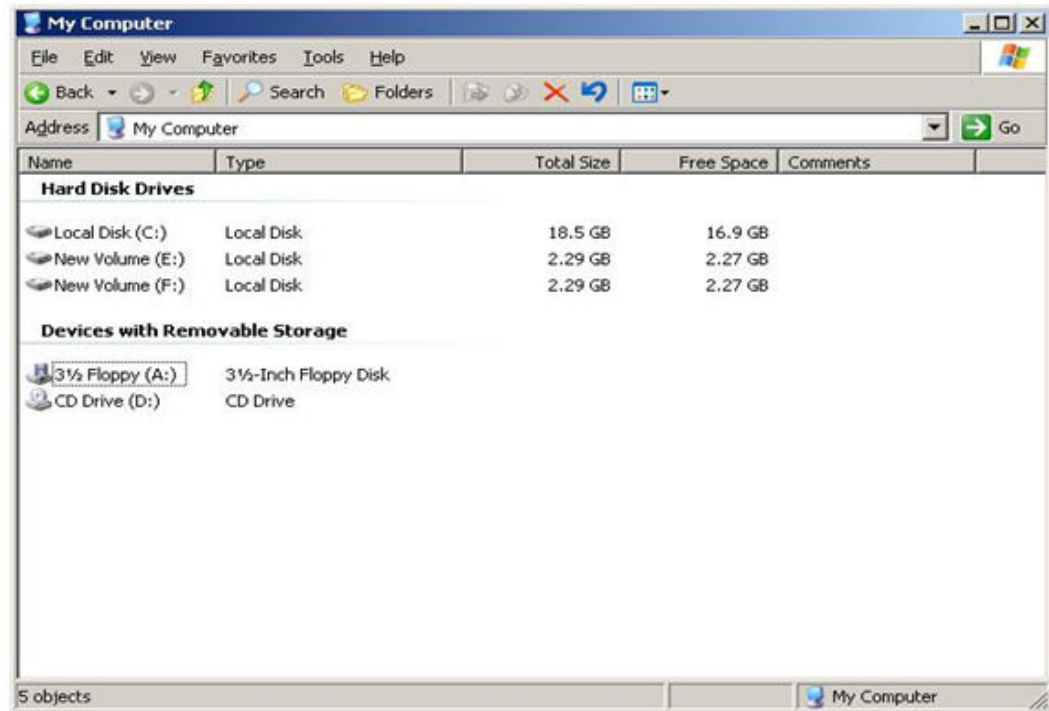
2. Select the device you want to verify, then display its **Properties** using either of the following methods:

   - On the **File** menu, click **Properties**.

   - Right-click and select **Properties**.

3. On the **Properties** dialog box, verify that the following properties are correct:

   - Label (optional)

   - Type

■ Capacity

■ File system
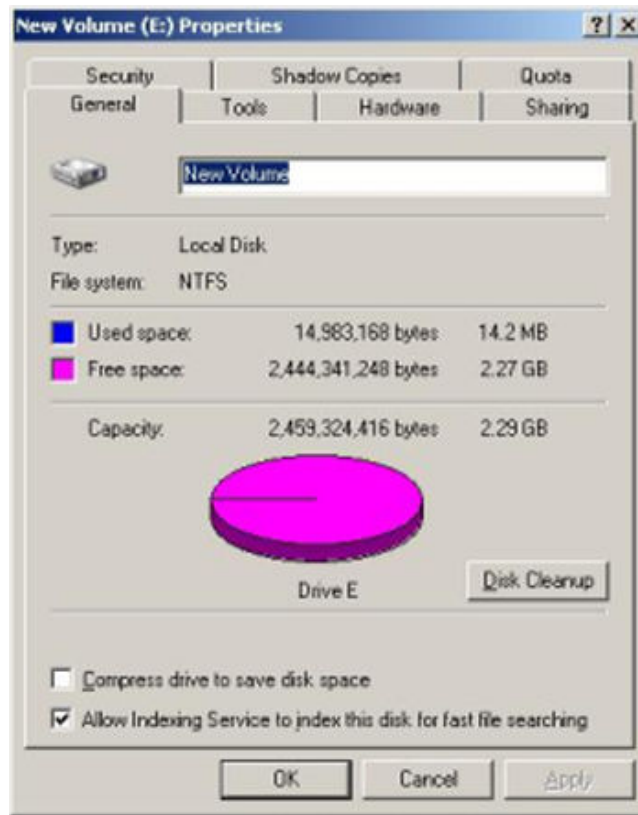
4. Copy a small file to the new device.

5. Display the contents of the new device to be sure the copy operation completed successfully (see the following example). The copied file should appear with the correct file size. If desired, compare the copied file with the original file to verify no differences.

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6. Delete the copied file from the new device, and verify that the file was deleted successfully.

7. Repeat steps 2 through 6 for each new SCSI disk device.

Verifying auto-mount for new devices for Windows

The last step in configuring the new devices is to verify that all new devices are mounted automatically at system boot up. Use the procedure below to verify auto-mount of the new devices.

Procedure

1. Shut down and then restart the Windows system.

2. Open My Computer and verify that all new SCSI disk devices are displayed.

3. Verify that the Windows host can access each new device by repeating the procedure in Verifying file system operations on SCSI disk device for Windows (on page 158):

a. Verify the device properties for each new device.
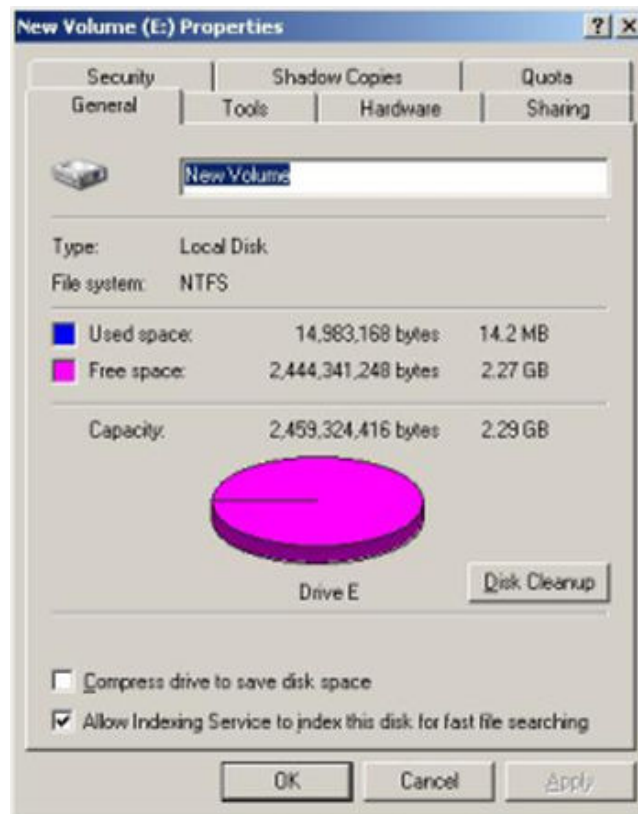
b. Copy a file to each new device to be sure the devices are working properly.

Changing the enable write caching option for Windows

The Enable Write Cache option has no effect on the cache algorithm when used with storage systems and is not related to any internal Windows server caching. Microsoft and Hitachi Vantara both recommend that you enable this option because it will provide a small improvement to Microsoft error reporting.

Procedure

1. Right-click My Computer.
2. Click **Manage**.
3. Click **Device Manager**.
4. Click the plus sign (+) next to **Disk Drives**.
5. In the list of disk drives, double-click the first Hitachi system disk drive.
6. Select the **Policies** or **Disk Properties** tab.
7. If **Enable write caching on the disk** is enabled, disable this option by clearing the check mark. If the **Enable Write Cache** option is grayed out, this option is disabled.
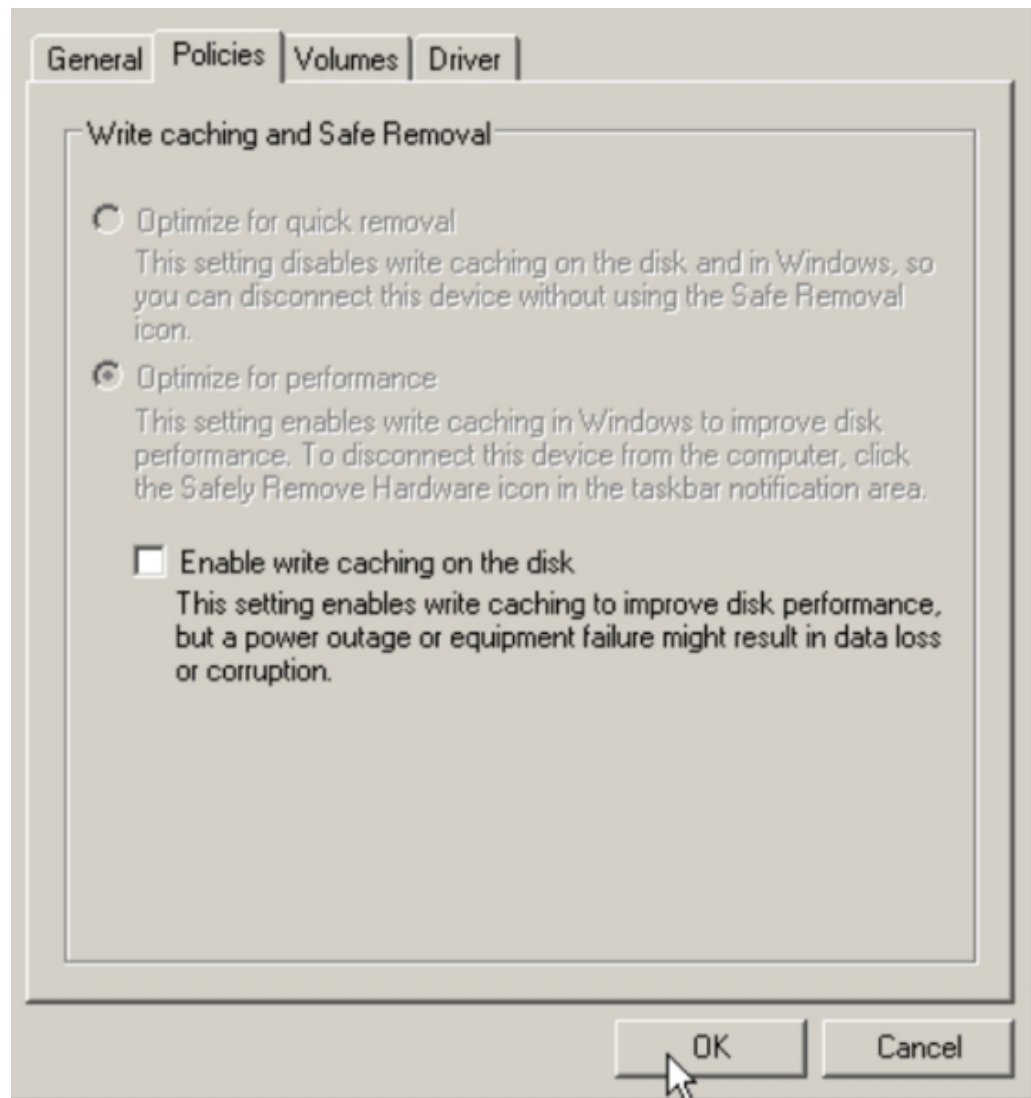
8. Repeat this procedure for all additional system disks.

Creating an online LUSE volume for Windows

This section explains how to safely expand an online LUSE volume in the Windows operating system.

> 📄 **Note:**
>
> - It is recommended that you stop all I/O activity before you perform an online LUSE expansion.
>
> - Data migration is not needed for OPEN V (required for other LU types). A host reboot is not required for Windows. For more information, contact your Hitachi Vantara representative.

The following information applies to the instructions below:

- LDEV # = 0:32

- Mount point = i

- capacity = 40 MB

Procedure

1. On the Windows host, confirm that Disk I is mounted and Disk 12 (the disk to be expanded) is on this system: Open **Windows Computer Management**, expand **Storage**, and select **Disk Management**.
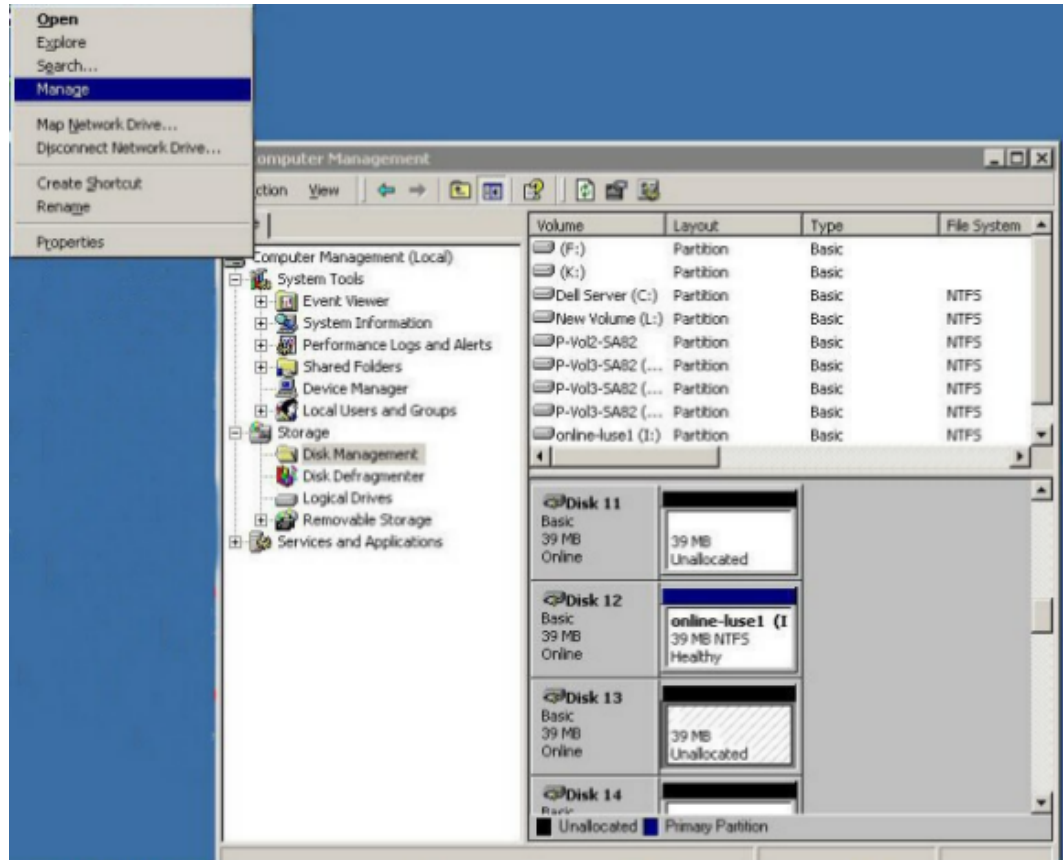
2. View the disk properties (right-click on the disk and select **Properties**) to get detailed information. In this example, details for Disk 13 are displayed.
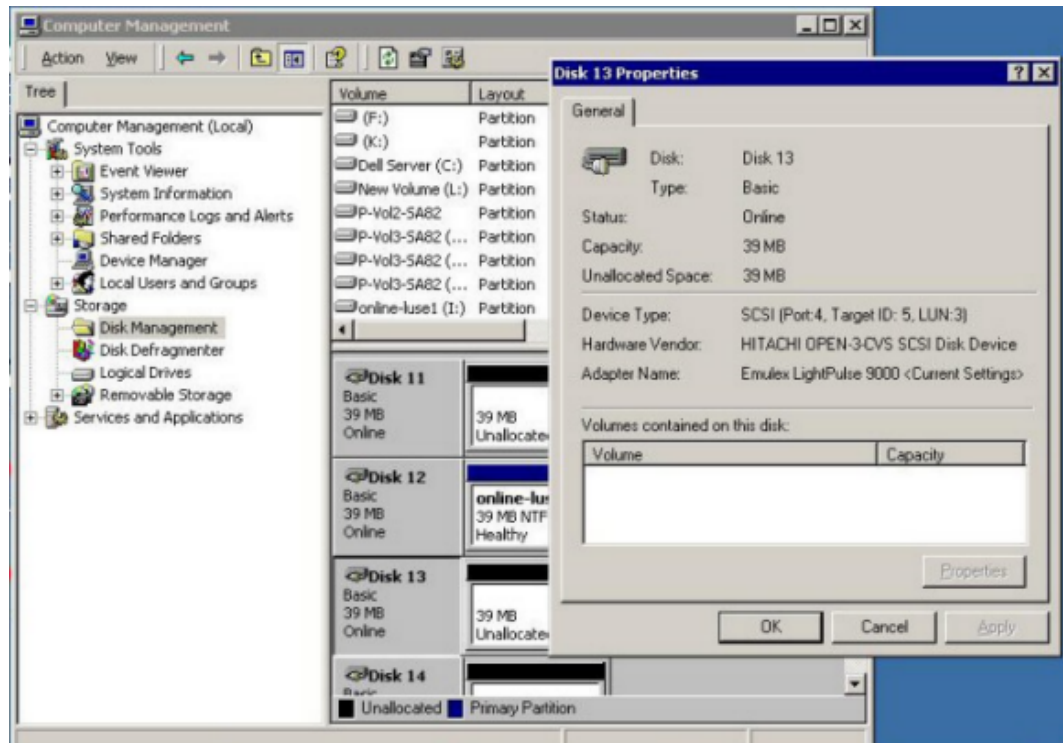
3. Create a LUSE volume. For instructions, see the *Provisioning Guide* for the storage system. After creating the LUSE volume, you can configure the Windows host to recognize the expanded LDEV (for example, using DISKPART).

4. Return to the Windows **Computer Management** application, and refresh the display: Select **Action** > **Rescan**.

   When the rescan has completed, he mounted volume *I:\ (disk 12)* is expanded from 40 MB to 80 MB, but the newly added disk is not yet formatted. You must now combine the new partition (for example, using DISKPART).
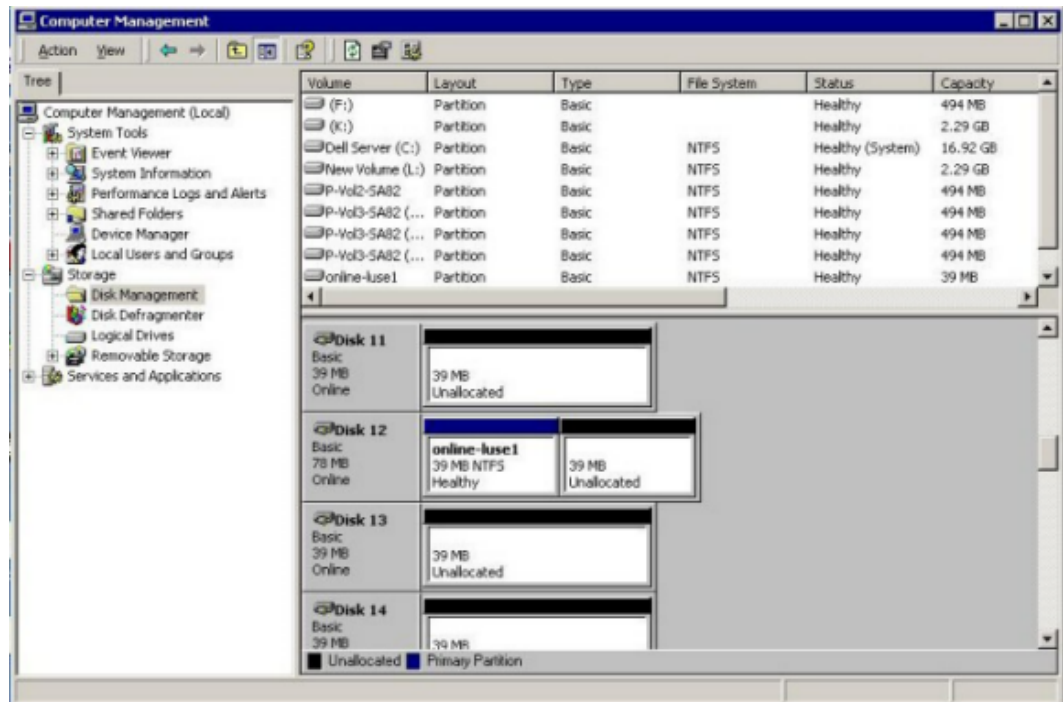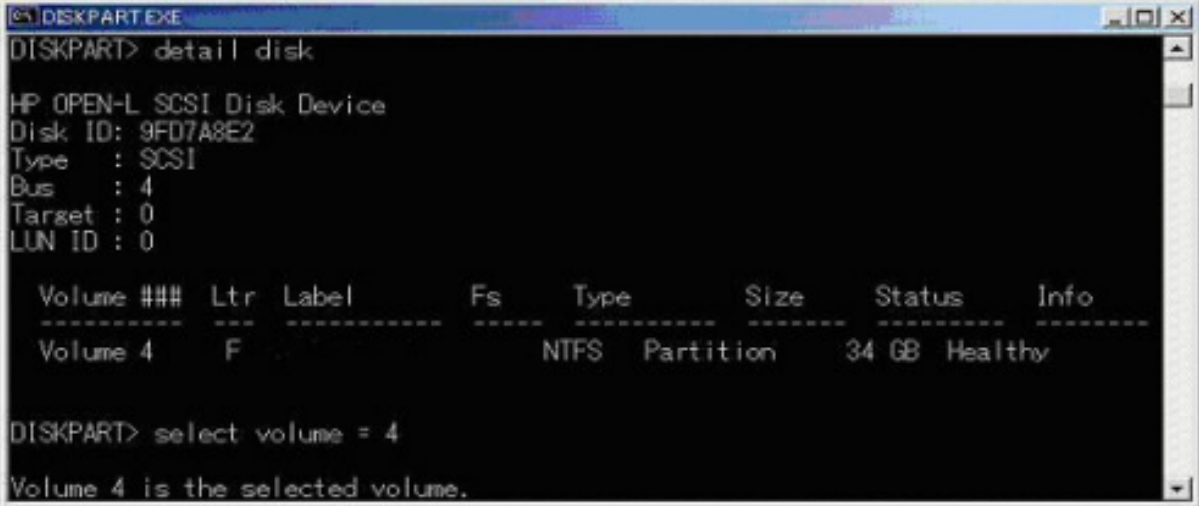
> **Note:** Before using DISKPART, read all applicable instructions.

5. At a command prompt, enter `Diskpart`, and press Enter.

6. At the `DISKPART>` prompt, enter `list disk`, and press Enter.

7. In the list of disks, when you have identified the disk to be expanded (Disk 1 in this example), enter `select disk=1` (for this example), and press Enter. Disk 1 is now the selected disk on which the operations will be performed.
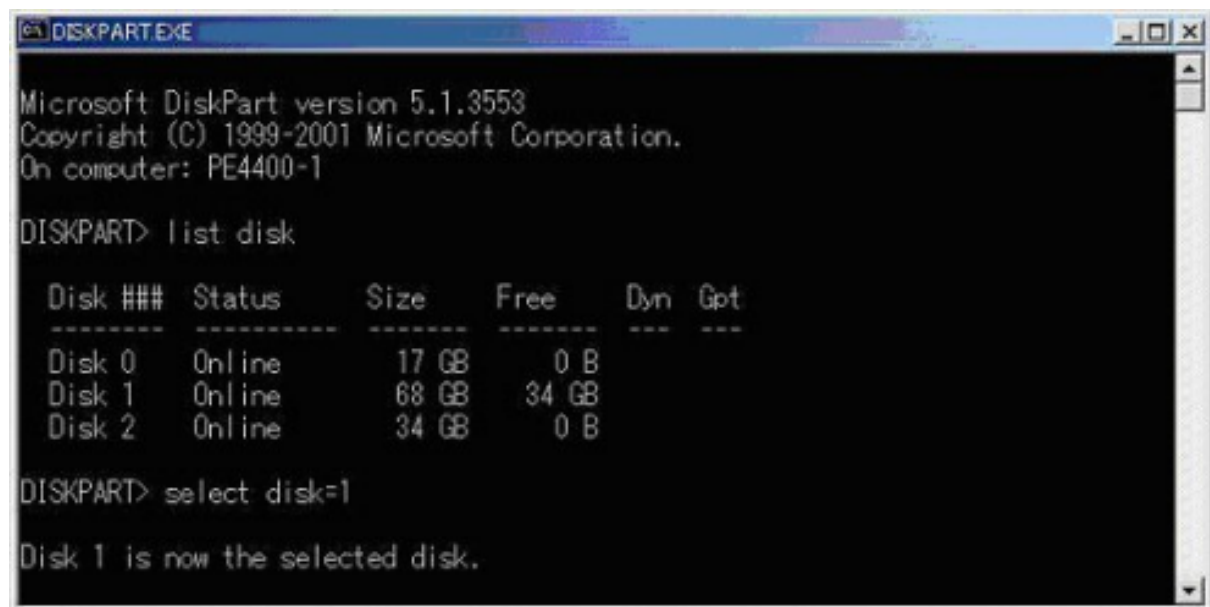
8. At the `DISKPART>` prompt enter `detail disk`, and press Enter.

