# HP 6400/8400 Enterprise Virtual Array User Guide


## Abstract

This document describes the components and operation of the HP 6400/8400 Enterprise Virtual Array.



HP Part Number: 5697-2479
Published: September 2013
Edition: 9

### Warranty

WARRANTY STATEMENT: To obtain a copy of the warranty for this product, see the warranty information website:

http://www.hp.com/go/storagewarranty

### Acknowledgements

# Contents

# 1 EVA6400/8400 hardware

The EVA6400/8400 contains the following hardware components:

- HSV controllers—Contains power supplies, cache batteries, fans, and an operator control panel (OCP)
- Fibre Channel disk enclosure—Contains disk drives, power supplies, fans, midplane, and I/O modules
- Fibre Channel Arbitrated Loop cables—Provides connectivity to the HSV controllers and the Fibre Channel disk enclosures
- Rack—Several free standing racks are available

## M6412A disk enclosures

The M6412A disk enclosure contains the disk drives used for data storage; a storage system contains multiple disk enclosures. The major components of the enclosure are:

- 12-bay enclosure
- Dual-loop, Fibre Channel drive enclosure I/O modules
- Copper Fibre Channel cables
- Fibre Channel disk drives and drive blanks
- Power supplies
- Fan modules

### Enclosure layout

The disk drives mount in bays in the front of the enclosure. The bays are numbered sequentially from top to bottom and left to right. A drive is referred to by its bay number (see Figure 1 (page 9)). Enclosure status indicators are located at the right of each disk. Figure 2 (page 9) shows the front and Figure 3 (page 10) shows the rear view of the disk enclosure.

**Figure 1 Disk drive bay numbering**

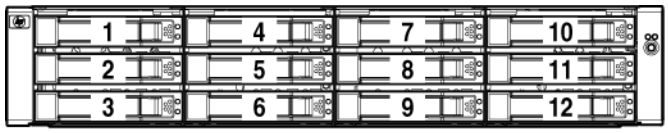


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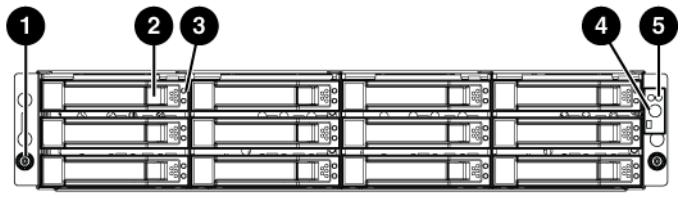
**Figure 2 Disk enclosure front view without bezel ears**

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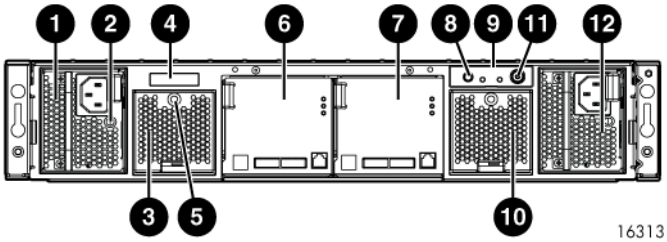
1. Rack-mounting thumbscrew
2. Disk drive release
3. Drive LEDs
4. UID push button
5. Enclosure status LEDs

### Figure 3 Disk enclosure rear view



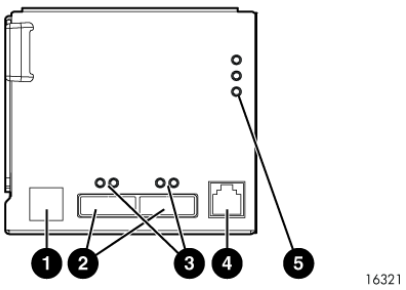

1. Power supply 1
2. Power supply 1 status LED
3. Fan 1
4. Enclosure product number and serial number
5. Fan 1 status LED
6. I/O module A
7. I/O module B
8. Rear UID push button
9. Enclosure status LEDs
10. Fan 2
11. Power push button
12. Power supply 2

## I/O modules

Two I/O modules provide the interface between the disk enclosure and the host controllers, (Figure 4 (page 10)). For redundancy, only dual-controller, dual-loop operation is supported. Each controller is connected to both I/O modules in the disk enclosure.

Each I/O module has two ports that can transmit and receive data for bidirectional operation. Activating a port requires connecting a Fibre Channel cable to the port. The port function depends upon the loop.

### Figure 4 I/O module detail




1. Double 7–segment display: enclosure ID
2. 4 Gb I/O ports
3. Port 1 (P1), Port 2 (P2) status LEDs
4. Manufacturing diagnostic port
5. I/O module status LEDs

## I/O module status indicators

There are five status indicators on the I/O module. See Figure 4 (page 10). The status indicator states for an operational I/O module are shown in Table 1 (page 11). Table 2 (page 11) shows the status indicator states for a non-operational I/O module.