9. After viewing the disk details, select the volume to be used. For this example, enter `select volume = 4`, and press Enter.
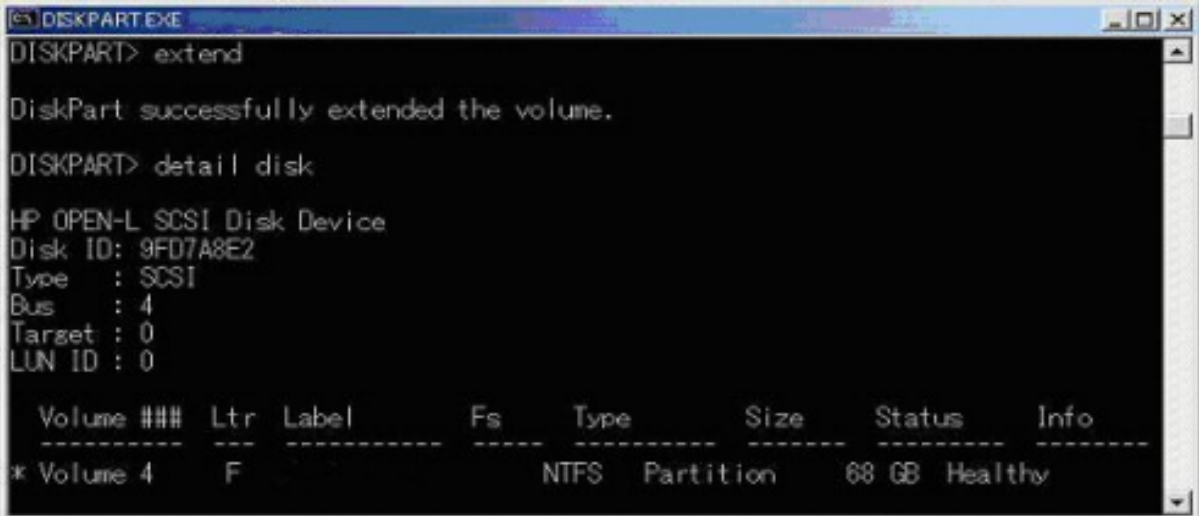
10. At the `DISKPART>` prompt, enter `extend`, and press Enter to combine the available volumes for the selected disk into a single partition.

11. Enter `detail disk` at the `DISKPART>` prompt, and press Enter to verify that the size is 68G.

Enabling MultiPath IO (MPIO) for Windows

You can enable and configure the MultiPath IO (Input/Output) feature of the Windows Server Manager for the storage systems.

Procedure

1. Open **Server Manager**, and open the **Administrator Tools** menu.
2. Select **Diagnostics**, and then open **Device Manager** window and verify that Hitachi OPEN x SCSI Disk Device is displayed as having n LDEV x 2 paths = 2n devices.
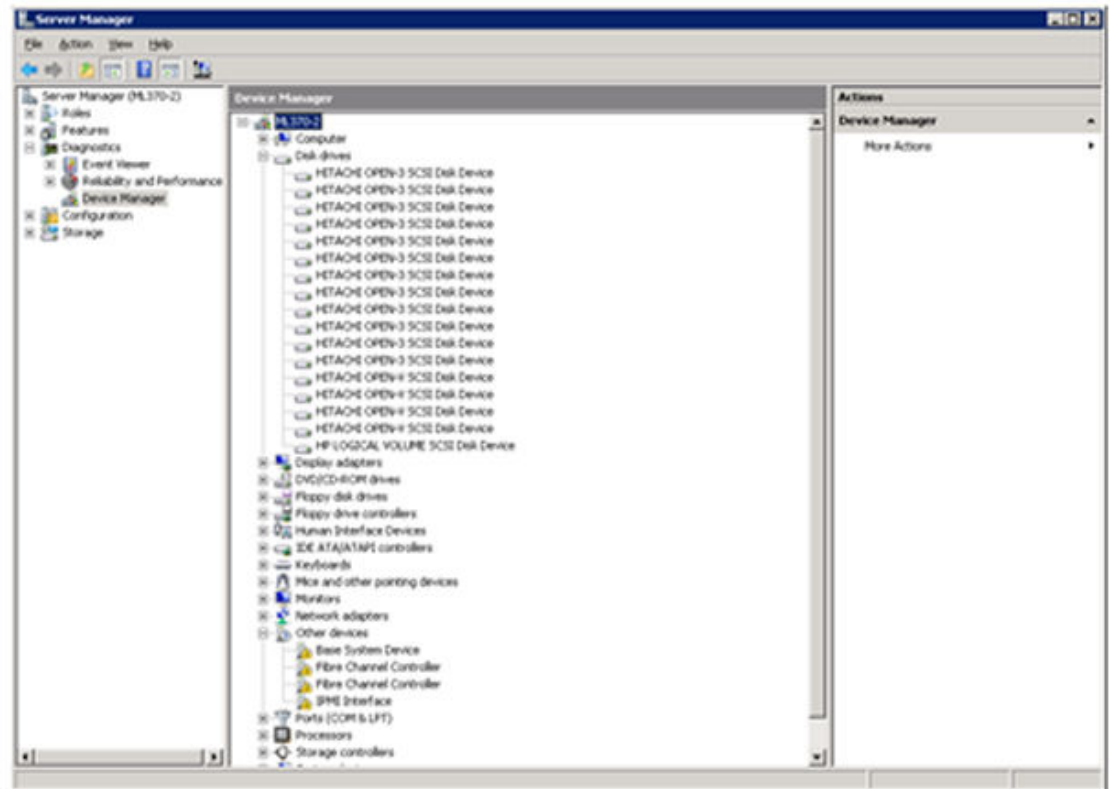
3. From **Server Manager**, select **Features** and click **Add Features**.
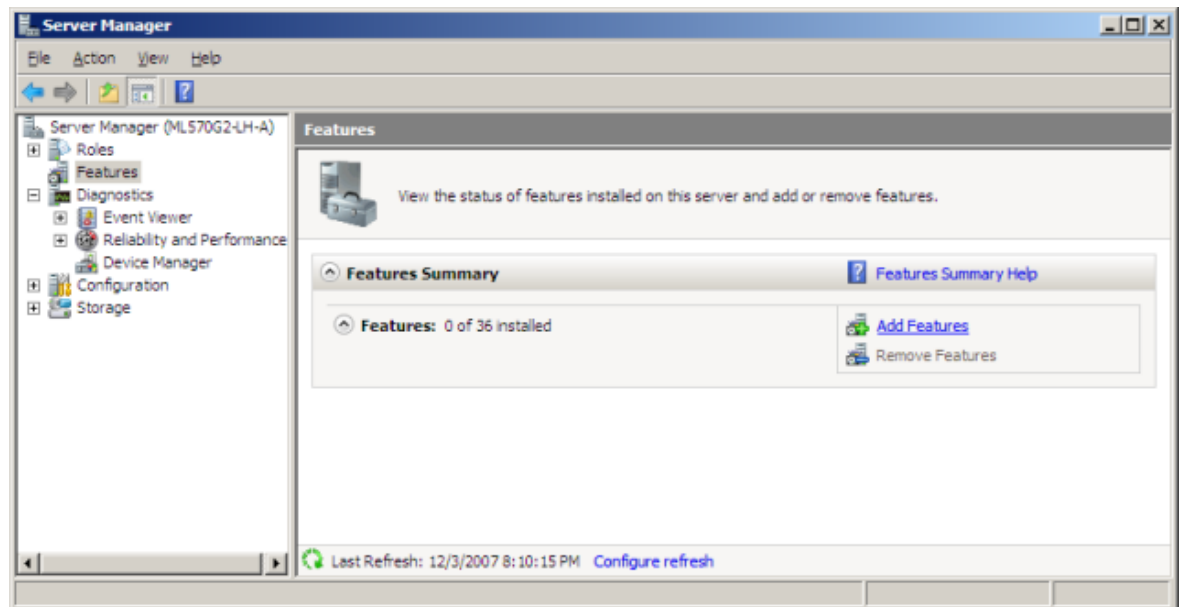
4. In the **Select Features** window, select **Multipath I/O** and click **Next**. If the **Cluster** option is selected, **Multipath I/O** and **Failover Clustering** must be selected.
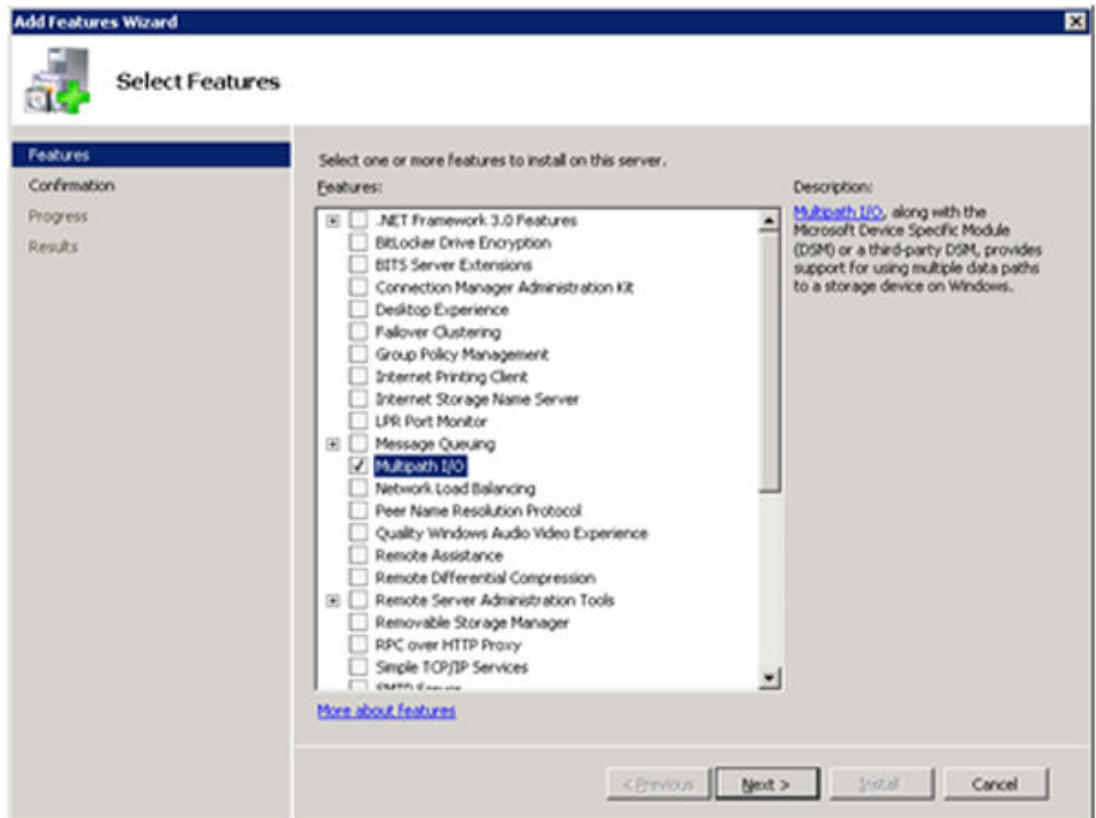
5. Confirm the installed content (Mutlipath I/O) and click **Install** to start the installation.
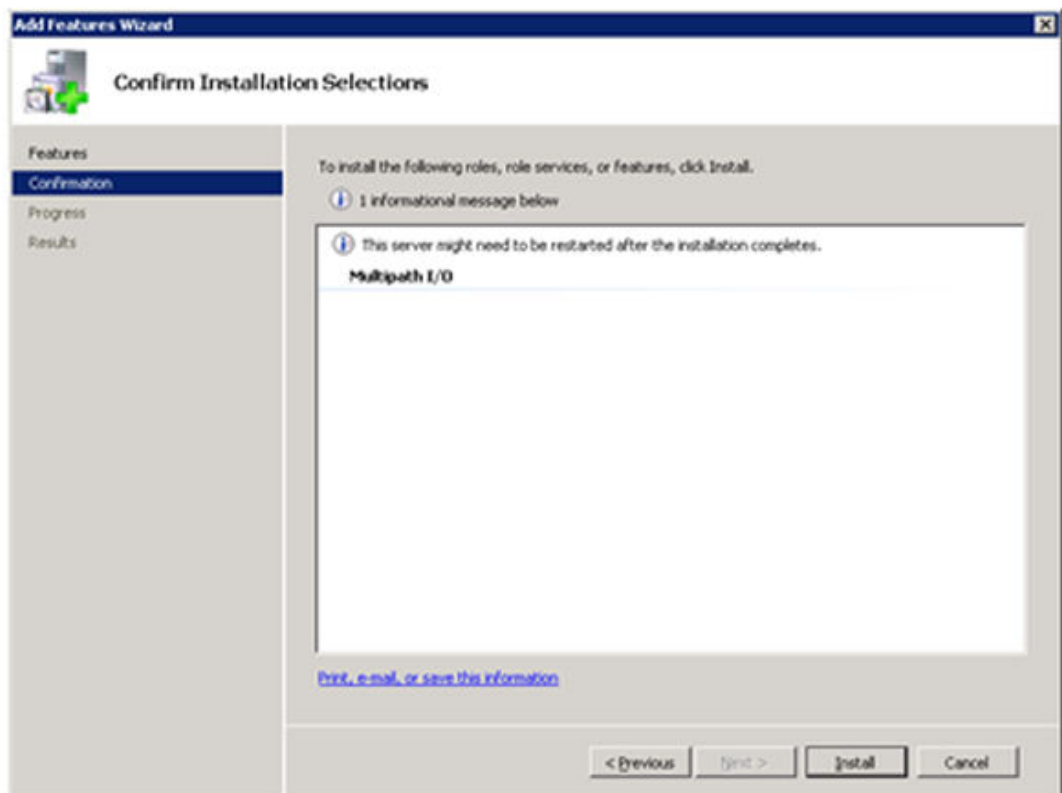
6. In the **Installation Results** window, review and confirm (if successful) by clicking **Close**.
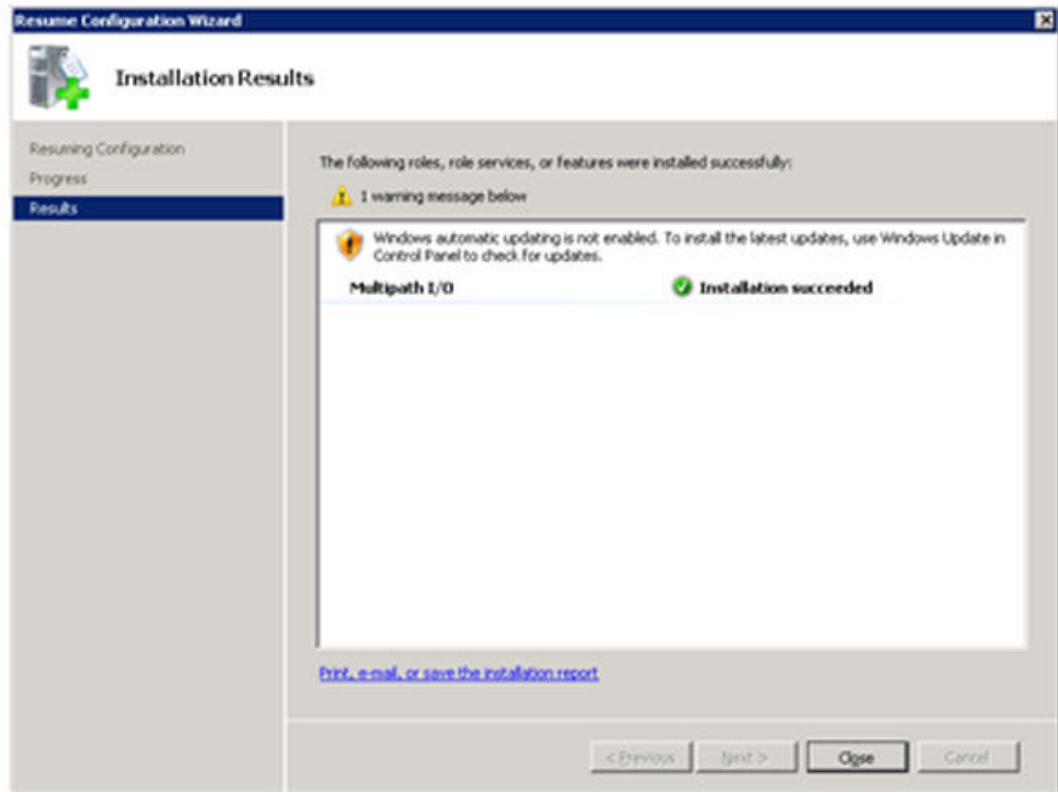
📄 **Note:** If the system notice shown below is displayed, restart the server.
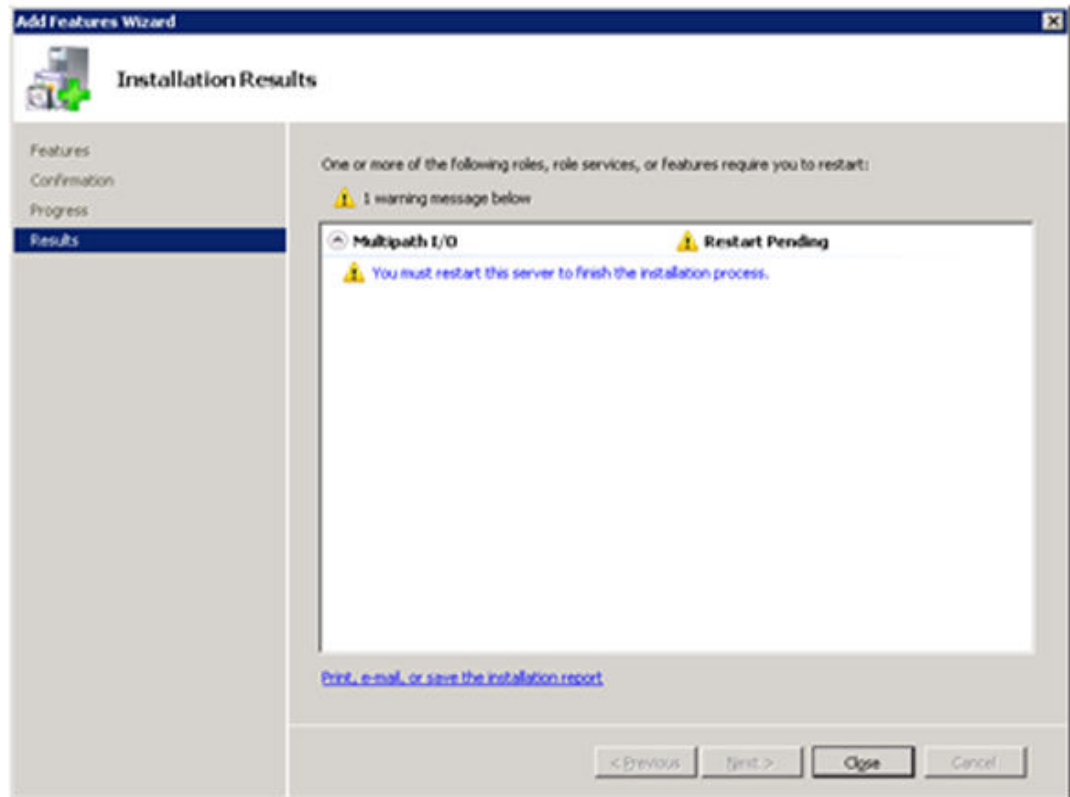
7. To launch MPIO, select **Start**, then from the **Control Panel**, double-click the **MPIO** icon.
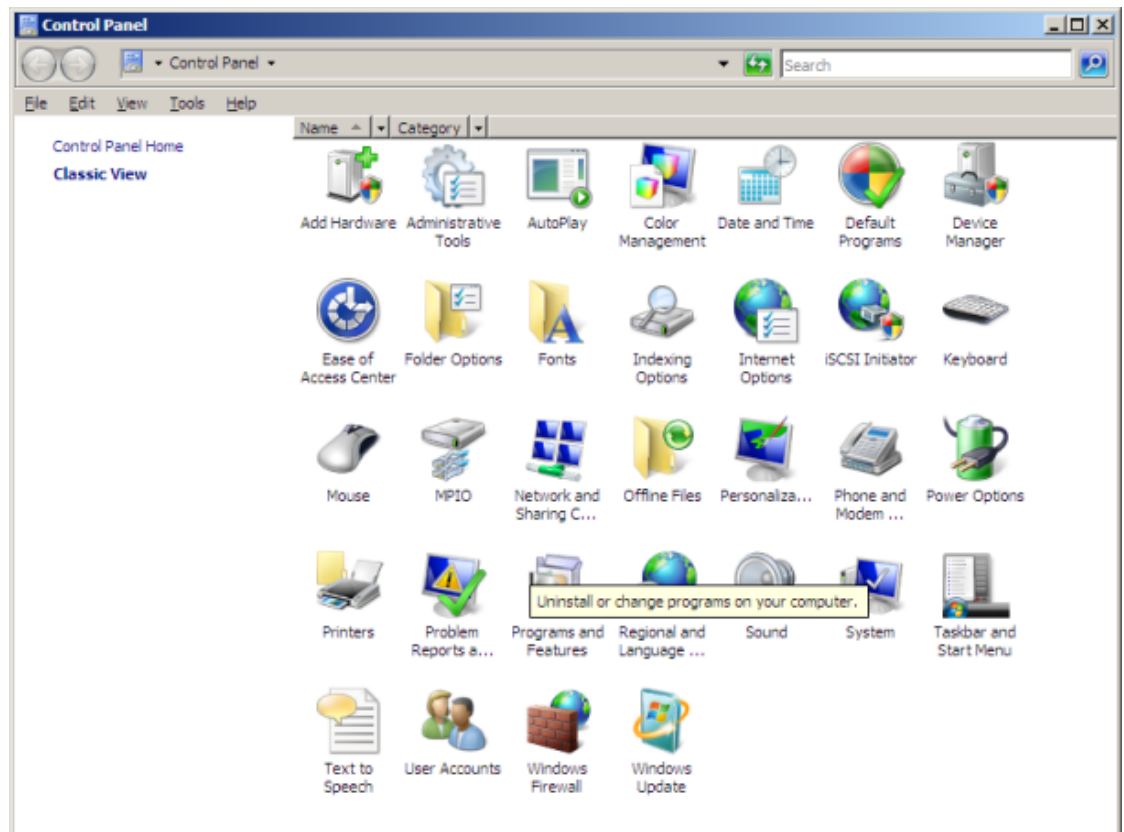
8. On the **MPIO Properties** window, select the **MPIO ed Devices** tab, select the device to add, and click **Add**.
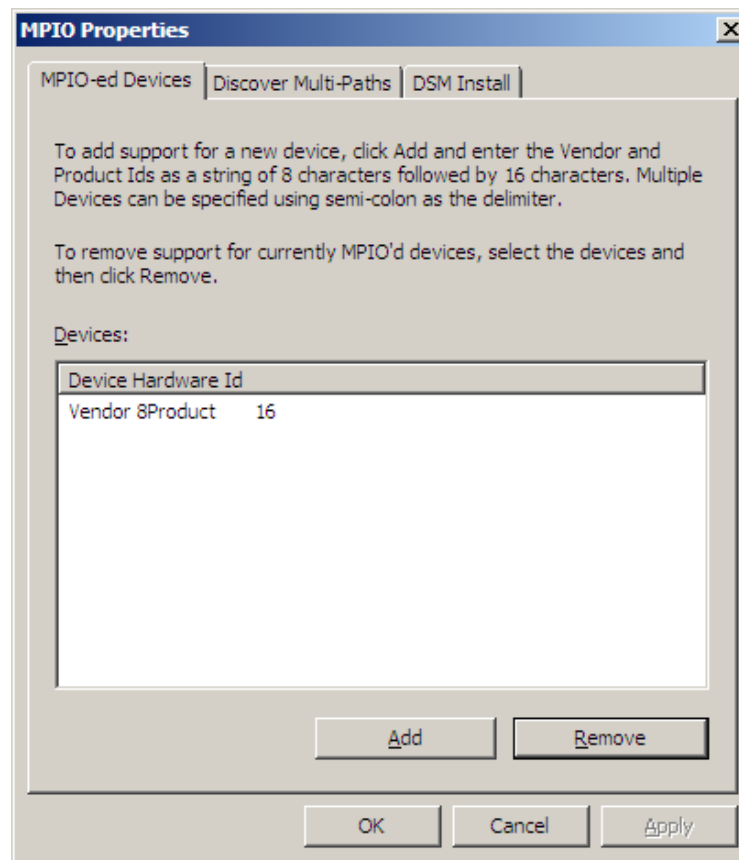
9. In the **Add MPIO Support** window, enter `HITACHI OPEN-`, and click **OK**.
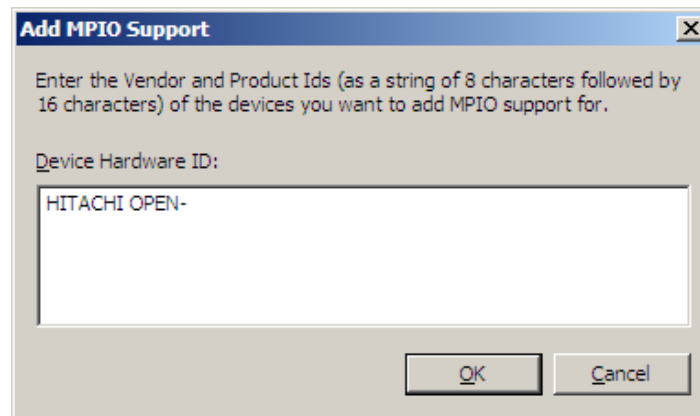
10. When the Reboot Required message is displayed, click **Yes**.
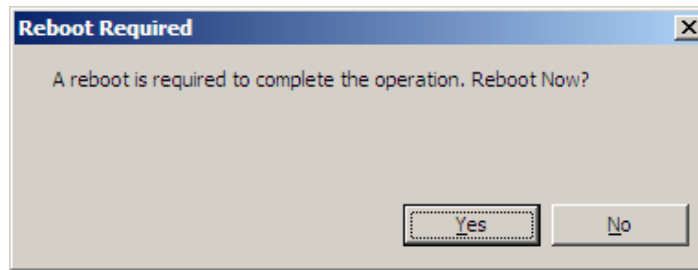
11. After the reboot, go to **Server Manager**, select **Diagnostics** and in the **Device Manager** window, verify that **HITACHI OPEN x Multi Path Disk Device** is displayed correctly.
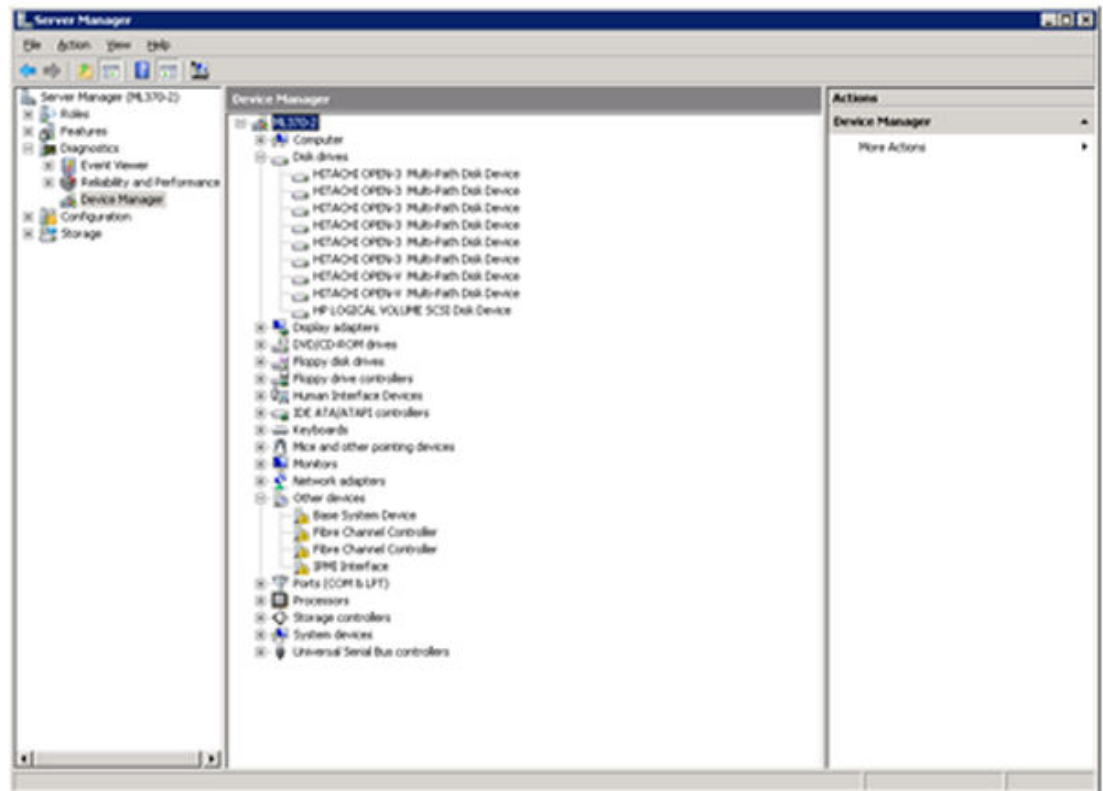
12. To set the Balance Policy, select the device and right-click to access its properties window. Select **Round Robin** for each LU. This policy setting is selectable on a per device basis.

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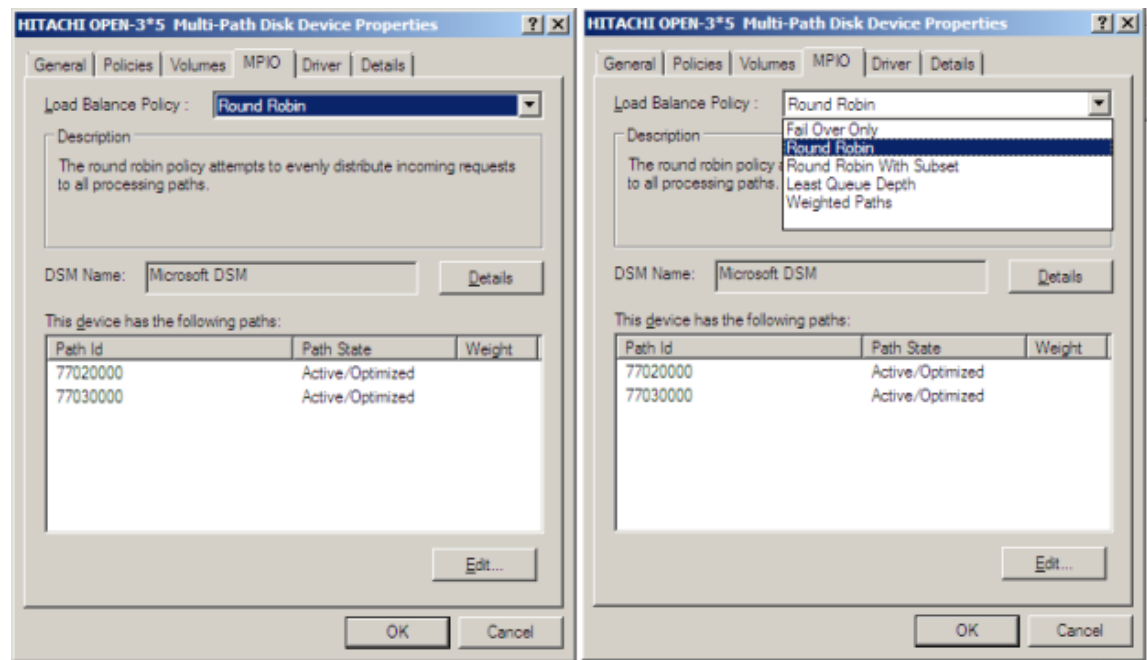
Troubleshooting for Windows host attachment

The following table lists potential error conditions that might occur during storage system installation on a Windows host and provides instructions for resolving the conditions. If you cannot resolve an error condition, contact customer support.

Error Condition	Recommended Action
The devices are not recognized by the system.	Be sure the READY indicator lights on the storage system are ON. Be sure the fibre cables are correctly installed and firmly connected.
The Windows system does not reboot properly after hard shutdown.	If the Windows system is powered off unexpectedly (without the normal shutdown process), wait three minutes before restarting the Windows system. This lets the storage system's internal time out process to purge all queued commands so the storage system is available (not busy) during system startup. If the Windows system is restarted too soon, the storage system tries to process the queued commands and the Windows system will not reboot successfully.

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Chapter 10: XenServer configuration and attachment

This chapter describes how to configure the new disk devices on a XenServer host. Configuration of the devices should be performed by the XenServer system administrator. Configuration requires superuser/root access to the host system. If you have questions or concerns, contact your Hitachi Vantara representative.

Storage system configuration for XenServer operations

The storage system must be fully configured before being attached to the XenServer host, as described in Configuring the storage system (on page 24).

- *Devices types*: The following devices types are supported for XenServer operations. For details, see Logical device types (on page 14).

    - OPEN-V

    - OPEN-3/8/9/E/L

    - LUSE (OPEN-*x**n)

    - VLL (OPEN-*x* VLL)

    - VLL LUSE (OPEN-*x**n VLL)

- *Host mode*: The required host mode for XenServer is *00*. Do not select a host mode other than *00* for XenServer. For a complete list of host modes for the storage system, see Host modes and host mode options (on page 205). For instructions on setting the host modes, see the *Provisioning Guide* for the storage system.

- *Host mode options*: You may also need to set host mode options (HMOs) to meet your operational requirements. For a complete list of HMOs for the storage system, see Host modes and host mode options (on page 205). For instructions on setting the HMOs, see the *Provisioning Guide* for the storage system.

Recognizing the new devices for XenServer

Once the storage system has been installed and connected, you are ready to recognize and configure the new storage devices on the storage system. The devices on the storage system do not require any special procedures and are configured in the same way as any new (HBA-attached) SCSI disk devices. You can use the XenCenter software or the XenServer CLI (`sr-probe` command) to recognize and configure the new storage devices. For details and instructions, see the XenServer user documentation.

Procedure

1. The following figure shows the **XenCenter New Storage** wizard for configuring new storage. Under **Virtual disk storage**, select **Hardware HBA** for the new devices on the storage system.
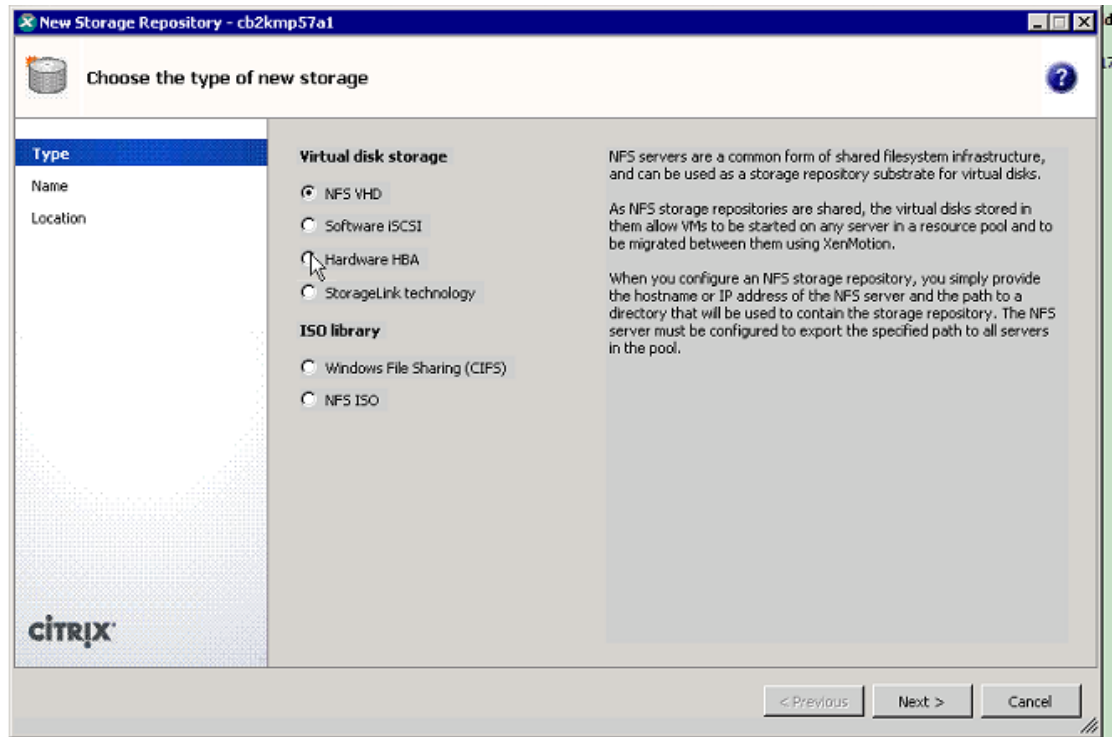
The new storage devices are recognized by the XenServer host as new scsi disk devices that are symlinked under the directory /dev/disk/by_id using the unique *scsi_ids*. To display the *scsi_ids* for a specific device, use the **sginfo** command with the device path, for example:

```
sginfo /dev/disk/by_id/ {scsi_id}
```

Creating storage repositories for XenServer

After recognizing the new disk devices, you can create storage repositories (SRs) for the new storage.

Procedure

1. The following figure shows the creation of an SR using the XenCenter software.
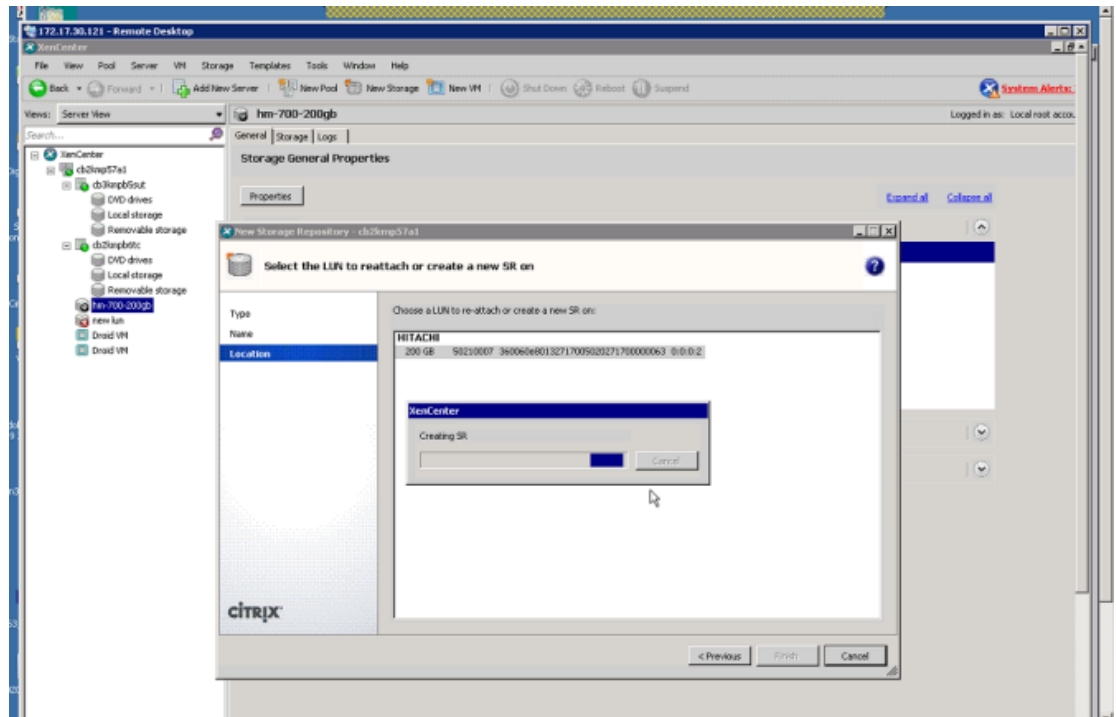
The following figure shows the device status (**OK**, **Connected**) and multipathing status (**2 of 2 paths active**) of a new SR (called **new lun**) for a device on a storage system.
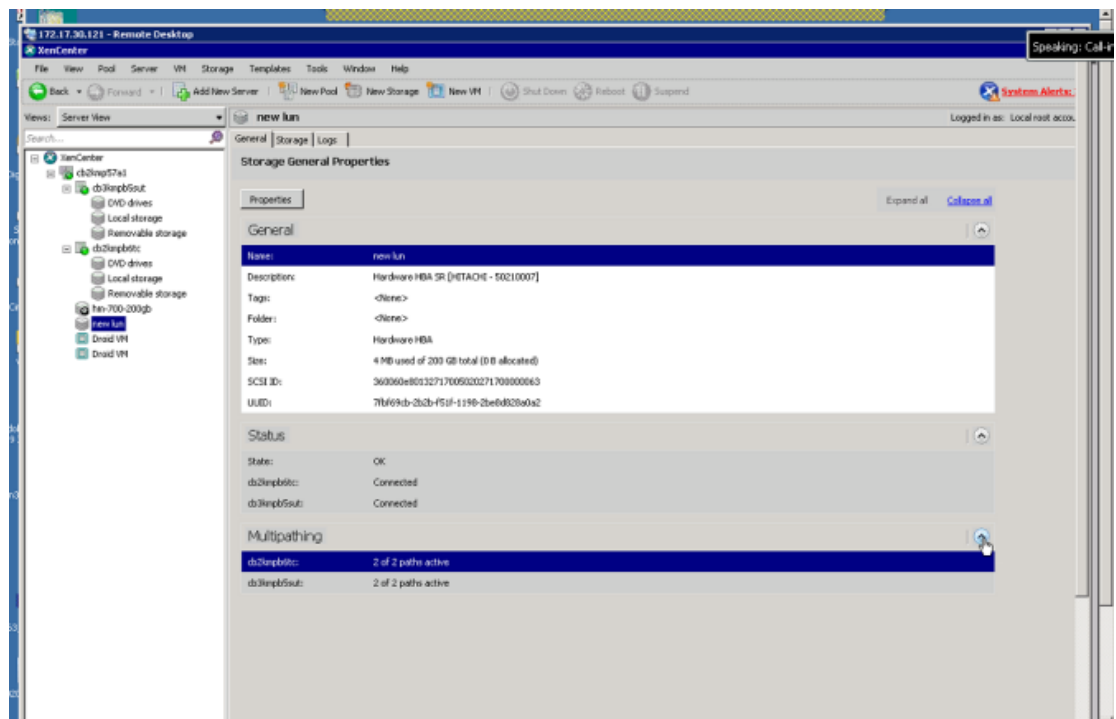
For details about SRs and instructions for creating and managing SRs, see the XenServer user documentation.

Configuring the new storage devices for host use for XenServer

After the SRs have been created and the status of the new SRs has been verified, you can configure the new storage devices for use by the Citrix XenServer host, for example, adding virtual disks (vdisks) and dynamic LUNs.

For details and instructions for configuring and managing Fibre Channel attached storage devices, see the Citrix XenServer user documentation.

Troubleshooting for XenServer host attachment

The following table lists potential error conditions that might occur during storage system installation on a XenServer host and provides instructions for resolving the conditions. If you cannot resolve an error condition, contact customer support.

Error Condition	Recommended Action
The logical devices are not recognized by the system.	Be sure the READY indicator lights on the storage system are ON.
	Run `sr-probe` to recheck the Fibre Channel for new devices.
	Be sure LUSE devices are not intermixed with normal LUs on the same Fibre Channel port.
	Verify that LUNs are configured properly for each TID.

Appendix A: SCSI TID Maps for FC adapters

This chapter describes the fixed mappings between the TID (drive) values assigned by the operating system and the Fibre Channel native addresses (AL_PA/SEL_ID) for Fibre Channel adapters.

About SCSI TID Maps for FC Adapters

When an arbitrated loop (AL) is established or re-established, the port addresses are assigned automatically to prevent duplicate target IDs (TID). When using the SCSI over Fibre Channel protocol (FCP), TIDs are no longer needed. SCSI is a bus-oriented protocol requiring each device to have a unique address since all commands go to all devices.

For Fibre Channel, the AL-PA is used instead of the TID to direct packets to the desired destination. Unlike traditional SCSI, once control of the loop is acquired, a point-to-point connection is established from the initiator to the target. To enable transparent use of FCP, the host operating system "maps" a TID to each AL-PA.

SCSI TID map (ScanDown=0) (on page 178) and SCSI TID map (ScanDown=1) (on page 184) identify the fixed mappings between the bus/TID/LUN addresses assigned by the host OS and the Fibre Channel native addresses (AL_PA/SEL_ID) for Fibre Channel adapters. There are two potential mappings depending on the value of the `ScanDown` registry parameter:

- For ScanDown = 0 (default), see SCSI TID map (ScanDown=0) (on page 178).

- For ScanDown = 1, see SCSI TID map (ScanDown=1) (on page 184).

> 📄 **Note:** When storage system devices and other types of devices are connected in the same arbitrated loop, the mappings cannot be guaranteed.

SCSI TID map (ScanDown=0)

Bus #	TID	LUN	AL_PA	SEL_ID
0	0-31	0-7	NONE	NONE
1	0	0-7	0x01	0x7D
	1	0-7	0x02	0x7C
	2	0-7	0x04	0x7B

Bus #	TID	LUN	AL_PA	SEL_ID
	3	0-7	0x08	0x7A
	4	0-7	0x0F	0x79
	5	0-7	0x10	0x78
	6	0-7	0x17	0x77
	7	0-7	0x18	0x76
	8	0-7	0x1B	0x75
	9	0-7	0x1D	0x74
	10	0-7	0x1E	0x73
	11	0-7	0x1F	0x72
	12	0-7	0x23	0x71
	13	0-7	0x25	0x70
	14	0-7	0x26	0x6F
	15	0-7	0x27	0x6E
	16	0-7	0x29	0x6D
	17	0-7	0x2A	0x6C
	18	0-7	0x2B	0x6B
	19	0-7	0x2C	0x6A
	20	0-7	0x2D	0x69
	21	0-7	0x2E	0x68
	22	0-7	0x31	0x67
	23	0-7	0x32	0x66
	24	0-7	0x33	0x65
	25	0-7	0x34	0x64
	26	0-7	0x35	0x63
	27	0-7	0x36	0x62
	28	0-7	0x39	0x61
	29	0-7	0x3A	0x60
	30	0-7	0x3C	0x5F
	31	0-7	NONE	NONE
2	0	0-7	0x43	0x5E
	1	0-7	0x45	0x5D
	2	0-7	0x46	0x5C

Appendix A: SCSI TID Maps for FC adapters

Bus #	TID	LUN	AL_PA	SEL_ID
	3	0-7	0x47	0x5B
	4	0-7	0x49	0x5A
	5	0-7	0x4A	0x59
	6	0-7	0x4B	0x58
	7	0-7	0x4C	0x57
	8	0-7	0x4D	0x56
	9	0-7	0x4E	0x55
	10	0-7	0x51	0x54
	11	0-7	0x52	0x53
	12	0-7	0x53	0x52
	13	0-7	0x54	0x51
	14	0-7	0x55	0x50
	15	0-7	0x56	0x4F
	16	0-7	0x59	0x4E
	17	0-7	0x5A	0x4D
	18	0-7	0x5C	0x4C
	19	0-7	0x63	0x4B
	20	0-7	0x65	0x4A
	21	0-7	0x66	0x49
	22	0-7	0x67	0x48
	23	0-7	0x69	0x47
	24	0-7	0x6A	0x46
	25	0-7	0x6B	0x45
	26	0-7	0x6C	0x44
	27	0-7	0x6D	0x43
	28	0-7	0x6E	0x42
	29	0-7	0x71	0x41
	30	0-7	0x72	0x40
	31	0-7	NONE	NONE
3	0	0-7	0x73	0x3F
	1	0-7	0x74	0x3E
	2	0-7	0x75	0x3D

Appendix A: SCSI TID Maps for FC adapters

Bus #	TID	LUN	AL_PA	SEL_ID
	3	0-7	0x76	0x3C
	4	0-7	0x79	0x3B
	5	0-7	0x7A	0x3A
	6	0-7	0x7C	0x39
	7	0-7	0x80	0x38
	8	0-7	0x81	0x37
	9	0-7	0x82	0x36
	10	0-7	0x84	0x35
	11	0-7	0x88	0x34
	12	0-7	0x8F	0x33
	13	0-7	0x90	0x32
	14	0-7	0x97	0x31
	15	0-7	0x98	0x30
	16	0-7	0x9B	0x2F
	17	0-7	0x9D	0x2E
	18	0-7	0x9E	0x2D
	19	0-7	0x9F	0x2C
	20	0-7	0xA3	0x2B
	21	0-7	0xA5	0x2A
	22	0-7	0xA6	0x29
	23	0-7	0xA7	0x28
	24	0-7	0xA9	0x27
	25	0-7	0xAA	0x26
	26	0-7	0xAB	0x25
	27	0-7	0xAC	0x24
	28	0-7	0xAD	0x23
	29	0-7	0xAE	0x22
	30	0-7	0xB1	0x21
	31	0-7	NONE	NONE
4	0	0-7	0xB2	0x20
	1	0-7	0xB3	0x1F
	2	0-7	0xB4	0x1E

Appendix A: SCSI TID Maps for FC adapters

Bus #	TID	LUN	AL_PA	SEL_ID
	3	0-7	0xB5	0x1D
	4	0-7	0xB6	0x1C
	5	0-7	0xB9	0x1B
	6	0-7	0xBA	0x1A
	7	0-7	0xBC	0x19
	8	0-7	0xC3	0x18
	9	0-7	0xC5	0x17
	10	0-7	0xC6	0x16
	11	0-7	0xC7	0x15
	12	0-7	0xC9	0x14
	13	0-7	0xCA	0x13
	14	0-7	0xCB	0x12
	15	0-7	0xCC	0x11
	16	0-7	0xCD	0x10
	17	0-7	0xCE	0x0F
	18	0-7	0xD1	0x0E
	19	0-7	0xD2	0x0D
	20	0-7	0xD3	0x0C
	21	0-7	0xD4	0x0B
	22	0-7	0xD5	0x0A
	23	0-7	0xD6	0x09
	24	0-7	0xD9	0x08
	25	0-7	0xDA	0x07
	26	0-7	0xDC	0x06
	27	0-7	0xE0	0x05
	28	0-7	0xE1	0x04
	29	0-7	0xE2	0x03
	30	0-7	0xE4	0x02
	31	0-7	NONE	NONE
5	0	0-7	0xE8	0x01
	1	0-7	0xEF	0x00
	2	0-7	NONE	NONE

Appendix A: SCSI TID Maps for FC adapters

Bus #	TID	LUN	AL_PA	SEL_ID
	3	0-7	NONE	NONE
	4	0-7	NONE	NONE
	5	0-7	NONE	NONE
	6	0-7	NONE	NONE
	7	0-7	NONE	NONE
	8	0-7	NONE	NONE
	9	0-7	NONE	NONE
	10	0-7	NONE	NONE
	11	0-7	NONE	NONE
	12	0-7	NONE	NONE
	13	0-7	NONE	NONE
	14	0-7	NONE	NONE
	15	0-7	NONE	NONE
	16	0-7	NONE	NONE
	17	0-7	NONE	NONE
	18	0-7	NONE	NONE
	19	0-7	NONE	NONE
	20	0-7	NONE	NONE
	21	0-7	NONE	NONE
	22	0-7	NONE	NONE
	23	0-7	NONE	NONE
	24	0-7	NONE	NONE
	25	0-7	NONE	NONE
	26	0-7	NONE	NONE
	27	0-7	NONE	NONE
	28	0-7	NONE	NONE
	29	0-7	NONE	NONE
	30	0-7	NONE	NONE
	31	0-7	NONE	NONE

Appendix A: SCSI TID Maps for FC adapters

SCSI TID map (ScanDown=1)

Bus #	TID	LUN	AL_PA	SEL_ID
0	0-31	0-7	NONE	NONE
1	0	0-7	0xEF	0x00
	1	0-7	0xE8	0x01
	2	0-7	0xE4	0x02
	3	0-7	0xE2	0x03
	4	0-7	0xE1	0x04
	5	0-7	0xE0	0x05
	6	0-7	0xDC	0x06
	7	0-7	0xDA	0x07
	8	0-7	0xD9	0x08
	9	0-7	0xD6	0x09
	10	0-7	0xD5	0x0A
	11	0-7	0xD4	0x0B
	12	0-7	0xD3	0x0C
	13	0-7	0xD2	0x0D
	14	0-7	0xD1	0x0E
	15	0-7	0xCE	0x0F
	16	0-7	0xCD	0x10
	17	0-7	0xCC	0x11
	18	0-7	0xCB	0x12
	19	0-7	0xCA	0x13
	20	0-7	0xC9	0x14
	21	0-7	0xC7	0x15
	22	0-7	0xC6	0x16
	23	0-7	0xC5	0x17
	24	0-7	0xC3	0x18
	25	0-7	0xBC	0x19
	26	0-7	0xBA	0x1A
	27	0-7	0xB9	0x1B
	28	0-7	0xB6	0x1C

Appendix A: SCSI TID Maps for FC adapters

Bus #	TID	LUN	AL_PA	SEL_ID
	29	0-7	0xB5	0x1D
	30	0-7	0xB4	0x1E
	31	0-7	NONE	NONE
2	0	0-7	0xB3	0x1F
	1	0-7	0xB2	0x20
	2	0-7	0xB1	0x21
	3	0-7	0xAE	0x22
	4	0-7	0xAD	0x23
	5	0-7	0xAC	0x24
	6	0-7	0xAB	0x25
	7	0-7	0xAA	0x26
	8	0-7	0xA9	0x27
	9	0-7	0xA7	0x28
	10	0-7	0xA6	0x29
	11	0-7	0xA5	0x2A
	12	0-7	0xA3	0x2B
	13	0-7	0x9F	0x2C
	14	0-7	0x9E	0x2D
	15	0-7	0x9D	0x2E
	16	0-7	0x9B	0x2F
	17	0-7	0x98	0x30
	18	0-7	0x97	0x31
	19	0-7	0x90	0x32
	20	0-7	0x8F	0x33
	21	0-7	0x88	0x34
	22	0-7	0x84	0x35
	23	0-7	0x82	0x36
	24	0-7	0x81	0x37
	25	0-7	0x80	0x38
	26	0-7	0x7C	0x39
	27	0-7	0x7A	0x3A
	28	0-7	0x79	0x3B

Appendix A: SCSI TID Maps for FC adapters

Bus #	TID	LUN	AL_PA	SEL_ID
	29	0-7	0x76	0x3C
	30	0-7	0x75	0x3D
	31	0-7	NONE	NONE
3	0	0-7	0x74	0x3E
	1	0-7	0x73	0x3F
	2	0-7	0x72	0x40
	3	0-7	0x71	0x41
	4	0-7	0x6E	0x42
	5	0-7	0x6D	0x43
	6	0-7	0x6C	0x44
	7	0-7	0x6B	0x45
	8	0-7	0x6A	0x46
	9	0-7	0x69	0x47
	10	0-7	0x67	0x48
	11	0-7	0x66	0x49
	12	0-7	0x65	0x4A
	13	0-7	0x63	0x4B
	14	0-7	0x5C	0x4C
	15	0-7	0x5A	0x4D
	16	0-7	0x59	0x4E
	17	0-7	0x56	0x4F
	18	0-7	0x55	0x50
	19	0-7	0x54	0x51
	20	0-7	0x53	0x52
	21	0-7	0x52	0x53
	22	0-7	0x51	0x54
	23	0-7	0x4E	0x55
	24	0-7	0x4D	0x56
	25	0-7	0x4C	0x57
	26	0-7	0x4B	0x58
	27	0-7	0x4A	0x59
	28	0-7	0x49	0x5A

Appendix A: SCSI TID Maps for FC adapters

Bus #	TID	LUN	AL_PA	SEL_ID
	29	0-7	0x47	0x5B
	30	0-7	0x46	0x5C
	31	0-7	NONE	NONE
4	0	0-7	0x45	0x5D
	1	0-7	0x43	0x5E
	2	0-7	0x3C	0x5F
	3	0-7	0x3A	0x60
	4	0-7	0x39	0x61
	5	0-7	0x36	0x62
	6	0-7	0x35	0x63
	7	0-7	0x34	0x64
	8	0-7	0x33	0x65
	9	0-7	0x32	0x66
	10	0-7	0x31	0x67
	11	0-7	0x2E	0x68
	12	0-7	0x2D	0x69
	13	0-7	0x2C	0x6A
	14	0-7	0x2B	0x6B
	15	0-7	0x2A	0x6C
	16	0-7	0x29	0x6D
	17	0-7	0x27	0x6E
	18	0-7	0x26	0x6F
	19	0-7	0x25	0x70
	20	0-7	0x23	0x71
	21	0-7	0x1F	0x72
	22	0-7	0x1E	0x73
	23	0-7	0x1D	0x74
	24	0-7	0x1B	0x75
	25	0-7	0x18	0x76
	26	0-7	0x17	0x77
	27	0-7	0x10	0x78
	28	0-7	0x0F	0x79

Appendix A: SCSI TID Maps for FC adapters

Bus #	TID	LUN	AL_PA	SEL_ID
	29	0-7	0x08	0x7A
	30	0-7	0x04	0x7B
	31	0-7	NONE	NONE
5	0	0-7	0x02	0x7C
	1	0-7	0x01	0x7D
	2	0-7	NONE	NONE
	3	0-7	NONE	NONE
	4	0-7	NONE	NONE
	5	0-7	NONE	NONE
	6	0-7	NONE	NONE
	7	0-7	NONE	NONE
	8	0-7	NONE	NONE
	9	0-7	NONE	NONE
	10	0-7	NONE	NONE
	11	0-7	NONE	NONE
	12	0-7	NONE	NONE
	13	0-7	NONE	NONE
	14	0-7	NONE	NONE
	15	0-7	NONE	NONE
	16	0-7	NONE	NONE
	17	0-7	NONE	NONE
	18	0-7	NONE	NONE
	19	0-7	NONE	NONE
	20	0-7	NONE	NONE
	21	0-7	NONE	NONE
	22	0-7	NONE	NONE
	23	0-7	NONE	NONE
	24	0-7	NONE	NONE
	25	0-7	NONE	NONE
	26	0-7	NONE	NONE
	27	0-7	NONE	NONE
	28	0-7	NONE	NONE

Appendix A: SCSI TID Maps for FC adapters

Bus #	TID	LUN	AL_PA	SEL_ID
	29	0-7	NONE	NONE
	30	0-7	NONE	NONE
	31	0-7	NONE	NONE

Appendix A: SCSI TID Maps for FC adapters

Appendix B: Using Veritas Cluster Server

This chapter provides important information about using Veritas Cluster Server with the Hitachi storage systems.

Note on using Veritas Cluster Server

By issuing a SCSI-3 Persistent Reserve command for a storage system, Veritas Cluster Server (VCS) provides the I/O fencing function that can prevent data corruption from occurring if the cluster communication stops. Each node of VCS registers reserve keys to the storage system, which enables these nodes to share a disk to which the reserve key is registered.

Each node of VCS registers the reserve key when importing a disk groups. One node registers the identical reserve key for all paths of all disks (LUs) in the disk group. The reserve key contains a unique value for each disk group and a value to distinguish nodes.

Key format: `<Node # + disk group-unique information>`

Example: `APGR0000`, `APGR0001`, `BPGR0000`, and so on.

When the storage system receives a request to register the reserve key, the reserve key and Port WWN of the node are recorded in the key registration table for each port of the storage system on which the registration request is received. The number of reserve keys that can be registered to a storage system is 2,048* per port. The storage system confirms duplication of registration by a combination of the node Port WWN and reserve key. Therefore, the number of entries of the registration table does not increase even though any request for registering duplicated reserve keys is accepted.

Calculation formula for the number of used entries of key registration table: `(number of nodes) × (number of Port WWNs of node) × (number of disk groups)`

* For VSP and HUS VM, you must set HMO 61 ON to increase the maximum number of reserve keys per port from 128 to 2,048.

When the number of registered reserve keys exceeds the upper limit of 2,048, key registration as well as operations such as installing an LU to the disk group fail. To avoid failure of reserve key registration, the number of reserve keys needs to be kept below 2,048. To accomplish this, restrictions might be necessary, such as limiting the number of nodes, the number of server ports using the LUN security function, or the number of disk groups.

Example

When adding LUs to increase disk capacity, add the LUs to existing disk groups instead of adding new disk groups.
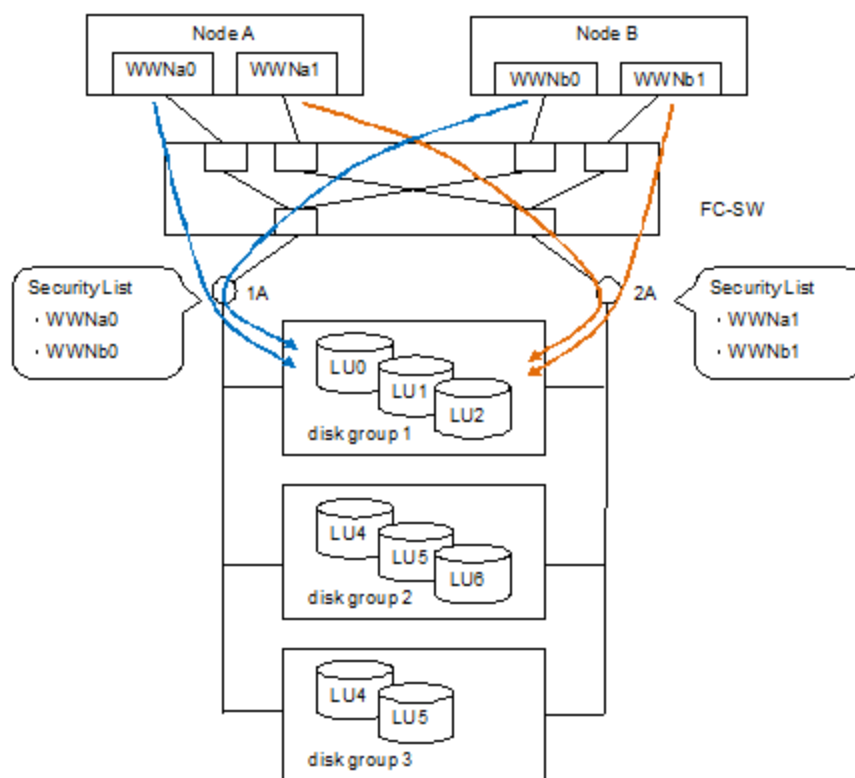
Key registration table for Port-1A		
Entry	**Reserve Key**	**WWN**
0	APGR0001	WWNa0
1	APGR0002	WWNa0
2	APGR0003	WWNa0
3	BPGR0001	WWNb0
4	BPGR0002	WWNb0
5	BPGR0003	WWNb0
6	-	-
:	:	:
127	-	-

Key registration table for Port-2A		
Entry	**Reserve Key**	**WWN**
0	APGR0001	WWNa1
1	APGR0002	WWNa1
2	APGR0003	WWNa1
3	BPGR0001	WWNb1
4	BPGR0002	WWNb1
5	BPGR0003	WWNb1
6	-	-
:	:	:
127	-	-

Note: For AIX® systems: The persistent reservation of a logical unit (LU) may not be canceled due to some reason when multiple hosts share a volume group rather than making up a cluster configuration.

Appendix C: Disk parameters for Hitachi disk types

The following tables list the disk parameters for the Hitachi SCSI disk devices. For information about configuring devices other than OPEN-V, contact your Hitachi Vantara representative.

Parameter values for OPEN-*x* disk types

	Parameter	Disk Type			
		OPEN-3	OPEN-9	OPEN-E	OPEN-L
Ty	Disk category	winchester	winchester	winchester	winchester
Dt	Control type	CSI	SCSI	SCSI	SCSI
Ns	sectors/tracks	96	96	96	96
nt	tracks/cylinder	15	15	15	15
nc	Number of all cylinders	3338	10016	19759	19759
rm	Number of rotations of the disk	6300	6300	6300	6300
oa	a partition offset (Starting block in a partition)	Set optionally	Set optionally	Set optionally	Set optionally
ob	b partition offset (Starting block in b partition)	Set optionally	Set optionally	Set optionally	Set optionally
oc	c partition offset (Starting block in c partition)	0	0	0	0
od	d partition offset (Starting block in d partition)	Set optionally	Set optionally	Set optionally	Set optionally

Appendix C: Disk parameters for Hitachi disk types

Parameter		Disk Type			
		OPEN-3	OPEN-9	OPEN-E	OPEN-L
oe	e partition offset (Starting block in e partition)	Set optionally	Set optionally	Set optionally	Set optionally
of	f partition offset (Starting block in f partition)	Set optionally	Set optionally	Set optionally	Set optionally
og	g partition offset (Starting block in g partition)	Set optionally	Set optionally	Set optionally	Set optionally
oh	h partition offset (Starting block in h partition)	Set optionally	Set optionally	Set optionally	Set optionally
pa	a partition size	Set optionally	Set optionally	Set optionally	Set optionally
pb	b partition size	Set optionally	Set optionally	Set optionally	Set optionally
pc	c partition size	4806720	14423040	28452960	28452960
pd	d partition size	Set optionally	Set optionally	Set optionally	Set optionally
pe	e partition size	Set optionally	Set optionally	Set optionally	Set optionally
pf	f partition size	Set optionally	Set optionally	Set optionally	Set optionally
pg	g partition size	Set optionally	Set optionally	Set optionally	Set optionally
ph	h partition size	Set optionally	Set optionally	Set optionally	Set optionally
ba	a partition block size	8192	8192	8192	8192
bb	b partition block size	8192	8192	8192	8192
bc	c partition block size	8192	8192	8192	8192
bd	d partition block size	8192	8192	8192	8192
be	e partition block size	8192	8192	8192	8192
bf	f partition block size	8192	8192	8192	8192
bg	g partition block size	8192	8192	8192	8192
bh	h partition block size	8192	8192	8192	8192
fa	a partition fragment size	1024	1024	1024	1024

Appendix C: Disk parameters for Hitachi disk types

	Parameter	Disk Type			
		OPEN-3	OPEN-9	OPEN-E	OPEN-L
fb	b partition fragment size	1024	1024	1024	1024
fc	c partition fragment size	1024	1024	1024	1024
fd	d partition fragment size	1024	1024	1024	1024
fe	e partition fragment size	1024	1024	1024	1024
ff	f partition fragment size	1024	1024	1024	1024
fg	g partition fragment size	1024	1024	1024	1024
fh	h partition fragment size	1024	1024	1024	1024

Parameter values for VLL disk types

	Parameter	Disk Type		
		OPEN-3 VLL	OPEN-9 VLL	OPEN-E VLL
ty	Disk category	winchester	winchester	winchester
dt	Control type	SCSI	SCSI	SCSI
ns	sectors/tracks	96	96	96
nt	tracks/cylinder	15	15	15
nc	Number of all cylinders	Depends on CV configuration	Depends on CV configuration	Depends on CV configuration
rm	Number of rotations of the disk	6300	6300	6300
oa	a partition offset (Starting block in a partition)	Set optionally	Set optionally	Set optionally
ob	b partition offset (Starting block in b partition)	Set optionally	Set optionally	Set optionally

Parameter		Disk Type		
		OPEN-3 VLL	**OPEN-9 VLL**	**OPEN-E VLL**
oc	c partition offset (Starting block in c partition)	0	0	0
od	d partition offset (Starting block in d partition)	Set optionally	Set optionally	Set optionally
oe	e partition offset (Starting block in e partition)	Set optionally	Set optionally	Set optionally
of	f partition offset (Starting block in f partition)	Set optionally	Set optionally	Set optionally
og	g partition offset (Starting block in g partition)	Set optionally	Set optionally	Set optionally
oh	h partition offset (Starting block in h partition)	Set optionally	Set optionally	Set optionally
pa	a partition size	Set optionally	Set optionally	Set optionally
pb	b partition size	Set optionally	Set optionally	Set optionally
pc	c partition size	Depends on CV configuration	Depends on CV configuration	Depends on CV configuration
pd	d partition size	Set optionally	Set optionally	Set optionally
pe	e partition size	Set optionally	Set optionally	Set optionally
pf	f partition size	Set optionally	Set optionally	Set optionally
pg	g partition size	Set optionally	Set optionally	Set optionally
ph	h partition size	Set optionally	Set optionally	Set optionally
ba	a partition block size	8192	8192	8192
bb	b partition block size	8192	8192	8192

Appendix C: Disk parameters for Hitachi disk types

Parameter		Disk Type		
		OPEN-3 VLL	OPEN-9 VLL	OPEN-E VLL
bc	c partition block size	8192	8192	8192
bd	d partition block size	8192	8192	8192
be	e partition block size	8192	8192	8192
bf	f partition block size	8192	8192	8192
bg	g partition block size	8192	8192	8192
bh	h partition block size	8192	8192	8192
fa	a partition fragment size	1024	1024	1024
fb	b partition fragment size	1024	1024	1024
fc	c partition fragment size	1024	1024	1024
fd	d partition fragment size	1024	1024	1024
fe	e partition fragment size	1024	1024	1024
ff	f partition fragment size	1024	1024	1024
fg	g partition fragment size	1024	1024	1024
fh	h partition fragment size	1024	1024	1024

Parameter values for LUSE disk types

Parameter		Disk Type			
		OPEN 3*n (n = 2 to 36)	OPEN 9*n (n = 2 to 36)	OPEN E*n (n = 2 to 36)	OPEN L*n (n = 2 to 12)
ty	Disk category	winchester	winchester	winchester	winchester
dt	Control type	SCSI	SCSI	SCSI	SCSI
ns	sectors/tracks	96	96	96	96
nt	tracks/cylinder	15	15	15	15
nc	Number of all cylinders	3338*n	Depends on CV configuration	19759*n	19759*n
rm	Number of rotations of the disk	6300	6300	6300	6300
oa	a partition offset (Starting block in a partition)	Set optionally	Set optionally	Set optionally	Set optionally
ob	b partition offset (Starting block in b partition)	Set optionally	Set optionally	Set optionally	Set optionally
oc	c partition offset (Starting block in c partition)	0	0	0	0
od	d partition offset (Starting block in d partition)	Set optionally	Set optionally	Set optionally	Set optionally
oe	e partition offset (Starting block in e partition)	Set optionally	Set optionally	Set optionally	Set optionally

Parameter		Disk Type			
		OPEN 3*n **(n = 2 to 36)**	**OPEN 9*n** **(n = 2 to 36)**	**OPEN E*n** **(n = 2 to 36)**	**OPEN L*n** **(n = 2 to 12)**
of	f partition offset (Starting block in f partition)	Set optionally	Set optionally	Set optionally	Set optionally
og	g partition offset (Starting block in g partition)	Set optionally	Set optionally	Set optionally	Set optionally
oh	h partition offset (Starting block in h partition)	Set optionally	Set optionally	Set optionally	Set optionally
pa	a partition size	Set optionally	Set optionally	Set optionally	Set optionally
pb	b partition size	Set optionally	Set optionally	Set optionally	Set optionally
pc	c partition size	4806720*n	Depends on CV configuration	28452960*n	28452960*n
pd	d partition size	Set optionally	Set optionally	Set optionally	Set optionally
pe	e partition size	Set optionally	Set optionally	Set optionally	Set optionally
pf	f partition size	Set optionally	Set optionally	Set optionally	Set optionally
pg	g partition size	Set optionally	Set optionally	Set optionally	Set optionally
ph	h partition size	Set optionally	Set optionally	Set optionally	Set optionally
ba	a partition block size	8192	8192	8192	8192
bb	b partition block size	8192	8192	8192	8192
bc	c partition block size	8192	8192	8192	8192
bd	d partition block size	8192	8192	8192	8192
be	e partition block size	8192	8192	8192	8192

Appendix C: Disk parameters for Hitachi disk types

Parameter		Disk Type			
		OPEN 3*n **(n = 2 to 36)**	**OPEN 9*n** **(n = 2 to 36)**	**OPEN E*n** **(n = 2 to 36)**	**OPEN L*n** **(n = 2 to 12)**
bf	f partition block size	8192	8192	8192	8192
bg	g partition block size	8192	8192	8192	8192
bh	h partition block size	8192	8192	8192	8192
fa	a partition fragment size	1024	1024	1024	1024
fb	b partition fragment size	1024	1024	1024	1024
fc	c partition fragment size	1024	1024	1024	1024
fd	d partition fragment size	1024	1024	1024	1024
fe	e partition fragment size	1024	1024	1024	1024
ff	f partition fragment size	1024	1024	1024	1024
fg	g partition fragment size	1024	1024	1024	1024
fh	h partition fragment size	1024	1024	1024	1024

Parameter values for VLL LUSE disk types

Parameter		Disk Type		
		OPEN 3 VLL*n **(n = 2 to 36)**	**OPEN 9 VLL*n** **(n = 2 to 36)**	**OPEN E VLL*n** **(n = 2 to 36)**
ty	winchester	winchester	winchester	winchester
dt	SCSI	SCSI	SCSI	SCSI

Appendix C: Disk parameters for Hitachi disk types

Parameter		Disk Type		
		OPEN 3 VLL*n (n = 2 to 36)	OPEN 9 VLL*n (n = 2 to 36)	OPEN E VLL*n (n = 2 to 36)
ns	96	96	96	116
nt	15	15	15	15
nc	Depends on CV configuration[3]	19759	10016*n	Depends on CV configuration
rm	6300	6300	6300	6300
oa	Set optionally	Set optionally	Set optionally	Set optionally
ob	Set optionally	Set optionally	Set optionally	Set optionally
oc	0	0	0	0
od	Set optionally	Set optionally	Set optionally	Set optionally
oe	Set optionally	Set optionally	Set optionally	Set optionally
of	Set optionally	Set optionally	Set optionally	Set optionally
og	Set optionally	Set optionally	Set optionally	Set optionally
oh	Set optionally	Set optionally	Set optionally	Set optionally
pa	Set optionally2	Set optionally	Set optionally	Set optionally
pb	Set optionally	Set optionally	Set optionally	Set optionally
pc	Depends on CV configuration[3]	28452960	14423040*n	Depends on CV configuration
pd	Set optionally	Set optionally	Set optionally	Set optionally
pe	Set optionally	Set optionally	Set optionally	Set optionally
pf	Set optionally	Set optionally	Set optionally	Set optionally
pg	Set optionally	Set optionally	Set optionally	Set optionally
ph	Set optionally	Set optionally	Set optionally	Set optionally
ba	8192	8192	8192	8192
bb	8192	8192	8192	8192
bc	8192	8192	8192	8192
bd	8192	8192	8192	8192
be	8192	8192	8192	8192

Appendix C: Disk parameters for Hitachi disk types

Parameter		Disk Type		
		OPEN 3 VLL*n **(n = 2 to 36)**	**OPEN 9 VLL*n** **(n = 2 to 36)**	**OPEN E VLL*n** **(n = 2 to 36)**
bf	8192	8192	8192	8192
bg	8192	8192	8192	8192
bh	8192	8192	8192	8192
fa	1024	1024	1024	1024
fb	1024	1024	1024	1024
fc	1024	1024	1024	1024
fd	1024	1024	1024	1024
fe	1024	1024	1024	1024
ff	1024	1024	1024	1024
fg	1024	1024	1024	1024
fh	1024	1024	1024	1024

Parameter values for OPEN-8 disk types

Parameter		Disk Type			
		OPEN 8	**OPEN-8*n** **(n = 2 to 36)**	**OPEN-8 VIR**	**OPEN-8*n VIR** **(n = 2 to 36)**
ty	Disk category	winchester	winchester	winchester	winchester
dt	Control type	SCSI	SCSI	SCSI	SCSI
ns	sectors/tracks	96	96	96	116
nt	tracks/cylinder	15	15	15	15
nc	Number of all cylinders	9966	9966*n	Depends on CV configuration	Depends on CV configuration
rm	Number of rotations of the disk	6300	6300	6300	6300

Appendix C: Disk parameters for Hitachi disk types

Parameter		Disk Type			
		OPEN 8	**OPEN-8*n** **(n = 2 to 36)**	**OPEN-8 VIR**	**OPEN-8*n VIR** **(n = 2 to 36)**
oa	a partition offset (Starting block in a partition)	Set optionally	Set optionally	Set optionally	Set optionally
ob	b partition offset (Starting block in b partition)	Set optionally	Set optionally	Set optionally	Set optionally
oc	c partition offset (Starting block in c partition)	0	0	0	0
od	d partition offset (Starting block in d partition)	Set optionally	Set optionally	Set optionally	Set optionally
oe	e partition offset (Starting block in e partition)	Set optionally	Set optionally	Set optionally	Set optionally
of	f partition offset (Starting block in f partition)	Set optionally	Set optionally	Set optionally	Set optionally
og	g partition offset (Starting block in g partition)	Set optionally	Set optionally	Set optionally	Set optionally
oh	h partition offset (Starting block in h partition)	Set optionally	Set optionally	Set optionally	Set optionally
pa	a partition size	Set optionally	Set optionally	Set optionally	Set optionally
pb	b partition size	Set optionally	Set optionally	Set optionally	Set optionally

Appendix C: Disk parameters for Hitachi disk types

Parameter		Disk Type			
		OPEN 8	OPEN-8*n (n = 2 to 36)	OPEN-8 VIR	OPEN-8*n VIR (n = 2 to 36)
pc	c partition size	14351040	14351040*n	Depends on CV configuration	Depends on CV configuration
pd	d partition size	Set optionally	Set optionally	Set optionally	Set optionally
pe	e partition size	Set optionally	Set optionally	Set optionally	Set optionally
pf	f partition size	Set optionally	Set optionally	Set optionally	Set optionally
pg	g partition size	Set optionally	Set optionally	Set optionally	Set optionally
ph	h partition size	Set optionally	Set optionally	Set optionally	Set optionally
ba	a partition block size	8192	8192	8192	8192
bb	b partition block size	8192	8192	8192	8192
bc	c partition block size	8192	8192	8192	8192
bd	d partition block size	8192	8192	8192	8192
be	e partition block size	8192	8192	8192	8192
bf	f partition block size	8192	8192	8192	8192
bg	g partition block size	8192	8192	8192	8192
bh	h partition block size	8192	8192	8192	8192
fa	a partition fragment size	1024	1024	1024	1024
fb	b partition fragment size	1024	1024	1024	1024
fc	c partition fragment size	1024	1024	1024	1024
fd	d partition fragment size	1024	1024	1024	1024

Appendix C: Disk parameters for Hitachi disk types

Parameter		Disk Type			
		OPEN 8	**OPEN-8*n** **(n = 2 to 36)**	**OPEN-8 VIR**	**OPEN-8*n VIR** **(n = 2 to 36)**
fe	e partition fragment size	1024	1024	1024	1024
ff	f partition fragment size	1024	1024	1024	1024
fg	g partition fragment size	1024	1024	1024	1024
fh	h partition fragment size	1024	1024	1024	1024

Appendix C: Disk parameters for Hitachi disk types

Appendix D: Host modes and host mode options

The host modes and host mode options (HMOs) must be set on the Fibre Channel ports before the hosts are connected. The host modes and HMOs differ depending on your Hitachi storage system model.

Host modes and HMOs for VSP 5000 series

Host modes for VSP 5000 series

Host mode	When to select this host mode
00 [Standard]	When registering Red Hat Linux server hosts or IRIX server hosts in the host group.* HMOs specific to this host mode: 68, 88, 91, 122, 131 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 22, 25, 68
01 [(Deprecated) VMware]	Do not select this host mode. Select host mode 21 VMware Extension instead. HMOs specific to this host mode: 54, 63, 68, 88, 110, 114, 122 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: See host mode 21 [VMware Extension] in this table.
03 [HP]	When registering HP-UX server hosts in the host group. HMOs specific to this host mode: 12, 33, 43, 60, 88 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 12, 22, 25, 60
05 [OpenVMS]	When registering OpenVMS server hosts in the host group. HMOs specific to this host mode: 33 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 22, 25

Host mode	When to select this host mode
07 [Tru64]	When registering Tru64 server hosts in the host group. HMOs available to this host mode: 2, 7, 13, 14, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 22, 25
09 [Solaris]	When registering Solaris server hosts in the host group. HMO specific to this host mode: 88 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 22, 25
0A [NetWare]	When registering NetWare server hosts in the host group. HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 22, 25
0C [(Deprecated) Windows]	Do not select this host mode. Select host mode 2C Windows Extension instead. HMOs specific to this host mode: 6, 40, 73, 88, 105, 110, 114, 122 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: See host mode 2C [Windows Extension] in this table.
0F [AIX]	When registering AIX ® server hosts in the host group. HMOs specific to this host mode: 15, 88 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113, 124 HMO best practice recommendations: 2, 15, 22, 25 When host mode 0F AIX ® is set, NACA (Normal Auto Contingent Allegiance) is enabled automatically. To ensure that the host responds correctly to a port with host mode 0F AIX enabled: 1. Shut down the host to be connected to the port. 2. Set the host mode on the port to 0F AIX, and enable the desired HMOs. 3. Connect the cables from the host to the port. 4. Boot the host. **Caution:** If the host mode of a port is changed to 0F AIX and the host had already recognized the Inquiry response for an LDEV on the port before host mode 0F AIX was set, the host might experience loss of device access (LDEV or LU). The host must be rebooted after the host mode is changed to 0F AIX to recognize the change in the response to the standard inquiry.
21 [VMware Extension]	When registering VMware server hosts in the host group.* HMOs specific to this host mode: 54, 63, 68, 82, 83, 88, 110, 114, 122 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113

Appendix D: Host modes and host mode options

Host mode	When to select this host mode
	HMO best practice recommendations: 2, 22, 25, 54, 63, 68, 110
2C [Windows Extension]	When registering Windows server hosts in the host group.*
	HMOs specific to this host mode: 6, 40, 73, 88, 105, 110, 114, 122
	HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113
	HMO best practice recommendations: 2, 22, 25, 40, 110

*Use host mode 21 only for VMware server hosts (Hypervisor host accessing VMFS formatted data stores, *not* Raw Device Mapping (RDM) disks. But when the (Linux-based OS or Windows) Virtual Machine host directly recognizes and manages the I/O stack on LUs by *RDM* (Raw Device Mapping), then the disk should only be assigned a host mode that is the same as the operating system of the virtual machine, even when running on VMware Hypervisor.

Unreliable access, errors, and performance problems will result if vCenter maps an RDM disk to a virtual machine that is part of a VMware host group with VMware host mode configured. This is because Windows and Linux use SCSI-3 version protocol and VMware uses SCSI-4 version protocol.

Linux-based OS (such as Red Hat Linux) or Windows Virtual Machine (VM) server hosts that use *virtual* disks and *not* RDM do not need any host group mapping because they are dependent on the VMware Hypervisor host for creating a virtual disk (VMDK file) from the VMFS file system residing on a Hypervisor-only data stores, because the VM disk files are ultimately VMware VMFS file system files and not actual disks.

To add VMware Hypervisor (not virtual machine) hosts to one host group, you must set this host mode and these HMOs for the host group:

- Host mode: 21 VMware Extension

- Host mode options: 2, 22, 25, 54, 63, 68, and 110 (for details, contact customer support)

Restrictions for VMware server hosts added to the host group:

Do not attempt to set Windows or Linux HMO functions on a VMware Hypervisor, they cannot be used by VMware:

- Thin Provisioning

- Offloaded Data Transfer (ODX)

The above functions are handled by the HMO 54 and 63 in the VMware host group instead.

Host mode options for VSP 5000 series

HMO	Function	Host mode	Description
2	VERITAS Database Edition/ Advanced Cluster	Any	Purpose: By default, Reservation Conflict is returned for Test Unit Ready run from host without the PERSISTENT GROUP RESERVATION key setting.
			In the following conditions, Good Status is expected.

HMO	Function	Host mode	Description
			When this HMO is enabled, the storage system will switch Test Unit Ready response to Good Status from Reservation Conflict.
			Use this HMO when any of the following conditions is met:
			▪ Windows Server Failover Clustering (WSFC) is used.
			▪ Microsoft Failover Cluster (MSFC) is used.
			▪ Linux with cluster configuration is used.
			▪ Symantec Cluster Server (previously known as Veritas Cluster Server (VCS)) is used.
			▪ The response for SPC-3 (Good Status) is required.
6	TPRLO	0C [(Deprecated) Windows] or 2C [Windows Extension]	Purpose: By default, PRLO is returned for TPRLO, however, LOGO might be expected under the following conditions.
			When this HMO is enabled, the storage system will switch the TPRLO response to LOGO from PRLO.
			Use this HMO when all these conditions are satisfied:
			▪ An Emulex host bus adapter is used in a Windows environment.
			▪ The mini-port driver is used.
			▪ TPRLO=2 is specified for the mini-port driver parameter of the host bus adapter.
7	Automatic recognition function of LUN	Any	Purpose: By default, Unit Attention response is not returned when adding a LUN using a host group.
			However, in some cases, the host may expect Unit Attention.
			When this HMO is enabled, the storage system will return the Unit Attention response.

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
			Use this HMO when any of the following conditions is met: ▪ SUN StorEdge SAN Foundation Software Version 4.2 or later is used. ▪ You want to enable the automatic recognition of the device increase or decrease when connecting a genuine SUN HBA. ▪ You want the Unit Attention (UA) response to be returned to the host at SCSI path change (sense code: REPORTED LUNS DATA HAS CHANGED). **Note:** If the UA response occurs frequently and the load on the host becomes high, the data transfer cannot be started on the host side and timeout might occur.
12	No display for ghost LUN	03 [HP]	Use this HMO when you want to suppress creation of device files for devices to which paths are not defined.
13	SIM report at link failure	Any	Use this HMO when you want SIMs (SIM=2194XX) to be issued when the number of link failures detected between FC ports (such as SSB=B65C and DDA1) exceeds the threshold. **Notes:** 1. Enable HMO 13 only when requested to do so. 2. When you use this HMO, set this HMO on the host group 0 of the target port.
14	HP TruCluster with TrueCopy function	07 [Tru64]	When all of the following conditions are satisfied: ▪ The host mode 07 Tru64 is used. ▪ You want to use TruCluster to set a cluster to each of primary volume and secondary volume for TrueCopy or Universal Replicator.
15	HACMP	0F [AIX]	Use this HMO when HACMP* or PowerHA® is used. * HACMP 4.5 version 4.5.0.13 or later, HACMP 5.1 version 5.1.0.4 or later, or HACMP 5.2 or later.
22	Veritas Cluster Server	Any	Purpose: By default, Reservation Conflict is returned to the MODE SENSE command from the host without the PERSISTENT GROUP RESERVATION key setting.

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
			In the following condition, GOOD status is expected when a reserved volume receives the MODE SENSE command from a node that is not reserving this volume.
			When this HMO is enabled, the storage system will switch the MODE SENSE command response to Good status from Reservation Conflict.
			Use this HMO when any of these conditions is satisfied:
			▪ Veritas Cluster Server is used.
			▪ An OS or middleware that supports SPC-4 is used.
			▪ A single-site or GAD dual-site Clustered VMDK configuration is used.
25	Support SPC-3 behavior on Persistent Reservation	Any	Purpose: By default, Reservation Conflict is returned for PERSISTENT RESERVE OUT (Service Action = REGISTER AND IGNORE EXISTING KEY) command if there is no registered key to be deleted.
			In the following conditions, Good Status (SPC-3 response) is expected.
			When this HMO is enabled, the storage system will switch this command response to Good Status from Reservation Conflict.
			Use this HMO when one of these conditions is satisfied:
			▪ Windows Server Failover Clustering (WSFC) is used.
			▪ Microsoft Failover Cluster (MSFC) is used.
			▪ Symantec Cluster Server (previously known as Veritas Cluster Server (VCS)) is used.
			▪ There is no registered key to be deleted when running the PERSISTENT RESERVE OUT command.
			Note: Host types other than above listed in Special Direction expect the response when the option is set to OFF.

HMO	Function	Host mode	Description
33	Set/Report Device Identifier enable	03 [HP] or 05 [OpenVMS]	Use this HMO when all these conditions are satisfied: ▪ If you assign a nickname to a device, you want to enable the required commands. ▪ You want to set UUIDs to identify logical volumes from the host. **Note:** When this HMO is enabled in the host mode 05 [OpenVMS], make sure to set a UUID.
39	Change the nexus specified in the SCSI Target Reset	Any	Use this HMO when you want to enable the host to set these ranges on all initiators in the host group, not only the initiator that issues the job resetting when receiving Target Reset, such as in the IBM SVC connection environment: ▪ Range of job resetting. ▪ Range of UAs (Unit Attentions) defined.
40	V-Vol expansion	0C [(Deprecated) Windows] or 2C [Windows Extension]	Purpose: This HMO is used to control whether UA is returned to the host when a command from the host is received for the LU whose capacity has been expanded. Use this HMO when you want to automate recognition of the DP-VOL capacity after increasing the DP-VOL capacity. **Note:** This option is applied when UA returning to the host is required after the DP-VOL capacity is expanded.
43	Queue Full Response	03 [HP]	Use this HMO when the command queue is full in your storage system connected to an HP-UX host, and you want to respond `Queue Full` (instead of `Busy`) from the storage system to the host.
51	Round Trip Set Up Option	Any	Use this HMO if you want to adjust the response time of the host I/O, for example when the distance between the primary and secondary storage systems in the TrueCopy or global-active device pair is long (approximately 100 km) and point-to-point topology is used.
54	(VAAI) Support Option for the EXTENDED COPY command	01 [(Deprecated) VMware] or 21 [VMware Extension]	Purpose: This HMO enables the XCOPY command to be used.

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
			When this HMO is enabled, the VENDOR SPECIFIC EXTENDED COPY command that the VAAI (vStorage APIs for Array Integration) function of VMware ESX/ESXi 4.1 or later issues to the storage system is available.
			Notes:
			1. The HMO is set to ON only when a VMware server of ESX/ESXi 4.1 or later using the VAAI (vStorage APIs for Array Integration) function is connected.
			2. If the HMO is not applied, the VMware support function, Cloning file blocks, cannot be used.
			3. When the VMware ESX/ESXi 4.*x* server is connected, set HMO 54 to ON. HMO 63 is not necessary.
			4. When the ESXi 5.*x*, ESXi 6.*x*, or later server is connected, set both HMO 54 and HMO 63 to ON.
			5. After setting HMO 54 to ON, perform an operation (such as a server reboot) leading to reissuing the `INQUIRY` command from the host.
60	LUN0 Change Guard	03 [HP]	Use this HMO when HP-UX 11.31 is used, and you want to suppress the addition or deletion of LUN 0.
63	(VAAI) Support Option for vStorage APIs based on T10 standards	01 [(Deprecated) VMware] or 21 [VMware Extension]	Purpose: This HMO enables the use of VAAI, which complies with SCSI T10. Use this HMO when you connect the storage system to VMware ESXi 5.0 or later and use the VAAI function for iSCSI T10. **Notes:** 1. After setting this HMO, perform the operation, such as the server reboot that reissues the `INQUIRY` command on the host side. 2. When ESXi 5.x or later is connected, set both HMO 54 and HMO 63 to ON.
68	Support Page Reclamation for Linux	00 [Standard], 01 [(Deprecated) VMware], or 21 [VMware Extension]	Purpose: When this HMO is enabled, the storage system will change the response that Linux OS can issue the WriteSame command to use the Page Reclamation function. Use this HMO when using the Page Reclamation function with a Linux host.

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
			Notes: 1. The option is applied when Dynamic Provisioning is used by Linux 2.6.33 or higher. 2. After setting HMO 68 to ON, perform the operation (such as a server reboot) that reissues the `INQUIRY` command from the host.
71	Change the Unit Attention for Blocked Pool-VOLs	Any	Purpose: There is a possibility to prevent a device file from being blocked while a DP pool is blocked. Use this HMO when a device file is blocked while a DP pool is blocked. **Note:** This option is applied if switching sense key/sense code returned as a response to Check Condition when a read/write I/O is received while a DP pool is blocked can prevent a device file from being blocked, and therefore the extent of impact can be reduced on host side.
73	Support Option for WS2012	0C [(Deprecated) Windows] or 2C [Windows Extension]	Purpose: Use this HMO if all the following functions provided by Windows Server 2012 (WS2012) or later are used with a Windows OS host running WS2012 or later: ▪ Thin Provisioning function ▪ OS Offloaded Data Transfer (ODX) function Use a combination of this HMO and HMO 114 when a VXIO driver with Veritas InfoScale 8.0 or later is used on the Windows OS host. **Notes:** 1. After setting HMO 73 to ON, perform an operation (such as a server reboot) that reissues the `INQUIRY` command on the host side. 2. This HMO is related to HMO 110. For behaviors when both of the options are set to ON, contact customer support. When both options are set to ON, the setting of HMO 73 is prioritized over that of HMO 110.
78	The non-preferred path option	Any	Purpose: To prevent the decrease of the response time of the host I/O using Hitachi Dynamic Link Manager (HDLM).

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
			Use this HMO if the following conditions are met:
			▪ Global-active device is used in the configuration with the data centers (Metro configuration).
			▪ HDLM is used as the alternative path software.
			Notes:
			1. The option is applied when GAD is used in HDLM environment built between long distance data centers. The option is only set to host groups of cross paths.
			2. If this HMO is set on the wrong host group, load balance of HDLM with the option set cannot be performed intended operations, which may cause a performance issue.
80	Multi Text OFF Mode	Any	By using the iSCSI interface, if the storage system connects with the host of which OS is not supported of the Multi Text function. For instance, connecting the storage system and the host of RHEL5.0 which does not support the Multi Text-function.
81	NOP-In Suppress Mode	0A [NetWare]	In the environment with iSCSI connection, the delayed reply of the Delayed Acknowledgment function, which is located on the upper layer, is restrained by sending NOP-IN for executing sense commands such as Inquiry, Test unit ready, or Mode sense. However, select this option when connecting the storage system and the host that does not need to send the NOP-IN.
			▪ When connecting the storage system and the Open Enterprise Server of Novell Co., Ltd.
			▪ When connecting the storage system and winBoot/i of emBoot Co., Ltd..
82	Discovery CHAP Mode	21 [VMware Extension]	Select this option when the CHAP authentication is performed at the time of the discovery login in the iSCSI connection environment.
			For instance: When the CHAP authentication is performed at the time of the discovery login in the iSCSI environment of the VMware host and storage system

HMO	Function	Host mode	Description
83	Report iSCSI Full Portal List Mode	21 [VMware Extension]	Use this HMO when all these conditions are met: ▪ Configuring alternate paths between the VMware host and storage system. ▪ Waiting for replying of the target information from the ports other than ports of discovery login. **Notes:** ▪ When this HMO is enabled, the same iSCSI target name and the same target number as the iSCSI target that receives the Send Target request are reported as the targets. For the target information that requires a portal list report, make sure that the iSCSI target name and the target number match with those of the iSCSI target under the port that receives the Send Target request. ▪ Set this HMO on all targets that require reporting.
88	Port consolidation	00 [Linux], 01 [(Deprecated) VMware], 03 [HP], 09 [Solaris], 0C [(Deprecated) Windows], 0F [AIX], 21 [VMware extension], 2C [Windows extension]	Use this HMO when converging multiple host-target ports used in the migration source storage system on one host group of the migration target storage system by enabling path definition from the host group to LDEVs of multiple virtual storage machines. ▪ Enabled: LUN path definition is enabled. ▪ Disabled: LUN path definition is disabled. This HMO setting is not supported when the HDLM or VxVM DMP multipath software is used. **Notes:** 1. Apply this HMO when all the following conditions are met: - You are using the NDM or GAD function to migrate volumes in multiple migration source storage systems that use the same server. - You need to converge target ports used on the migration target storage system. - Host mode 00, 01 03, 09, 0C, 0F, 21, or 2C is used.

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
			2. Do not apply this HMO to host groups without the specified host modes enabled. Applying this HMO to host groups with other host modes can cause the following problems: - Path addition from the server to the migration target storage system might fail. - Display of devices that the server recognizes might be invalid. 3. When using VMware NMP, use the same LUN# for the migration source and migration target. 4. If a LUN path is defined from the host group to an LDEV defined in a virtual storage machine different from the one to which the host group belongs, this HMO cannot be set to OFF.
91	Disable I/O wait for OpenStack Option	00 [Standard]	Use this HMO when manually creating host groups or iSCSI targets that are used as the I/O data paths for OpenStack.
96	Change the nexus specified in the SCSI Logical Unit Reset	Any	Use this HMO when you want to enable the host to set these ranges on all initiators in the host group, not only the initiator that issues the job resetting when receiving an LU Reset, such as in the IBM SVC connection environment: ▪ Range of job resetting. ▪ Range of UAs (Unit Attentions) defined.
97	Proprietary ANCHOR command support	00 [Standard]	Do not enable HMO 97 when connecting with Hitachi NAS Platform (HNAS). This setting does not enable any HNAS functionality at this time. **Note:** This HMO was intended to be used only for NAS but was never implemented in NAS software, and therefore it is currently not supported by NAS and should not be used.
105	Task Set Full response in the event of I/O overload	0C [(Deprecated) Windows] or 2C [Windows Extension]	Use this HMO when you want to return Task Set Full response from the storage system to the host when an overload of I/Os occurs on the storage system.
110	ODX support for WS2012	01 [(Deprecated) [VMware], 21 [VMware Extension], 0C [(Deprecated) Windows] or 2C	Purpose: This HMO is used to enable the Windows Server 2012 Offloaded Data Transfer (ODX) function to work.

HMO	Function	Host mode	Description
		[Windows Extension]	Use this HMO when ODX provided by Windows Server 2012 or later is used, in the environment with which the WS2012 or later host connects. **Notes:** 1. After setting HMO 110 to ON, perform an operation (such as a server reboot) leading to reissuing the `INQUIRY` command from the host. 2. When VMware and Linux servers, or VMware and Windows servers are added to the same host group, select VMware Extension for the host mode and then set the option to ON. 3. This HMO is related to HMO 73. For behaviors when both of the options are set to ON, contact customer support. When both options are set to ON, the setting of HMO 73 is prioritized over that of HMO 110.
113	iSCSI CHAP Authentication Log	Any	Use this HMO when the result of the CHAP authentication is output to the audit log (DKC). **Notes:** 1. When you use this HMO, set this HMO on the host group 0. 2. The setting of this HMO applies to all iSCSI targets on the port. Therefore, set this HMO only in iSCSI target 00 of the port.
114	The automatic asynchronous reclamation on ESXi 6.5 or later	01 [(Deprecated) [VMware], 21 [VMware Extension], 0C [(Deprecated) Windows], or 2C [Windows Extension]	If either of the following conditions is met: ▪ Use a combination of this HMO and HMO 63 when connecting to VMware ESXi 6.5 or later, and when using the zero data page reclamation function which is performed automatically if files on the VMFS (Virtual Machine File System) are deleted. ▪ Use a combination of this HMO and HMO 73 when a VXIO driver with Veritas InfoScale 8.0 or later is used on the Windows OS host. **Notes:** 1. The option is applied to use Auto UNMAP with ESXi6.5 or later.

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
			2. After setting HMO 114 to ON, perform an operation (such as a server reboot) leading to reissuing the `INQUIRY` command from the host side.
122	Task Set Full response after reaching QoS upper limit	01 [(Deprecated) VMware], 21 [VMware Extension], 0C [(Deprecated) Windows], 2C [Windows Extension], or 00 [Standard]	Use this HMO when a Windows/Linux/VMware host is connected, and when the QoS upper limit is reached, if you want to return a TASK SET FULL response to the host in order not to retain an I/O inside the storage system. **Note:** If this option is set for a host other than a Windows/Linux/VMware host, an I/O might not be issued from the host.
124	Guaranteed response during controller failure	0F [AIX]	Use this HMO when connecting to an AIX™ host and using HDLM-EX as the alternative path software. **Note:** If this option is set for a configuration other than the AIX™ host and HDLM-EX, an I/O might not be issued from the host.
131	WCE bit OFF mode	00 [Standard]	Purpose: This HMO is used to change the WCE (Write Cache Enable) bit in Cache Mode page (08h) of the MODE SENSE command to OFF "Write Cache Disabled", which is returned to the host. Use this HMO when an I/O performance problem occurs while Oracle ASM is used in Linux environment. **Notes:** 1. The option is applied when an I/O performance issue occurs while Oracle ASM is used in a Linux environment. In other environments than Linux, the behavior when the option is used is not guaranteed. 2. This option is related to system option mode (SOM) 779. 3. After setting this HMO to ON, perform an operation (such as server reboot) by which the INQUIRY command is run again on the host side. 4. With the support for this HMO, only the outside I/F is changed, but there is no change in cache used internally in the storage system (because the cache in the storage system is equal to non-volatile memory by battery).

Appendix D: Host modes and host mode options

Host modes and HMOs for VSP G1x00 and VSP F1500

Host modes for VSP G1000, VSP G1500, and VSP F1500

Host mode	When to select this host mode
00 [Standard]	When registering Red Hat Linux server hosts or IRIX server hosts in the host group. HMOs specific to this host mode: 68, 88, 91 HMOs available to this host mode: 2, 7, 13, 22, 39, 51, 71, 78, 80, 96, 113
01 [(Deprecated) VMware]	Do not select this host mode. Select host mode 21 VMware Extension instead. HMOs specific to this host mode: 54, 63, 68, 88, 114
03 [HP]	When registering HP-UX server hosts in the host group.
08 [HP]	When registering HP-UX server hosts in the host group.
09 [Solaris]	When registering Solaris server hosts in the host group.
0C [(Deprecated) Windows]	Do not select this host mode. Select host mode 2C Windows Extension instead. HMOs specific to this host mode: 6, 25, 40, 73, 88, 105 HMOs available to this host mode: 2, 7, 13, 22, 39, 51, 71, 78, 80, 96, 113
0F [AIX]	When registering AIX $^®$ server hosts in the host group. When host mode 0F AIX $^®$ is set, NACA (Normal Auto Contingent Allegiance) is enabled automatically. To ensure that the host responds correctly to a port with host mode 0F AIX enabled: 1. Shut down the host to be connected to the port. 2. Set the host mode on the port to 0F AIX, and enable the desired HMOs. 3. Connect the cables from the host to the port. 4. Boot the host. **Caution:** If the host mode of a port is changed to 0F AIX and the host had already recognized the Inquiry response for an LDEV on the port before host mode 0F AIX was set, the host might experience loss of device access (LDEV or LU). The host must be rebooted after the host mode is changed to 0F AIX to recognize the change in the response to the standard inquiry.
21 [VMware Extension]	When registering VMware server hosts in the host group.* HMOs specific to this host mode: 54, 63, 68, 82, 83, 88, 114 HMOs available to this host mode: 2, 7, 13, 22, 39, 51, 71, 78, 80, 96, 113

Appendix D: Host modes and host mode options

Host mode	When to select this host mode
2C [Windows Extension]	When registering Windows server hosts in the host group.* HMOs specific to this host mode: 6, 25, 40, 73, 88, 105 HMOs available to this host mode: 2, 7, 13, 22, 39, 51, 71, 78, 80, 96, 113

*Use host mode 21 only for VMware server hosts (Hypervisor host accessing VMFS formatted data stores, *not* Raw Device Mapping (RDM) disks. But when the (Linux-based OS or Windows) Virtual Machine host directly recognizes and manages the I/O stack on LUs by *RDM* (Raw Device Mapping), then the disk should only be assigned a host mode that is the same as the operating system of the virtual machine, even when running on VMware Hypervisor.

Unreliable access, errors, and performance problems will result if vCenter maps an RDM disk to a virtual machine that is part of a VMware host group with VMware host mode configured. This is because Windows and Linux use SCSI-3 version protocol and VMware uses SCSI-4 version protocol.

Linux-based OS (such as Red Hat Linux) or Windows Virtual Machine (VM) server hosts that use *virtual* disks and *not* RDM do not need any host group mapping because they are dependent on the VMware Hypervisor host for creating a virtual disk (VMDK file) from the VMFS file system residing on a Hypervisor-only data stores, because the VM disk files are ultimately VMware VMFS file system files and not actual disks.

To add VMware Hypervisor (not virtual machine) hosts to one host group, you must set this host mode and these HMOs for the host group:

- Host mode: 21 VMware Extension

- Host mode options: 2, 22, 25, 54, 63, 68, and 110 (for details, contact customer support)

Restrictions for VMware server hosts added to the host group:

Do not attempt to set Windows or Linux HMO functions on a VMware Hypervisor, they cannot be used by VMware:

- Thin Provisioning

- Offloaded Data Transfer (ODX)

The above functions are handled by the HMO 54 and 63 in the VMware host group instead.

Host mode options for VSP G1000, VSP G1500, and VSP F1500

HMO	Function	Host mode	Description
2	VERITAS Database Edition/ Advanced Cluster	Any	Use this HMO when any of the following conditions is met: - Windows Server Failover Clustering (WSFC) is used. - Microsoft Failover Cluster (MSFC) is used. - Linux with cluster configuration is used.

HMO	Function	Host mode	Description
			▪ Symantec Cluster Server (previously known as Veritas Cluster Server (VCS)) is used. ▪ The response for SPC-3 (Good Status) is required.
6	TPRLO	0C [(Deprecated) Windows] or 2C [Windows Extension]	Purpose: By default, PRLO is returned for TPRLO, however, LOGO might be expected under the following conditions. When this HMO is enabled, the storage system will switch the TPRLO response to LOGO from PRLO. Use this HMO when all these conditions are satisfied: ▪ An Emulex host bus adapter is used in a Windows environment. ▪ The mini-port driver is used. ▪ TPRLO=2 is specified for the mini-port driver parameter of the host bus adapter.
7	Automatic recognition function of LUN	Any	Use this HMO when you want the Unit Attention (UA) response to be returned at SCSI path change (sense code: REPORTED LUNS DATA HAS CHANGED). **Notes:** 1. If the UA response occurs frequently and the host load becomes high, the data transfer cannot be started on the host side and timeout might occur. 2. When both HMO 07 and HMO 69 are enabled, the UA of HMO 69 is returned to the host.
12	No display for ghost LUN	03 [HP]	Use this HMO when you want to suppress creation of device files for devices to which paths are not defined.
13	SIM report at link failure	Any	Use this HMO when you want SIMs (SIM=2194XX) to be issued when the number of link failures detected between FC ports (such as SSB=B65C and DDA1) exceeds the threshold. **Notes:** 1. Enable HMO 13 only when requested to do so. 2. When you use this HMO, set this HMO on the host group 0 of the target port.

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
15	HACMP	0F [AIX]	Use this HMO when HACMP* or PowerHA® is used. * HACMP 4.5 version 4.5.0.13 or later, HACMP 5.1 version 5.1.0.4 or later, or HACMP 5.2 or later.
22	Improves MODE SENSE command response for a reserved volume	Any	Use this HMO when any of these conditions is satisfied: ▪ Veritas Cluster Server is used. ▪ An OS or middleware that supports SPC-4 is used. ▪ A single-site or GAD dual-site Clustered VMDK configuration is used. **Notes:** 1. By applying HMO 22, the volume status (reserved / non-reserved) will be checked more frequently. 2. By applying HMO 22, the host OS will not be receiving warning messages when the MODE SENSE command is being issued to a reserved volume.
25	Support SPC-3 behavior on Persistent Reservation	Any	Use this HMO when one of these conditions is satisfied: ▪ Windows Server Failover Clustering (WSFC) is used. ▪ Microsoft Failover Cluster (MSFC) is used. ▪ Symantec Cluster Server (previously known as Veritas Cluster Server (VCS)) is used. ▪ There is no registered key to be deleted when running the PERSISTENT RESERVE OUT command.
39	Change the nexus specified in the SCSI Target Reset	Any	Use this HMO when you want to enable the host to set these ranges on all initiators in the host group, not only the initiator that issues the job resetting when receiving Target Reset, such as in the IBM SVC connection environment: ▪ Range of job resetting. ▪ Range of UAs (Unit Attentions) defined.

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
40	V-Vol expansion	0C [(Deprecated) Windows] or 2C [Windows Extension]	Use this HMO when you want to automate recognition of the DP-VOL capacity after increasing the DP-VOL capacity. When a VMware, Linux, or Windows server is added to a host group, select VMware Extension for the host mode and then set the option to ON.
43	Queue Full Response	03 [HP]	Use this HMO when the command queue is full in your storage system connected to an HP-UX host, and you want to respond `Queue Full` (instead of `Busy`) from the storage system to the host.
51	Round Trip Set Up Option	Any	Use this HMO if you want to adjust the response time of the host I/O, for example when the distance between the primary and secondary storage systems in the TrueCopy or global-active device pair is long (approximately 100 km) and point-to-point topology is used.
54	(VAAI) Support Option for the EXTENDED COPY command	01 [(Deprecated) VMware] or 21 [VMware Extension]	Use this HMO when the VAAI (vStorage API for Array Integration) function of VMware ESX/ESXi 4.1 or later is used. **Note:** After setting this HMO, perform the operation, such as the server reboot that reissues the `INQUIRY` command on the host side.
60	LUN0 Change Guard	03 [HP]	Use this HMO when HP-UX 11.31 is used, and you want to suppress the addition or deletion of LUN 0.
63	(VAAI) Support Option for the EXTENDED COPY command	01 [(Deprecated) VMware] or 21 [VMware Extension]	Use this HMO when you connect the storage system to VMware ESXi 5.0 or later and use the VAAI function for iSCSI T10. Use a combination of this HMO and HMO 54. **Note:** After setting this HMO, perform the operation, such as the server reboot that reissues the `INQUIRY` command on the host side.
68	Support Page Reclamation for Linux	00 [Standard], 01 [(Deprecated) VMware], or 21 [VMware Extension]	Use this HMO when using the Page Reclamation function with a Linux host. **Note:** After setting this HMO, perform the operation, such as the server reboot that reissues the `INQUIRY` command on the host side.
71	Change the Unit Attention for Blocked Pool-VOLs	Any	Use this HMO when you want to change the unit attention (UA) from `NOT READY` to `MEDIUM ERROR` while a DP pool is blocked.

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
72	AIX GPFS Support		Use this HMO if either of the following conditions is met: ▪ General Parallel File System (GPFS) is used in the storage system connecting to the AIX® host. ▪ A single-site or GAD dual-site Clustered VMDK configuration is used.
73	Support Option for WS2012	0C [(Deprecated) Windows] or 2C [Windows Extension]	Use this HMO if all the following functions provided by Windows Server 2012 (WS2012) or later are used with a Windows host running WS2012 or later: ▪ Thin Provisioning function ▪ Offloaded Data Transfer (ODX) function Use a combination of this HMO and HMO 114 when a VXIO driver with Veritas InfoScale 8.0 or later is used on the Windows OS host. **Note:** After setting HMO 73 to ON, perform an operation (such as a server reboot) that reissues the `INQUIRY` command on the host side.
78	The non-preferred path option	Any	Use this HMO when all these conditions are satisfied: ▪ Global-active device is used in the configuration with the data centers (Metro configuration). ▪ Hitachi Dynamic Link Manager (HDLM) is used as the alternative path software. ▪ The host group is on the non-optimized path of HDLM. ▪ The performance deterioration of I/O responses can be avoided without I/O using the non-optimized path of HDLM. **Caution:** If this HMO is set on the wrong host group, load balance of HDLM with the option cannot be performed intended operations, which may cause a performance issue.
80	Multi Text OFF Mode	Any	By using the iSCSI interface, if the storage system connects with the host of which OS is not supported of the Multi Text function. For instance, connecting the storage system and the host of RHEL5.0 which does not support the Multi Text-function.

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
82	Discovery CHAP Mode	21 [VMware Extension]	Select this option when the CHAP authentication is performed at the time of the discovery login in the iSCSI connection environment. For instance: When the CHAP authentication is performed at the time of the discovery login in the iSCSI environment of the VMware host and storage system
83	Report iSCSI Full Portal List Mode	21 [VMware Extension]	Use this HMO when all these conditions are met: ▪ Configuring alternate paths between the VMware host and storage system. ▪ Waiting for replying of the target information from the ports other than ports of discovery login. **Notes:** ▪ When this HMO is enabled, the same iSCSI target name and the same target number as the iSCSI target that receives the Send Target request are reported as the targets. For the target information that requires a portal list report, make sure that the iSCSI target name and the target number match with those of the iSCSI target under the port that receives the Send Target request. ▪ Set this HMO on all targets that require reporting.
88	Port consolidation	00 [Linux], 01 [(Deprecated) VMware], 03 [HP], 09 [Solaris], 0C [(Deprecated) Windows], 0F [AIX], 21 [VMware extension], 2C [Windows extension]	Use this HMO when converging multiple host-target ports used in the migration source storage system on one host group of the migration target storage system by enabling path definition from the host group to LDEVs of multiple virtual storage machines. ▪ Enabled: LUN path definition is enabled. ▪ Disabled: LUN path definition is disabled. This HMO setting is not supported when the HDLM or VxVM DMP multipath software is used. **Notes:**

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
			1. Apply this HMO when all the following conditions are met:
			- You are using the NDM or GAD function to migrate volumes in multiple migration source storage systems that use the same server.
			- You need to converge target ports used on the migration target storage system.
			- Host mode 00, 01 03, 09, 0C, 0F, 21, or 2C is used.
			2. Do not apply this HMO to host groups without the specified host modes enabled. Applying this HMO to host groups with other host modes can cause the following problems:
			- Path addition from the server to the migration target storage system might fail.
			- Display of devices that the server recognizes might be invalid.
			3. When using VMware NMP, use the same LUN# for the migration source and migration target.
			4. If a LUN path is defined from the host group to an LDEV defined in a virtual storage machine different from the one to which the host group belongs, this HMO cannot be set to OFF.
91	Disable I/O wait for OpenStack Option	00 [Standard]	Use this HMO when manually creating host groups or iSCSI targets that are used as the I/O data paths for OpenStack.
96	Change the nexus specified in the SCSI Logical Unit Reset	Any	Use this HMO when you want to enable the host to set these ranges on all initiators in the host group, not only the initiator that issues the job resetting when receiving an LU Reset, such as in the IBM SVC connection environment: • Range of job resetting. • Range of UAs (Unit Attentions) defined.
97	Proprietary ANCHOR command support	00 [Standard]	Do not enable HMO 97 when connecting with Hitachi NAS Platform (HNAS). This setting does not enable any HNAS functionality at this time. **Note:** This HMO was intended to be used only for NAS but was never implemented in NAS software, and therefore it is currently not supported by NAS and should not be used.

HMO	Function	Host mode	Description
105	Task Set Full response in the event of I/O overload	0C [(Deprecated) Windows] or 2C [Windows Extension]	Use this HMO when you want to return Task Set Full response from the storage system to the host when an overload of I/Os occurs on the storage system.
113	iSCSI CHAP Authentication Log	Any	Use this HMO when the result of the CHAP authentication is output to the audit log (DKC). **Notes:** 1. When you use this HMO, set this HMO on the host group 0. 2. The setting of this HMO applies to all iSCSI targets on the port. Therefore, set this HMO only in iSCSI target 00 of the port.
114	The automatic asynchronous reclamation on ESXi 6.5 or later	01 [(Deprecated) [VMware] ,21 [VMware Extension], 0C [(Deprecated) Windows], or 2C [Windows Extension]	If either of the following conditions is met: ▪ Use a combination of this HMO and HMO 63 when connecting to VMware ESXi 6.5 or later, and when using the zero data page reclamation function, which is performed automatically if files on the VMFS (Virtual Machine File System) are deleted. ▪ Use a combination of this HMO and HMO 73 when a VXIO driver with Veritas InfoScale 8.0 or later is used on the Windows OS host. **Note:** After setting this HMO, perform the operation, such as the server reboot, that reissues the `INQUIRY` command on the host side.

Host modes and HMOs for VSP E series

Host modes for VSP E series

Host mode	When to select this host mode
00 [Standard]	When registering Red Hat Linux server hosts or IRIX server hosts in the host group.* HMOs specific to this host mode: 68, 88, 91, 122, 131 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 22, 25, 68

Host mode	When to select this host mode
01 [(Deprecated) VMware]	Do not select this host mode. Select host mode 21 VMware Extension instead. HMOs specific to this host mode: 54, 63, 68, 88, 110, 114, 122 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: See host mode 21 [VMware Extension] in this table.
03 [HP]	When registering HP-UX server hosts in the host group. HMOs specific to this host mode: 12, 33, 43, 60, 88 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 12, 22, 25, 60
05 [OpenVMS]	When registering OpenVMS server hosts in the host group. HMOs specific to this host mode: 33 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 22, 25
07 [Tru64]	When registering Tru64 server hosts in the host group. HMOs available to this host mode: 2, 7, 13, 14, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 22, 25
09 [Solaris]	When registering Solaris server hosts in the host group. HMO specific to this host mode: 88 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 22, 25
0A [NetWare]	When registering NetWare server hosts in the host group. HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 22, 25
0C [(Deprecated) Windows]	Do not select this host mode. Select host mode 2C Windows Extension instead. HMOs specific to this host mode: 6, 40, 73, 88, 105, 110, 114, 122 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: See host mode 2C [Windows Extension] in this table.
0F [AIX]	When registering AIX [®] server hosts in the host group. HMOs specific to this host mode: 15, 88 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113, 124

Appendix D: Host modes and host mode options

Host mode	When to select this host mode
	HMO best practice recommendations: 2, 15, 22, 25
	When host mode 0F AIX ® is set, NACA (Normal Auto Contingent Allegiance) is enabled automatically. To ensure that the host responds correctly to a port with host mode 0F AIX enabled: 1. Shut down the host to be connected to the port. 2. Set the host mode on the port to 0F AIX, and enable the desired HMOs. 3. Connect the cables from the host to the port. 4. Boot the host. **Caution:** If the host mode of a port is changed to 0F AIX and the host had already recognized the Inquiry response for an LDEV on the port before host mode 0F AIX was set, the host might experience loss of device access (LDEV or LU). The host must be rebooted after the host mode is changed to 0F AIX to recognize the change in the response to the standard inquiry.
21 [VMware Extension]	When registering VMware server hosts in the host group.* HMOs specific to this host mode: 54, 63, 68, 82, 83, 88, 110, 114, 122 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 22, 25, 54, 63, 68, 110
2C [Windows Extension]	When registering Windows server hosts in the host group.* HMOs specific to this host mode: 6, 40, 73, 88, 105, 110, 114, 122 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 22, 25, 40, 110

*Use host mode 21 only for VMware server hosts (Hypervisor host accessing VMFS formatted data stores, *not* Raw Device Mapping (RDM) disks. But when the (Linux-based OS or Windows) Virtual Machine host directly recognizes and manages the I/O stack on LUs by *RDM* (Raw Device Mapping), then the disk should only be assigned a host mode that is the same as the operating system of the virtual machine, even when running on VMware Hypervisor.

Unreliable access, errors, and performance problems will result if vCenter maps an RDM disk to a virtual machine that is part of a VMware host group with VMware host mode configured. This is because Windows and Linux use SCSI-3 version protocol and VMware uses SCSI-4 version protocol.

Linux-based OS (such as Red Hat Linux) or Windows Virtual Machine (VM) server hosts that use *virtual* disks and *not* RDM do not need any host group mapping because they are dependent on the VMware Hypervisor host for creating a virtual disk (VMDK file) from the VMFS file system residing on a Hypervisor-only data stores, because the VM disk files are ultimately VMware VMFS file system files and not actual disks.

To add VMware Hypervisor (not virtual machine) hosts to one host group, you must set this host mode and these HMOs for the host group:

- Host mode: 21 VMware Extension

- Host mode options: 2, 22, 25, 54, 63, 68, and 110 (for details, contact customer support)

Appendix D: Host modes and host mode options

Host mode	When to select this host mode
Restrictions for VMware server hosts added to the host group: Do not attempt to set Windows or Linux HMO functions on a VMware Hypervisor, they cannot be used by VMware: ▪ Thin Provisioning ▪ Offloaded Data Transfer (ODX) The above functions are handled by the HMO 54 and 63 in the VMware host group instead.	

Host mode options for VSP E series

HMO	Function	Host mode	Description
2	VERITAS Database Edition/ Advanced Cluster	Any	Purpose: By default, Reservation Conflict is returned for Test Unit Ready run from host without the PERSISTENT GROUP RESERVATION key setting. In the following conditions, Good Status is expected. When this HMO is enabled, the storage system will switch Test Unit Ready response to Good Status from Reservation Conflict. Use this HMO when any of the following conditions is met: ▪ Windows Server Failover Clustering (WSFC) is used. ▪ Microsoft Failover Cluster (MSFC) is used. ▪ Linux with cluster configuration is used. ▪ Symantec Cluster Server (previously known as Veritas Cluster Server (VCS)) is used. ▪ The response for SPC-3 (Good Status) is required.
6	TPRLO	0C [(Deprecated) Windows] or 2C [Windows Extension]	Purpose: By default, PRLO is returned for TPRLO, however, LOGO might be expected under the following conditions. When this HMO is enabled, the storage system will switch the TPRLO response to LOGO from PRLO.

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
			Use this HMO when all these conditions are satisfied:
			▪ An Emulex host bus adapter is used in a Windows environment.
			▪ The mini-port driver is used.
			▪ TPRLO=2 is specified for the mini-port driver parameter of the host bus adapter.
7	Automatic recognition function of LUN	Any	Purpose: By default, Unit Attention response is not returned when adding a LUN using a host group.
			However, in some cases, the host may expect Unit Attention.
			When this HMO is enabled, the storage system will return the Unit Attention response.
			Use this HMO when any of the following conditions is met:
			▪ SUN StorEdge SAN Foundation Software Version 4.2 or later is used.
			▪ You want to enable the automatic recognition of the device increase or decrease when connecting a genuine SUN HBA.
			▪ You want the Unit Attention (UA) response to be returned to the host at SCSI path change (sense code: REPORTED LUNS DATA HAS CHANGED).
			Note: If the UA response occurs frequently and the load on the host becomes high, the data transfer cannot be started on the host side and timeout might occur.
12	No display for ghost LUN	03 [HP]	Use this HMO when you want to suppress creation of device files for devices to which paths are not defined.
13	SIM report at link failure	Any	Use this HMO when you want SIMs (SIM=2194XX) to be issued when the number of link failures detected between FC ports (such as SSB=B65C and DDA1) exceeds the threshold.
			Notes:
			1. Enable HMO 13 only when requested to do so.
			2. When you use this HMO, set this HMO on the host group 0 of the target port.

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
15	HACMP	0F [AIX]	Use this HMO when HACMP* or PowerHA® is used. * HACMP 4.5 version 4.5.0.13 or later, HACMP 5.1 version 5.1.0.4 or later, or HACMP 5.2 or later.
22	Veritas Cluster Server	Any	Purpose: By default, Reservation Conflict is returned to the MODE SENSE command from the host without the PERSISTENT GROUP RESERVATION key setting. In the following condition, GOOD status is expected when a reserved volume receives the MODE SENSE command from a node that is not reserving this volume. When this HMO is enabled, the storage system will switch the MODE SENSE command response to Good status from Reservation Conflict. Use this HMO when any of these conditions is satisfied: ▪ Veritas Cluster Server is used. ▪ An OS or middleware that supports SPC-4 is used. ▪ A single-site or GAD dual-site Clustered VMDK configuration is used.
25	Support SPC-3 behavior on Persistent Reservation	Any	Purpose: By default, Reservation Conflict is returned for PERSISTENT RESERVE OUT (Service Action = REGISTER AND IGNORE EXISTING KEY) command if there is no registered key to be deleted. In the following conditions, Good Status (SPC-3 response) is expected. When this HMO is enabled, the storage system will switch this command response to Good Status from Reservation Conflict. Use this HMO when one of these conditions is satisfied: ▪ Windows Server Failover Clustering (WSFC) is used. ▪ Microsoft Failover Cluster (MSFC) is used.

HMO	Function	Host mode	Description
			▪ Symantec Cluster Server (previously known as Veritas Cluster Server (VCS)) is used. ▪ There is no registered key to be deleted when running the PERSISTENT RESERVE OUT command. **Note:** Host types other than above listed in Special Direction expect the response when the option is set to OFF.
25	Support SPC-3 behavior on Persistent Reservation	Any	Use this HMO when one of these conditions is satisfied: ▪ Windows Server Failover Clustering (WSFC) is used. ▪ Microsoft Failover Cluster (MSFC) is used. ▪ Symantec Cluster Server (previously known as Veritas Cluster Server (VCS)) is used. ▪ There is no registered key to be deleted when running the PERSISTENT RESERVE OUT command.
33	Set/Report Device Identifier enable	03 [HP] or 05 [OpenVMS]	Use this HMO when all these conditions are satisfied: ▪ If you assign a nickname to a device, you want to enable the required commands. ▪ You want to set UUIDs to identify logical volumes from the host. **Note:** When this HMO is enabled in the host mode 05 [OpenVMS], make sure to set a UUID.
39	Change the nexus specified in the SCSI Target Reset	Any	Use this HMO when you want to enable the host to set these ranges on all initiators in the host group, not only the initiator that issues the job resetting when receiving Target Reset, such as in the IBM SVC connection environment: ▪ Range of job resetting. ▪ Range of UAs (Unit Attentions) defined.
40	V-VOL expansion	0C [(Deprecated) Windows] or 2C [Windows Extension]	Use this HMO when you want to automate recognition of the DP-VOL capacity after increasing the DP-VOL capacity. When a VMware, Linux, or Windows server is added to a host group, select VMware Extension for the host mode and then set the option to ON.

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
43	Queue Full Response	03 [HP]	Use this HMO when the command queue is full in your storage system connected to an HP-UX host, and you want to respond `Queue Full` (instead of `Busy`) from the storage system to the host.
51	Round Trip Set Up Option	Any	Use this HMO if you want to adjust the response time of the host I/O, for example when the distance between the MCU and RCU of the TrueCopy or global-active device pair is long (approximately 100 km) and point-to-point topology is used.
54	(VAAI) Support Option for the EXTENDED COPY command	01 [(Deprecated) VMware] or 21 [VMware Extension]	Purpose: This HMO enables the XCOPY command to be used. When this HMO is enabled, the VENDOR SPECIFIC EXTENDED COPY command that the VAAI (vStorage APIs for Array Integration) function of VMware ESX/ESXi 4.1 or later issues to the storage system is available. **Notes:** 1. The HMO is set to ON only when a VMware server of ESX/ESXi 4.1 or later using the VAAI (vStorage APIs for Array Integration) function is connected. 2. If the HMO is not applied, the VMware support function, Cloning file blocks, cannot be used. 3. When the VMware ESX/ESXi 4.*x* server is connected, set HMO 54 to ON. HMO 63 is not necessary. 4. When the ESXi 5.*x*, ESXi 6.*x*, or later server is connected, set both HMO 54 and HMO 63 to ON. 5. After setting HMO 54 to ON, perform an operation (such as a server reboot) leading to reissuing the `INQUIRY` command from the host.
60	LUN0 Change Guard	03 [HP]	Use this HMO when HP-UX 11.31 is used, and you want to suppress the addition or deletion of LUN 0.
63	(VAAI) Support Option for vStorage APIs based on T10 standards	01 [(Deprecated) VMware] or 21 [VMware Extension]	Purpose: This HMO enables the use of VAAI, which complies with SCSI T10. Use this HMO when you connect the storage system to VMware ESXi 5.0 or later and use the VAAI function for iSCSI T10. **Notes:**

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
			1. After setting this HMO, perform the operation, such as the server reboot that reissues the `INQUIRY` command on the host side.
			2. When ESXi 5.x or later is connected, set both HMO 54 and HMO 63 to ON.
63	(VAAI) Support Option for the EXTENDED COPY command	01 [(Deprecated) VMware] or 21 [VMware Extension]	Use this HMO when you connect the storage system to VMware ESXi 5.0 or later and use the VAAI function for iSCSI T10. Use a combination of this HMO and HMO 54. **Note:** After setting this HMO, perform the operation, such as the server reboot that reissues the `INQUIRY` command on the host side.
68	Support Page Reclamation for Linux	00 [Standard], 01 [(Deprecated) VMware], or 21 [VMware Extension]	Purpose: When this HMO is enabled, the storage system will change the response that Linux OS can issue the WriteSame command to use the Page Reclamation function. Use this HMO when using the Page Reclamation function with a Linux host. **Notes:** 1. The option is applied when Dynamic Provisioning is used by Linux 2.6.33 or higher. 2. After setting HMO 68 to ON, perform the operation (such as a server reboot) that reissues the `INQUIRY` command from the host.
71	Change the Unit Attention for Blocked Pool-VOLs	Any	Use this HMO when you want to change the unit attention (UA) from `NOT READY` to `MEDIUM ERROR` while a DP pool is blocked.
73	Support Option for WS2012	0C [(Deprecated) Windows] or 2C [Windows Extension]	Purpose: Use this HMO if all the following functions provided by Windows Server 2012 (WS2012) or later are used with a Windows OS host running WS2012 or later: ▪ Thin Provisioning function ▪ OS Offloaded Data Transfer (ODX) function Use a combination of this HMO and HMO 114 when a VXIO driver with Veritas InfoScale 8.0 or later is used on the Windows OS host. **Notes:**

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
			1. After setting HMO 73 to ON, perform an operation (such as a server reboot) that reissues the `INQUIRY` command on the host side.
			2. This HMO is related to HMO 110. For behaviors when both of the options are set to ON, contact customer support.
			When both options are set to ON, the setting of HMO 73 is prioritized over that of HMO 110.
78	The non-preferred path option	Any	Use this HMO when all these conditions are satisfied: ▪ Global-active device is used in the configuration with the data centers (Metro configuration). ▪ Hitachi Dynamic Link Manager (HDLM) is used as the alternative path software. ▪ The host group is on the non-optimized path of HDLM. ▪ The performance deterioration of I/O responses can be avoided without I/O using the non-optimized path of HDLM. **Caution:** If this HMO is set on the wrong host group, load balance of HDLM with the option cannot be performed intended operations, which may cause a performance issue.
80	Multi Text OFF Mode	Any	By using the iSCSI interface, if the storage system connects with the host of which OS is not supported of the Multi Text function. For instance, connecting the storage system and the host of RHEL5.0 which does not support the Multi Text-function.
82	Discovery CHAP Mode	21 [VMware Extension]	Select this option when the CHAP authentication is performed at the time of the discovery login in the iSCSI connection environment. For instance: When the CHAP authentication is performed at the time of the discovery login in the iSCSI environment of the VMware host and storage system

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
83	Report iSCSI Full Portal List Mode	21 [VMware Extension]	Use this HMO when all these conditions are met: ▪ Configuring alternate paths between the VMware host and storage system. ▪ Waiting for replying of the target information from the ports other than ports of discovery login. **Notes:** ▪ When this HMO is enabled, the same iSCSI target name and the same target number as the iSCSI target that receives the Send Target request are reported as the targets. For the target information that requires a portal list report, make sure that the iSCSI target name and the target number match with those of the iSCSI target under the port that receives the Send Target request. ▪ Set this HMO on all targets that require reporting.
88	Port consolidation	00 [Linux], 01 [(Deprecated) VMware], 03 [HP], 09 [Solaris], 0C [(Deprecated) Windows], 0F [AIX], 21 [VMware extension], 2C [Windows extension]	Use this HMO when converging multiple host-target ports used in the migration source storage system on one host group of the migration target storage system by enabling path definition from the host group to LDEVs of multiple virtual storage machines. ▪ Enabled: LUN path definition is enabled. ▪ Disabled: LUN path definition is disabled. This HMO setting is not supported when the HDLM or VxVM DMP multipath software is used. **Notes:** 1. Apply this HMO when all the following conditions are met: - You are using the NDM or GAD function to migrate volumes in multiple migration source storage systems that use the same server. - You need to converge target ports used on the migration target storage system. - Host mode 00, 01 03, 09, 0C, 0F, 21, or 2C is used.

HMO	Function	Host mode	Description
			2. Do not apply this HMO to host groups without the specified host modes enabled. Applying this HMO to host groups with other host modes can cause the following problems:
			- Path addition from the server to the migration target storage system might fail.
			- Display of devices that the server recognizes might be invalid.
			3. When using VMware NMP, use the same LUN# for the migration source and migration target.
			4. If a LUN path is defined from the host group to an LDEV defined in a virtual storage machine different from the one to which the host group belongs, this HMO cannot be set to OFF.
91	Disable I/O wait for OpenStack Option	00 [Standard]	Use this HMO when manually creating host groups or iSCSI targets that are used as the I/O data paths for OpenStack.
94	Disable initiator function on port	Any	Use this HMO when prompted to set this option while using an SAN Boot system in a configuration connecting to a specific host.
			For example, this HMO is used to configure a SAN Boot system by directly connecting the Fibre Channel channel board on the storage system to the Broadcom (Emulex) 16-Gbps or 32-Gbps Fibre Channel HBA that supports the connection to the storage system.
			Note: For details about the conditions of the supported connection configuration, contact customer support. After you set this option, do not use the port for an external storage connection or a remote copy connection.
			Note: This HMO option setting can be specified for each port. Set this HMO to host group 0 of the target port.
96	Change the nexus specified in the SCSI Logical Unit Reset	Any	Use this HMO when you want to enable the host to set these ranges on all initiators in the host group, not only the initiator that issues the job resetting when receiving an LU Reset, such as in the IBM SVC connection environment:
			▪ Range of job resetting.
			▪ Range of UAs (Unit Attentions) defined.

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
97	Proprietary ANCHOR command support	00 [Standard]	Do not enable HMO 97 when connecting with Hitachi NAS Platform (HNAS). This setting does not enable any HNAS functionality at this time. **Note:** This HMO was intended to be used only for NAS but was never implemented in NAS software, and therefore it is currently not supported by NAS and should not be used.
105	Task Set Full response in the event of I/O overload	0C [(Deprecated) Windows] or 2C [Windows Extension]	Use this HMO when you want to return Task Set Full response from the storage system to the host when an overload of I/Os occurs on the storage system.
109	Change FLOGI TOV on port	Any	Use this HMO when prompted to set this option while using an SAN Boot system in a configuration connecting to a specific host. **Note:** For details about the conditions of the supported connection configuration, contact customer support. After you set this option, do not use the port for external storage connection or remote copy connection. **Note:** This HMO option setting can be specified for each port. Set this HMO to host group 0 of the target port.
110	ODX support for WS2012	01 [(Deprecated) [VMware], 21 [VMware Extension], 0C [(Deprecated) Windows] or 2C [Windows Extension]	Use this HMO when ODX (Offloaded Data Transfer) provided by Windows Server 2012 or later is used, in the environment with which the WS2012 or later host connects. **Notes:** ▪ After setting this HMO, perform the operation, such as the server reboot that reissues the `INQUIRY` command on the host side. ▪ If both HMO 73 and HMO 110 are set, HMO 73 takes precedence over HMO 110.
113	SCSI CHAP Authentication Log	Any	Use this HMO when the result of the CHAP authentication is output to the audit log (DKC). **Notes:** 1. This HMO option setting can be specified for each port. Set this HMO on the host group 0 of the target port.

HMO	Function	Host mode	Description
			2. The setting of this HMO applies to all iSCSI targets on the port. Therefore, set this HMO only in iSCSI target 00 of the port.
114	The automatic asynchronous reclamation on ESXi 6.5 or later	01 [(Deprecated) [VMware] ,21 [VMware Extension], 0C [(Deprecated) Windows], or 2C [Windows Extension]	If either of the following conditions is met: • Use a combination of this HMO and HMO 63 when connecting to VMware ESXi 6.5 or later, and when using the zero data page reclamation function, which is performed automatically if files on the VMFS (Virtual Machine File System) are deleted. • Use a combination of this HMO and HMO 73 when a VXIO driver with Veritas InfoScale 8.0 or later is used on the Windows OS host. **Note:** After setting this HMO, perform the operation, such as the server reboot, that reissues the `INQUIRY` command on the host side.
122	Task Set Full response after reaching QoS upper limit	01 [(Deprecated) VMware], 21 [VMware Extension], 0C [(Deprecated) Windows], 2C [Windows Extension], or 00 [Standard]	Use this HMO when a Windows/Linux/VMware host is connected, and when the QoS upper limit is reached, if you want to return a TASK SET FULL response to the host in order not to retain an I/O inside the storage system. **Note:** If this option is set for a host other than a Windows/Linux/VMware host, an I/O might not be issued from the host.
124	Guaranteed response during controller failure	0F [AIX]	Use this HMO when connecting to an AIX™ host and using HDLM-EX as the alternative path software. **Note:** If this option is set for a configuration other than the AIX™ host and HDLM-EX, an I/O might not be issued from the host.

Appendix D: Host modes and host mode options

Host modes and HMOs for VSP G130, G/F350, G/F370, G/F700, G/F900

Host modes for VSP G130, G/F350, G/F370, G/F700, G/F900

Host mode	When to select this host mode
00 [Standard]	When registering Red Hat Linux server hosts or IRIX server hosts in the host group.* HMOs specific to this host mode: 68, 88, 91, 122, 131 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 22, 25, 68
01 [(Deprecated) VMware]	Do not select this host mode. Select host mode 21 VMware Extension instead. HMOs specific to this host mode: 54, 63, 68, 88, 110, 114, 122 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: See host mode 21 [VMware Extension] in this table.
03 [HP]	When registering HP-UX server hosts in the host group. HMOs specific to this host mode: 12, 33, 43, 60, 88 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 12, 22, 25, 60
09 [Solaris]	When registering Solaris server hosts in the host group. HMO specific to this host mode: 88 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 22, 25
0C [(Deprecated) Windows]	Do not select this host mode. Select host mode 2C Windows Extension instead. HMOs specific to this host mode: 6, 40, 73, 88, 105, 110, 114, 122 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: See host mode 2C [Windows Extension] in this table.
0F [AIX]	When registering AIX [®] server hosts in the host group. HMOs specific to this host mode: 15, 88 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113, 124 HMO best practice recommendations: 2, 15, 22, 25

Appendix D: Host modes and host mode options

Host mode	When to select this host mode
	When host mode 0F AIX [®] is set, NACA (Normal Auto Contingent Allegiance) is enabled automatically. To ensure that the host responds correctly to a port with host mode 0F AIX enabled: 1. Shut down the host to be connected to the port. 2. Set the host mode on the port to 0F AIX, and enable the desired HMOs. 3. Connect the cables from the host to the port. 4. Boot the host. **Caution:** If the host mode of a port is changed to 0F AIX and the host had already recognized the Inquiry response for an LDEV on the port before host mode 0F AIX was set, the host might experience loss of device access (LDEV or LU). The host must be rebooted after the host mode is changed to 0F AIX to recognize the change in the response to the standard inquiry.
21 [VMware Extension]	When registering VMware server hosts in the host group.* HMOs specific to this host mode: 54, 63, 68, 82, 83, 88, 110, 114, 122 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 22, 25, 54, 63, 68, 110
2C [Windows Extension]	When registering Windows server hosts in the host group.* HMOs specific to this host mode: 6, 40, 73, 88, 105, 110, 114, 122 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 22, 25, 40, 110

*Use host mode 21 only for VMware server hosts (Hypervisor host accessing VMFS formatted data stores, *not* Raw Device Mapping (RDM) disks. But when the (Linux-based OS or Windows) Virtual Machine host directly recognizes and manages the I/O stack on LUs by *RDM* (Raw Device Mapping), then the disk should only be assigned a host mode that is the same as the operating system of the virtual machine, even when running on VMware Hypervisor.

Unreliable access, errors, and performance problems will result if vCenter maps an RDM disk to a virtual machine that is part of a VMware host group with VMware host mode configured. This is because Windows and Linux use SCSI-3 version protocol and VMware uses SCSI-4 version protocol.

Linux-based OS (such as Red Hat Linux) or Windows Virtual Machine (VM) server hosts that use *virtual* disks and *not* RDM do not need any host group mapping because they are dependent on the VMware Hypervisor host for creating a virtual disk (VMDK file) from the VMFS file system residing on a Hypervisor-only data stores, because the VM disk files are ultimately VMware VMFS file system files and not actual disks.

To add VMware Hypervisor (not virtual machine) hosts to one host group, you must set this host mode and these HMOs for the host group:

▪ Host mode: 21 VMware Extension

▪ Host mode options: 2, 22, 25, 54, 63, 68, and 110 (for details, contact customer support)

Restrictions for VMware server hosts added to the host group:

Host mode	When to select this host mode
Do not attempt to set Windows or Linux HMO functions on a VMware Hypervisor, they cannot be used by VMware: ▪ Thin Provisioning ▪ Offloaded Data Transfer (ODX) The above functions are handled by the HMO 54 and 63 in the VMware host group instead.	

Host mode options for VSP G130, G/F350, G/F370, G/F700, G/F900

HMO	Function	Host mode	Description
2	VERITAS Database Edition/ Advanced Cluster	Any	Use this HMO when any of the following conditions is met: ▪ Windows Server Failover Clustering (WSFC) is used. ▪ Microsoft Failover Cluster (MSFC) is used. ▪ Linux with cluster configuration is used. ▪ Symantec Cluster Server (previously known as Veritas Cluster Server (VCS)) is used. ▪ The response for SPC-3 (Good Status) is required.
6	TPRLO	0C [(Deprecated) Windows] or 2C [Windows Extension]	Purpose: By default, PRLO is returned for TPRLO, however, LOGO might be expected under the following conditions. When this HMO is enabled, the storage system will switch the TPRLO response to LOGO from PRLO. Use this HMO when all these conditions are satisfied: ▪ An Emulex host bus adapter is used in a Windows environment. ▪ The mini-port driver is used. ▪ TPRLO=2 is specified for the mini-port driver parameter of the host bus adapter.
7	Automatic recognition function of LUN	Any	Use this HMO when you want the Unit Attention (UA) response to be returned at SCSI path change (sense code: REPORTED LUNS DATA HAS CHANGED). **Notes:**

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
			1. If the UA response occurs frequently and the host load becomes high, the data transfer cannot be started on the host side and timeout might occur. 2. When both HMO 07 and HMO 69 are enabled, the UA of HMO 69 is returned to the host.
12	No display for ghost LUN	03 [HP]	Use this HMO when you want to suppress creation of device files for devices to which paths are not defined.
13	SIM report at link failure	Any	Use this HMO when you want SIMs (SIM=2194XX) to be issued when the number of link failures detected between FC ports (such as SSB=B65C and DDA1) exceeds the threshold. **Notes:** 1. Enable HMO 13 only when requested to do so. 2. When you use this HMO, set this HMO on the host group 0 of the target port.
15	HACMP	0F [AIX]	Use this HMO when HACMP* or PowerHA® is used. * HACMP 4.5 version 4.5.0.13 or later, HACMP 5.1 version 5.1.0.4 or later, or HACMP 5.2 or later.
22	Improves MODE SENSE command response for a reserved volume	Any	Use this HMO when Veritas Cluster Server is used, or an OS or middleware that supports SPC-4 is used.
25	Support SPC-3 behavior on Persistent Reservation	Any	Use this HMO when one of these conditions is satisfied: ▪ Windows Server Failover Clustering (WSFC) is used. ▪ Microsoft Failover Cluster (MSFC) is used. ▪ Symantec Cluster Server (previously known as Veritas Cluster Server (VCS)) is used. ▪ There is no registered key to be deleted when running the PERSISTENT RESERVE OUT command.
39	Change the nexus specified in the SCSI Target Reset	Any	Use this HMO when you want to enable the host to set these ranges on all initiators in the host group, not only the initiator that issues the job resetting

HMO	Function	Host mode	Description
			when receiving Target Reset, such as in the IBM SVC connection environment: ▪ Range of job resetting. ▪ Range of UAs (Unit Attentions) defined.
40	V-Vol expansion	0C [(Deprecated) Windows] or 2C [Windows Extension]	Use this HMO when you want to automate recognition of the DP-VOL capacity after increasing the DP-VOL capacity. When a VMware, Linux, or Windows server is added to a host group, select VMware Extension for the host mode and then set the option to ON.
43	Queue Full Response	03 [HP]	Use this HMO when the command queue is full in your storage system connected to an HP-UX host, and you want to respond `Queue Full` (instead of `Busy`) from the storage system to the host.
51	Round Trip Set Up Option	Any	Use this HMO if you want to adjust the response time of the host I/O, for example when the distance between the MCU and RCU of the TrueCopy or global-active device pair is long (approximately 100 km) and point-to-point topology is used.
54	(VAAI) Support Option for the EXTENDED COPY command	01 [(Deprecated) VMware] or 21 [VMware Extension]	Use this HMO when the VAAI (vStorage API for Array Integration) function of VMware ESX/ESXi 4.1 or later is used. **Note:** After setting this HMO, perform the operation, such as the server reboot that reissues the **INQUIRY** command on the host side.
60	LUN0 Change Guard	03 [HP]	Use this HMO when HP-UX 11.31 is used, and you want to suppress the addition or deletion of LUN 0.
63	(VAAI) Support Option for the EXTENDED COPY command	01 [(Deprecated) VMware] or 21 [VMware Extension]	Use this HMO when you connect the storage system to VMware ESXi 5.0 or later and use the VAAI function for iSCSI T10. Use a combination of this HMO and HMO 54. **Note:** After setting this HMO, perform the operation, such as the server reboot that reissues the **INQUIRY** command on the host side.
68	Support Page Reclamation for Linux	00 [Standard], 01 [(Deprecated) VMware], or 21 [VMware Extension]	Use this HMO when using the Page Reclamation function with a Linux host. **Note:** After setting this HMO, perform the operation, such as the server reboot that reissues the **INQUIRY** command on the host side.

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
71	Change the Unit Attention for Blocked Pool-VOLs	Any	Use this HMO when you want to change the unit attention (UA) from NOT READY to MEDIUM ERROR while a DP pool is blocked.
73	Support Option for WS2012	0C [(Deprecated) Windows] or 2C [Windows Extension]	Use this HMO when using these functions provided by Windows Server 2012 (WS2012) or later with a Windows host running WS2012 or later: ▪ Thin Provisioning function ▪ Offload Data Transfer (ODX) function Use a combination of this HMO and HMO 114 when a VXIO driver with Veritas InfoScale 8.0 or later is used on the Windows OS host. **Note:** ▪ After setting this HMO, perform the operation, such as the server reboot that reissues the **INQUIRY** command on the host side. ▪ If both HMO 73 and HMO 110 are set, HMO 73 takes precedence over HMO 110.
78	The non-preferred path option	Any	Use this HMO when all these conditions are satisfied: ▪ Global-active device is used in the configuration with the data centers (Metro configuration). ▪ Hitachi Dynamic Link Manager (HDLM) is used as the alternative path software. ▪ The host group is on the non-optimized path of HDLM. ▪ The performance deterioration of I/O responses can be avoided without I/O using the non-optimized path of HDLM. **Caution:** If this HMO is set on the wrong host group, load balance of HDLM with the option cannot be performed intended operations, which may cause a performance issue.
80	Multi Text OFF Mode	Any	By using the iSCSI interface, if the storage system connects with the host of which OS is not supported of the Multi Text function. For instance, connecting the storage system and the host of RHEL5.0 which does not support the Multi Text-function.

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
82	Discovery CHAP Mode	21 [VMware Extension]	Select this option when the CHAP authentication is performed at the time of the discovery login in the iSCSI connection environment. For instance: When the CHAP authentication is performed at the time of the discovery login in the iSCSI environment of the VMware host and storage system
83	Report iSCSI Full Portal List Mode	21 [VMware Extension]	Use this HMO when all these conditions are met: ▪ Configuring alternate paths between the VMware host and storage system. ▪ Waiting for replying of the target information from the ports other than ports of discovery login. **Notes:** ▪ When this HMO is enabled, the same iSCSI target name and the same target number as the iSCSI target that receives the Send Target request are reported as the targets. For the target information that requires a portal list report, make sure that the iSCSI target name and the target number match with those of the iSCSI target under the port that receives the Send Target request. ▪ Set this HMO on all targets that require reporting.
88	Port consolidation	00 [Linux], 01 [(Deprecated) VMware], 03 [HP], 09 [Solaris], 0C [(Deprecated) Windows], 0F [AIX], 21 [VMware extension], 2C [Windows extension]	Use this HMO when converging multiple host-target ports used in the migration source storage system on one host group of the migration target storage system by enabling path definition from the host group to LDEVs of multiple virtual storage machines. ▪ Enabled: LUN path definition is enabled. ▪ Disabled: LUN path definition is disabled. This HMO setting is not supported when the HDLM or VxVM DMP multipath software is used. **Notes:**

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
			1. Apply this HMO when all the following conditions are met: - You are using the NDM or GAD function to migrate volumes in multiple migration source storage systems that use the same server. - You need to converge target ports used on the migration target storage system. - Host mode 00, 01 03, 09, 0C, 0F, 21, or 2C is used. 2. Do not apply this HMO to host groups without the specified host modes enabled. Applying this HMO to host groups with other host modes can cause the following problems: - Path addition from the server to the migration target storage system might fail. - Display of devices that the server recognizes might be invalid. 3. When using VMware NMP, use the same LUN# for the migration source and migration target. 4. If a LUN path is defined from the host group to an LDEV defined in a virtual storage machine different from the one to which the host group belongs, this HMO cannot be set to OFF.
91	Disable I/O wait for OpenStack Option	00 [Standard]	Use this HMO when manually creating host groups or iSCSI targets that are used as the I/O data paths for OpenStack.
94	Disable initiator function on port	Any	Use this HMO when prompted to set this option while using an SAN Boot system in a configuration connecting to a specific host. For example, this HMO is used to configure a SAN Boot system by directly connecting the Fibre Channel channel board on the storage system to the Broadcom (Emulex) 16-Gbps or 32-Gbps Fibre Channel HBA that supports the connection to the storage system. **Note:** For details about the conditions of the supported connection configuration, contact customer support. After you set this option, do not use the port for an external storage connection or a remote copy connection.

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
			Note: This HMO option setting can be specified for each port. Set this HMO to host group 0 of the target port.
96	Change the nexus specified in the SCSI Logical Unit Reset	Any	Use this HMO when you want to enable the host to set these ranges on all initiators in the host group, not only the initiator that issues the job resetting when receiving an LU Reset, such as in the IBM SVC connection environment: ▪ Range of job resetting. ▪ Range of UAs (Unit Attentions) defined.
97	Proprietary ANCHOR command support	00 [Standard]	Do not enable HMO 97 when connecting with Hitachi NAS Platform (HNAS). This setting does not enable any HNAS functionality at this time. **Note:** This HMO was intended to be used only for NAS but was never implemented in NAS software, and therefore it is currently not supported by NAS and should not be used.
102	(GAD) Standard Inquiry Expansion for Hitachi Command Suite	0C [(Deprecated) Windows], 2C [Windows Extension], or 0F [AIX]	Use this HMO when all these conditions are satisfied: ▪ The OS of the host is Windows or AIX $^®$ and the MPIO function is used. ▪ Global-active device (GAD) or nondisruptive migration (NDM) is used. ▪ Hitachi Device Manager (HDvM) Agent is used.
105	Task Set Full response in the event of I/O overload	0C [(Deprecated) Windows] or 2C [Windows Extension]	Use this HMO when you want to return Task Set Full response from the storage system to the host when an overload of I/Os occurs on the storage system.
109	Change FLOGI TOV on port	Any	Use this HMO when prompted to set this option while using an SAN Boot system in a configuration connecting to a specific host. **Note:** For details about the conditions of the supported connection configuration, contact customer support. After you set this option, do not use the port for external storage connection or remote copy connection. **Note:** This HMO option setting can be specified for each port. Set this HMO to host group 0 of the target port.

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
110	ODX support for WS2012	01 [(Deprecated) [VMware], 21 [VMware Extension], 0C [(Deprecated) Windows] or 2C [Windows Extension]	Use this HMO when ODX (Offloaded Data Transfer) provided by Windows Server 2012 or later is used, in the environment with which the WS2012 or later host connects. **Note:** After setting this HMO, perform the operation, such as the server reboot that reissues the `INQUIRY` command on the host side.
113	iSCSI CHAP Authentication Log	Any	Use this HMO when the result of the CHAP authentication is output to the audit log (DKC). **Notes:** 1. When you use this HMO, set this HMO on the host group 0. 2. The setting of this HMO applies to all iSCSI targets on the port. Therefore, set this HMO only in iSCSI target 00 of the port.
114	The automatic asynchronous reclamation on ESXi 6.5 or later	01 [(Deprecated) [VMware] ,21 [VMware Extension], 0C [(Deprecated) Windows], or 2C [Windows Extension]	If either of the following conditions is met: • Use a combination of this HMO and HMO 63 when connecting to VMware ESXi 6.5 or later, and when using the zero data page reclamation function, which is performed automatically if files on the VMFS (Virtual Machine File System) are deleted. • Use a combination of this HMO and HMO 73 when a VXIO driver with Veritas InfoScale 8.0 or later is used on the Windows OS host. **Note:** After setting this HMO, perform the operation, such as the server reboot, that reissues the `INQUIRY` command on the host side.
122	Task Set Full response after reaching QoS upper limit	01 [(Deprecated) VMware], 21 [VMware Extension], 0C [(Deprecated) Windows], 2C [Windows Extension], or 00 [Standard]	Use this HMO when a Windows/Linux/VMware host is connected, and when the QoS upper limit is reached, if you want to return a TASK SET FULL response to the host in order not to retain an I/O inside the storage system. **Note:** If this option is set for a host other than a Windows/Linux/VMware host, an I/O might not be issued from the host.

Appendix D: Host modes and host mode options

Host modes and HMOs for VSP G200, G/F400, G/F600, G/F800

Host modes for VSP G200, G400, G600, G800 and VSP F400, F600, F800

Host mode	When to select this host mode
00 [Standard]	When registering Red Hat Linux server hosts or IRIX server hosts in the host group. HMOs specific to this host mode: 68, 88, 91 HMOs available to this host mode: 2, 7, 13, 22, 39, 51, 71, 78, 80, 96, 113
01 [(Deprecated) VMware]	Do not select this host mode. Select host mode 21 VMware Extension instead. HMOs specific to this host mode: 54, 63, 68, 88, 110, 114, 122 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: See host mode 21 [VMware Extension] in this table.
03 [HP]	When registering HP-UX server hosts in the host group. HMOs specific to this host mode: 12, 33, 43, 60, 88 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 12, 22, 25, 60
09 [Solaris]	When registering Solaris server hosts in the host group. HMO specific to this host mode: 88 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 22, 25
0C [(Deprecated) Windows]	Do not select this host mode. Select host mode 2C Windows Extension instead. HMOs specific to this host mode: 6, 40, 73, 88, 105, 110, 114, 122 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: See host mode 2C [Windows Extension] in this table.
0F [AIX]	When registering AIX $^®$ server hosts in the host group. HMOs specific to this host mode: 15, 88 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113, 124 HMO best practice recommendations: 2, 15, 22, 25 When host mode 0F AIX $^®$ is set, NACA (Normal Auto Contingent Allegiance) is enabled automatically. To ensure that the host responds correctly to a port with host mode 0F AIX enabled:

Appendix D: Host modes and host mode options

Host mode	When to select this host mode
	1. Shut down the host to be connected to the port. 2. Set the host mode on the port to 0F AIX, and enable the desired HMOs. 3. Connect the cables from the host to the port. 4. Boot the host. **Caution:** If the host mode of a port is changed to 0F AIX and the host had already recognized the Inquiry response for an LDEV on the port before host mode 0F AIX was set, the host might experience loss of device access (LDEV or LU). The host must be rebooted after the host mode is changed to 0F AIX to recognize the change in the response to the standard inquiry.
21 [VMware Extension]	When registering VMware server hosts in the host group.* HMOs specific to this host mode: 54, 63, 68, 82, 83, 88, 110, 114, 122 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 22, 25, 54, 63, 68, 110
2C [Windows Extension]	When registering Windows server hosts in the host group.* HMOs specific to this host mode: 6, 40, 73, 88, 105, 110, 114, 122 HMOs available to this host mode: 2, 7, 13, 22, 25, 39, 71, 78, 80, 96, 97, 113 HMO best practice recommendations: 2, 22, 25, 40, 110

Host mode options for VSP G200, G400, G600, G800 and VSP F400, F600, F800

HMO	Function	Host mode	Description
2	VERITAS Database Edition/ Advanced Cluster	Any	Use this HMO when any of the following conditions is met: ▪ Windows Server Failover Clustering (WSFC) is used. ▪ Microsoft Failover Cluster (MSFC) is used. ▪ Linux with cluster configuration is used. ▪ Symantec Cluster Server (previously known as Veritas Cluster Server (VCS)) is used. ▪ The response for SPC-3 (Good Status) is required.
6	TPRLO	0C [(Deprecated) Windows] or 2C [Windows Extension]	Purpose: By default, PRLO is returned for TPRLO, however, LOGO might be expected under the following conditions. When this HMO is enabled, the storage system will switch the TPRLO response to LOGO from PRLO.

HMO	Function	Host mode	Description
			Use this HMO when all these conditions are satisfied: ▪ An Emulex host bus adapter is used in a Windows environment. ▪ The mini-port driver is used. ▪ TPRLO=2 is specified for the mini-port driver parameter of the host bus adapter.
7	Automatic recognition function of LUN	Any	Use this HMO when you want the Unit Attention (UA) response to be returned at SCSI path change (sense code: REPORTED LUNS DATA HAS CHANGED). **Notes:** 1. If the UA response occurs frequently and the host load becomes high, the data transfer cannot be started on the host side and timeout might occur. 2. When both HMO 07 and HMO 69 are enabled, the UA of HMO 69 is returned to the host.
12	No display for ghost LUN	03 [HP]	Use this HMO when you want to suppress creation of device files for devices to which paths are not defined.
13	SIM report at link failure	Any	Use this HMO when you want SIMs (SIM=2194XX) to be issued when the number of link failures detected between FC ports (such as SSB=B65C and DDA1) exceeds the threshold. **Notes:** 1. Enable HMO 13 only when requested to do so. 2. When you use this HMO, set this HMO on the host group 0 of the target port.
15	HACMP	0F [AIX]	Use this HMO when HACMP* or PowerHA® is used. * HACMP 4.5 version 4.5.0.13 or later, HACMP 5.1 version 5.1.0.4 or later, or HACMP 5.2 or later.
22	Improves MODE SENSE command response for a reserved volume	Any	Use this HMO when any of these conditions is satisfied: ▪ Veritas Cluster Server is used. ▪ An OS or middleware that supports SPC-4 is used. ▪ A single-site or GAD dual-site Clustered VMDK configuration is used.

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
			Notes:
			1. By applying HMO 22, the volume status (reserved / non-reserved) will be checked more frequently.
			2. By applying HMO 22, the host OS will not be receiving warning messages when the MODE SENSE command is being issued to a reserved volume.
25	Support SPC-3 behavior on Persistent Reservation	Any	Use this HMO when one of these conditions is satisfied: ▪ Windows Server Failover Clustering (WSFC) is used. ▪ Microsoft Failover Cluster (MSFC) is used. ▪ Symantec Cluster Server (previously known as Veritas Cluster Server (VCS)) is used. ▪ There is no registered key to be deleted when running the PERSISTENT RESERVE OUT command.
39	Change the nexus specified in the SCSI Target Reset	Any	Use this HMO when you want to enable the host to set these ranges on all initiators in the host group, not only the initiator that issues the job resetting when receiving Target Reset, such as in the IBM SVC connection environment: ▪ Range of job resetting. ▪ Range of UAs (Unit Attentions) defined.
40	V-Vol expansion	0C [(Deprecated) Windows] or 2C [Windows Extension]	Use this HMO when you want to automate recognition of the DP-VOL capacity after increasing the DP-VOL capacity. When a VMware, Linux, or Windows server is added to a host group, select VMware Extension for the host mode and then set the option to ON.
43	Queue Full Response	03 [HP]	Use this HMO when the command queue is full in your storage system connected to an HP-UX host, and you want to respond `Queue Full` (instead of `Busy`) from the storage system to the host.

HMO	Function	Host mode	Description
51	Round Trip Set Up Option	Any	Use this HMO if you want to adjust the response time of the host I/O, for example when the distance between the MCU and RCU of the TrueCopy or global-active device pair is long (approximately 100 km) and point-to-point topology is used.
51	Round Trip Set Up Option	Any	Use this HMO if you want to adjust the response time of the host I/O, for example when the distance between the primary and secondary storage systems in the TrueCopy or global-active device pair is long (approximately 100 km) and point-to-point topology is used.
54	(VAAI) Support Option for the EXTENDED COPY command	01 [(Deprecated) VMware] or 21 [VMware Extension]	Use this HMO when the VAAI (vStorage API for Array Integration) function of VMware ESX/ESXi 4.1 or later is used. **Note:** After setting this HMO, perform the operation, such as the server reboot that reissues the `INQUIRY` command on the host side.
60	LUN0 Change Guard	03 [HP]	Use this HMO when HP-UX 11.31 is used, and you want to suppress the addition or deletion of LUN 0.
63	(VAAI) Support Option for the EXTENDED COPY command	01 [(Deprecated) VMware] or 21 [VMware Extension]	Use this HMO when you connect the storage system to VMware ESXi 5.0 or later and use the VAAI function for iSCSI T10. Use a combination of this HMO and HMO 54. **Note:** After setting this HMO, perform the operation, such as the server reboot that reissues the `INQUIRY` command on the host side.
68	Support Page Reclamation for Linux	00 [Standard], 01 [(Deprecated) VMware], or 21 [VMware Extension]	Use this HMO when using the Page Reclamation function with a Linux host. **Note:** After setting this HMO, perform the operation, such as the server reboot that reissues the `INQUIRY` command on the host side.
71	Change the Unit Attention for Blocked Pool-VOLs	Any	Use this HMO when you want to change the unit attention (UA) from `NOT READY` to `MEDIUM ERROR` while a DP pool is blocked.
72	AIX GPFS Support		When using General Parallel File System (GPFS) in the storage system connecting to the AIX® host.

HMO	Function	Host mode	Description
73	Support Option for WS2012	0C [(Deprecated) Windows] or 2C [Windows Extension]	Use this HMO when using these functions provided by Windows Server 2012 (WS2012) or later with a Windows host running WS2012 or later: ▪ Thin Provisioning function ▪ Offload Data Transfer (ODX) function Use a combination of this HMO and HMO 114 when a VXIO driver with Veritas InfoScale 8.0 or later is used on the Windows OS host. **Note:** ▪ After setting this HMO, perform the operation, such as the server reboot that reissues the `INQUIRY` command on the host side. ▪ If both HMO 73 and HMO 110 are set, HMO 73 takes precedence over HMO 110.
78	The non-preferred path option	Any	Use this HMO when all these conditions are satisfied: ▪ Global-active device is used in the configuration with the data centers (Metro configuration). ▪ Hitachi Dynamic Link Manager (HDLM) is used as the alternative path software. ▪ The host group is on the non-optimized path of HDLM. ▪ The performance deterioration of I/O responses can be avoided without I/O using the non-optimized path of HDLM. **Caution:** If this HMO is set on the wrong host group, load balance of HDLM with the option cannot be performed intended operations, which may cause a performance issue.
80	Multi Text OFF Mode	Any	By using the iSCSI interface, if the storage system connects with the host of which OS is not supported of the Multi Text function. For instance, connecting the storage system and the host of RHEL5.0 which does not support the Multi Text-function.

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
82	Discovery CHAP Mode	21 [VMware Extension]	Select this option when the CHAP authentication is performed at the time of the discovery login in the iSCSI connection environment. For instance: When the CHAP authentication is performed at the time of the discovery login in the iSCSI environment of the VMware host and storage system
83	Report iSCSI Full Portal List Mode	21 [VMware Extension]	Use this HMO when all these conditions are met: ▪ Configuring alternate paths between the VMware host and storage system. ▪ Waiting for replying of the target information from the ports other than ports of discovery login. **Notes:** ▪ When this HMO is enabled, the same iSCSI target name and the same target number as the iSCSI target that receives the Send Target request are reported as the targets. For the target information that requires a portal list report, make sure that the iSCSI target name and the target number match with those of the iSCSI target under the port that receives the Send Target request. ▪ Set this HMO on all targets that require reporting.
88	Port consolidation	00 [Linux], 01 [(Deprecated) VMware], 03 [HP], 09 [Solaris], 0C [(Deprecated) Windows], 0F [AIX], 21 [VMware extension], 2C [Windows extension]	Use this HMO when converging multiple host-target ports used in the migration source storage system on one host group of the migration target storage system by enabling path definition from the host group to LDEVs of multiple virtual storage machines. ▪ Enabled: LUN path definition is enabled. ▪ Disabled: LUN path definition is disabled. This HMO setting is not supported when the HDLM or VxVM DMP multipath software is used. **Notes:**

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
			1. Apply this HMO when all the following conditions are met: - You are using the NDM or GAD function to migrate volumes in multiple migration source storage systems that use the same server. - You need to converge target ports used on the migration target storage system. - Host mode 00, 01 03, 09, 0C, 0F, 21, or 2C is used. **2.** Do not apply this HMO to host groups without the specified host modes enabled. Applying this HMO to host groups with other host modes can cause the following problems: - Path addition from the server to the migration target storage system might fail. - Display of devices that the server recognizes might be invalid. **3.** When using VMware NMP, use the same LUN# for the migration source and migration target. **4.** If a LUN path is defined from the host group to an LDEV defined in a virtual storage machine different from the one to which the host group belongs, this HMO cannot be set to OFF.
91	Disable I/O wait for OpenStack Option	00 [Standard]	Use this HMO when manually creating host groups or iSCSI targets that are used as the I/O data paths for OpenStack.
96	Change the nexus specified in the SCSI Logical Unit Reset	Any	Use this HMO when you want to enable the host to set these ranges on all initiators in the host group, not only the initiator that issues the job resetting when receiving an LU Reset, such as in the IBM SVC connection environment: ▪ Range of job resetting. ▪ Range of UAs (Unit Attentions) defined.
97	Proprietary ANCHOR command support	00 [Standard]	Do not enable HMO 97 when connecting with Hitachi NAS Platform (HNAS). This setting does not enable any HNAS functionality at this time. **Note:** This HMO was intended to be used only for NAS but was never implemented in NAS software, and therefore it is currently not supported by NAS and should not be used.

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
105	Task Set Full response in the event of I/O overload	0C [(Deprecated) Windows] or 2C [Windows Extension]	Use this HMO when you want to return Task Set Full response from the storage system to the host when an overload of I/Os occurs on the storage system.
113	iSCSI CHAP Authentication Log	Any	Use this HMO when the result of the CHAP authentication is output to the audit log (DKC). **Notes:** 1. When you use this HMO, set this HMO on the host group 0. 2. The setting of this HMO applies to all iSCSI targets on the port. Therefore, set this HMO only in iSCSI target 00 of the port.
114	The automatic asynchronous reclamation on ESXi 6.5 or later	01 [(Deprecated) [VMware] ,21 [VMware Extension], 0C [(Deprecated) Windows], or 2C [Windows Extension]	If either of the following conditions is met: ▪ Use a combination of this HMO and HMO 63 when connecting to VMware ESXi 6.5 or later, and when using the zero data page reclamation function, which is performed automatically if files on the VMFS (Virtual Machine File System) are deleted. ▪ Use a combination of this HMO and HMO 73 when a VXIO driver with Veritas InfoScale 8.0 or later is used on the Windows OS host. **Note:** After setting this HMO, perform the operation, such as the server reboot, that reissues the `INQUIRY` command on the host side.

Host modes and host mode options for HUS VM

Host Modes for HUS VM

Host mode	When to select this mode
00 Standard	When registering Red Hat Linux server hosts or IRIX server hosts in the host group.
01 VMware	When registering VMware server hosts in the host group (see *Notes*).
03 HP	When registering HP-UX server hosts in the host group.
09 Solaris	When registering Solaris server hosts in the host group.

Appendix D: Host modes and host mode options

Host mode	When to select this mode
0C Windows	When registering Windows server hosts in the host group (see *Notes*).
0F AIX	When registering AIX® server hosts in the host group
21 VMware Extension	When registering VMware server hosts in the host group (see *Notes*).
2C Windows Extension	When registering Windows server hosts in the host group (see *Notes*).

Notes:

- If Windows server hosts are registered in a host group, ensure that the host mode of the host group is 0C Windows or 2C Windows Extension.

  If the host mode of a host group is 0C Windows and an LU path is defined between the host group and a logical volume, the logical volume cannot be combined with other logical volumes to form a LUSE volume (that is, an expanded LU).

  If the host mode of a host group is 2C Windows Extension and an LU path is defined between the host group and a logical volume, the logical volume can be combined with other logical volumes to form a LUSE volume (that is, an expanded LU). If you plan to expand LUs by using LUSE in the future, set the host mode 2C Windows Extension.

- If VMware server hosts are registered in a host group, ensure that the host mode of the host group is 01 VMware or 21 VMware Extension.

  If the host mode of a host group is 01 VMware and an LU path is defined between the host group and a logical volume, the logical volume cannot be combined with other logical volumes to form a LUSE volume (that is, an expanded LU).

  If the host mode of a host group is 21 VMware Extension and an LU path is defined between the host group and a logical volume, the logical volume can be combined with other logical volumes to form a LUSE volume (that is, an expanded LU). If you plan to expand LUs by using LUSE in the future, set the host mode 21 VMware Extension.

- If you plan to expand LUs by using LUSE in case of Windows virtual host on VMware recognizing LU by Raw Device Mapping (RDM) method, set the host mode 2C Windows Extension. If the host mode 2C Windows Extension is not set, change the host mode to 2C. Before changing the host mode, back up the LUSE volume. After changing the mode, restore the LUSE volume.

Host Mode Options for HUS VM

HMO	Function	When to select this option
2	Test Unit Ready (TUR) response	When one of these conditions is satisfied: - Windows Server Failover Clustering (WSFC) is used. - Microsoft Failover Cluster (MSFC) is used. - Linux with cluster configuration is used.

HMO	Function	When to select this option
		▪ Symantec Cluster Server (previously known as Veritas Cluster Server (VCS)) is used. ▪ The response for SPC-3 (Good Status) is required.
6	TPRLO (Third-party process layout)	Use when all the following conditions are satisfied: ▪ The host mode *0C Windows* or *2C Windows Extension* is used ▪ The Emulex host bus adapter is used ▪ The mini-port driver is used ▪ TPRLO=2 is specified for the mini-port driver parameter of the host bus adapter
7	Automatic recognition function of LUN	Use when all the following conditions are satisfied: ▪ The host mode *00 Standard* or *09 Solaris* is used. ▪ SUN StorEdge SAN Foundation Software Version 4.2 or higher is used ▪ You want to automate recognition of increase and decrease of devices when genuine SUN HBA is connected. Enable this HMO when connected to Hitachi NAS Platform version 12.5 or later. *Note*: When you use Hitachi Ops Center Administrator(Administrator) to allocate storage to the NAS modules on ports 1A and 2A, this HMO is enabled automatically.
12	No display for ghost LUN	Use when all the following conditions are satisfied: ▪ The host mode *03 HP* is used. ▪ You want to suppress creation of device files for devices to which paths are not defined.
13	SIM report at link failure1	Use when you want to be informed by SIM (service information message) that the number of link failures detected between ports exceeds the threshold.
15	HACMP/PowerHA®	Use when all the following conditions are satisfied: ▪ The host mode *0F AIX* is used. ▪ HACMP* or PowerHA® is used. * HACMP 4.5 version 4.5.0.13 or later, HACMP 5.1 version 5.1.0.4 or later, or HACMP 5.2 or later.

Appendix D: Host modes and host mode options

HMO	Function	When to select this option
22	Veritas Cluster Server Oracle Solaris Cluster (Sun Cluster)	Use when Veritas Cluster Server is used. Use when Oracle Solaris Cluster (Sun Cluster) is used.
39	Change the nexus specified in the SCSI Target Reset	When you want to control the following ranges per host group when receiving Target Reset: ▪ Range of job resetting. ▪ Range of UAs (Unit Attentions) defined.
40	V-VOL expansion	When all of the following conditions are satisfied: ▪ The host mode *0C Windows* or *2C Windows Extension* is used ▪ You want to automate recognition of the DP-VOL capacity after increasing the DP-VOL capacity.
41	Prioritized device recognition command	When you want to execute commands to recognize the device preferentially.
42	Prevent "OHUB PCI retry"	When IBM Z10 Linux is used.
43	Queue Full Response	When the command queue is full in the HUS VM storage system connecting with the HP-UX host, and if you want to respond Queue Full, instead of Busy, from the storage system to the host.
48	HAM S-VOL Read	When you do not want to generate the failover from MCU to RCU, and when the applications that issue the Read commands more than the threshold to S-VOL of the pair made with High Availability Manager are performed.
49	BB Credit Set Up Option1[3]	When you want to adjust the number of buffer-to-buffer credits (BBCs) to control the transfer data size by the Fibre Channel, for example when the distance between MCU and RCU of the TrueCopy pair is long (approximately 100 kilometers) and the Point-to-Point topology is used. Use the combination of this host mode option and the host mode option 50.
50	BB Credit Set Up Option2[3]	When you want to adjust the number of buffer-to-buffer credits (BBCs) to control the transfer data size by the Fibre Channel, for example when the distance between MCU and RCU of the TrueCopy pair is long (approximately 100 kilometers) and the Point-to-Point topology is used. Use the combination of this host mode option and the host mode option 49.

Appendix D: Host modes and host mode options

HMO	Function	When to select this option
51	Round Trip Set Up Option[3]	If you want to adjust the response time of the host I/O, for example when the distance between MCU and RCU of the TrueCopy pair is long (approximately 100 kilometers) and the Point-to-Point topology is used. *Note*: Set host mode option 51 for both ports on MCU and RCU.
52	HAM and Cluster software for SCSI-2 Reserve	When a cluster software using the SCSI-2 reserve is used in the High Availability Manager environment.
54	(VAAI) Support Option for the EXTENDED COPY command	When the VAAI (vStorage API for Array Integration) function of VMware ESX/ESXi 4.1 is used.
57	HAM response change	When you use *0C Windows*, *2C Windows Extension* , *01 VMware*, or *21 VMware Extension* as the host mode in the High Availability Manager environment.
60	LUN0 Change Guard	When HP-UX 11.31 is used, and when you want to prevent adding or deleting of LUN0.
61	Expanded Persistent Reserve Key	Increases Reservation Keys from 128 to 2,048.
63	(VAAI) Support Option for vStorage APIs based on T10 standards	When you connect the storage system to VMware ESXi 5.0 and use the VAAI function for T10.
67	Change of the ED_TOV value	When the OPEN Fibre Channel port configuration applies to following: ▪ The topology is the Fibre Channel direct connection. ▪ The port type is *Target* or *RCU Target*.
68	Support Page Reclamation for Linux	When using the Page Reclamation function from the environment which is being connected to the Linux host. When connected to Hitachi NAS Platform to allow the NAS host to retrieve thin provisioning information and support the SCSI UNMAP command. *Note*: When you use Hitachi Ops Center Administrator(Administrator) to allocate storage to the NAS modules on ports 1A and 2A, this HMO is enabled automatically.
69	Online LUSE expansion	When you want the host to be notified of expansion of LUSE volume capacity.

Appendix D: Host modes and host mode options

HMO	Function	When to select this option
71	Change the Unit Attention for Blocked Pool-VOLs	When you want to change the unit attention (UA) from *NOT READY* to *MEDIUM ERROR* during the pool-VOLs blockade.
72	AIX GPFS Support	When using General Parallel File System (GPFS) in the HUS VM storage system connecting to the AIX® host.
73	Support Option for WS2012	When using the following functions provided by Windows Server 2012 (WS2012) from an environment which is being connected to the WS2012: ▪ Thin Provisioning function ▪ Offload Data Transfer (ODX) function
Notes:		
1. Configure these host mode options only when requested to do so.		
2. Host mode options 49, 50, and 51 are enabled only for the HF8G package.		

Replication port host mode options

The following host mode options should only be set on the host group configured on ports designated for replication. When applied to the host group of ports designated for replication, these HMOs will cause a link down and up event. Therefore, it is recommended to apply these HMOs prior to putting the link in production. Furthermore, all supported VSP 5000 series operating systems can send traffic through the designated replication link when these HMOs are enabled on the host group of the designated replication ports. Ensure that the desired HMOs are set on the host group of both the source and the destination designated replication group.

To keep the configuration simple, administrators are advised to simply set these HMOs on the default host group of the ports designated for replication and to keep LUN security turned off. If you must enable LUN security, then you must create an arbitrary host group on the designated replication port, register the WWPN of the desired remote array replication port to the host group, apply the desired host mode options to this host group, and turn LUN security on. To delete this arbitrary host group, first set the disable the host mode option on the host group.

HMO	Function	Host mode	Description
49	16GFC CHA	Any	Set this HMO only on your 16GFC CHA ports. Do not set this HMO on your 32GFC CHA ports.

Appendix D: Host modes and host mode options

HMO	Function	Host mode	Description
50	16GFC CHA	Any	Set this HMO only on your 16GFC CHA ports. Do not set this HMO on your 32GFC CHA ports.
51	Round Trip Set Up Option	Any	Use this HMO if you want to adjust the response time of the host I/O, for example when the distance between the primary and secondary storage systems in the TrueCopy or global-active device pair is long (approximately 100 km) and point-to-point topology is used.

Appendix D: Host modes and host mode options