### Table 1 Port status LEDs

| Status LED | Description |
|---|---|
| Green (left) | • Solid green— Active link<br>• Flashing green—Locate, remotely asserted by application client |
| Amber (right) | • Solid amber—Module fault, no synchronization<br>• Flashing amber—Module fault |

### Table 2 I/O module status LEDs

| Status LED | Description |
|---|---|
| UID | • Locate<br>• Flashing blue—Remotely asserted by application client |
| | • Module health indicator<br>• Flashing green—I/O module powering up.<br>• Solid green—Normal operation<br>• Green off—Firmware malfunction |
| ⚠ | • Fault indicator<br>• Flashing amber—Warning condition (not visible when solid amber showing)<br>• Solid amber—Replace FRU<br>• Amber off—Normal operation |

## Fiber optic Fibre Channel cables

The Enterprise Virtual Array uses orange, 50-µm, multi-mode, fiber optic cables for connection to the SAN or the host, where there is a direct connection to the host. The fiber optic cable assembly consists of two 2-m fiber optic strands and small form-factor connectors on each end. See Figure 5 (page 12).

To ensure optimum operation, the fiber optic cable components require protection from contamination and mechanical hazards. Failure to provide this protection can cause degraded operation. Observe the following precautions when using fiber optic cables.

- To avoid breaking the fiber within the cable:
  - Do not kink the cable
  - Do not use a cable bend-radius of less than 30 mm (1.18 inch)
- To avoid deforming, or possibly breaking the fiber within the cable, do not place heavy objects on the cable.
- To avoid contaminating the optical connectors:
  - Do not touch the connectors
  - Never leave the connectors exposed to the air
  - Install a dust cover on each transceiver and fiber cable connector when they are disconnected

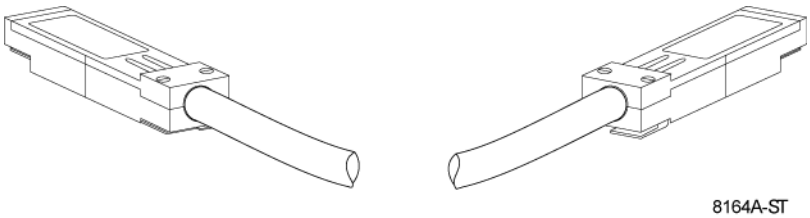
If an open connector is exposed to dust, or if there is any doubt about the cleanliness of the connector, clean the connector as described in "Handling fiber optic cables" (page 43).

**Figure 5 Fiber Optic Fibre Channel cable**


## Copper Fibre Channel cables

The Enterprise Virtual Array uses copper Fibre Channel cables to interconnect disk shelves. The cables are available in 0.6-meter (1.97 ft.) and 2.0-meter (6.56 ft.) lengths. Copper cables provide performance comparable to fiber optic cables. Copper cable connectors differ from fiber optic small form-factor connectors (see Figure 6 (page 12)).

**Figure 6 Copper Fibre Channel cable**




## Fibre Channel disk drives

The Fibre Channel disk drives are hot-pluggable and include the following features:

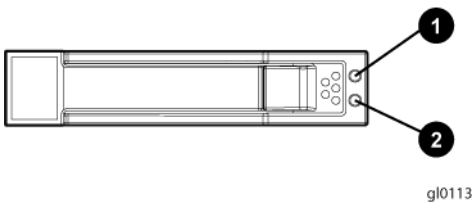
- Dual-ported 4 Gbps Fibre Channel controller interface that allows up to 96 disk drives to be supported per array controller enclosure
- Compact, direct-connect design for maximum storage density and increased reliability and signal integrity
- Both online high-performance disk drives and FATA disk drives supported in a variety of capacities and spindle speeds
- Better vibration damping for improved performance

Up to 12 disk drives can be installed in a drive enclosure.

### Disk drive status indicators

Two status indicators display drive operational status. Figure 7 (page 12) identifies the disk drive status indicators. Table 3 (page 13) describes them.

**Figure 7 Disk status indicators**




1. Bi-color (amber/blue)
2. Green

**Table 3 Disk status indicator LED descriptions**

| Drive LED | Description |
|---|---|
| Bi-color (top) | • Slow flashing blue (0.5 Hz)—Used to locate drive.<br>• Solid amber—Drive fault. |
| Green (bottom) | • Flashing—Drive is spinning up or down and is not ready.<br>• Solid—Drive is ready to perform I/O operations.<br>• Flickering—Indicates drive activity. |

### Disk drive blank

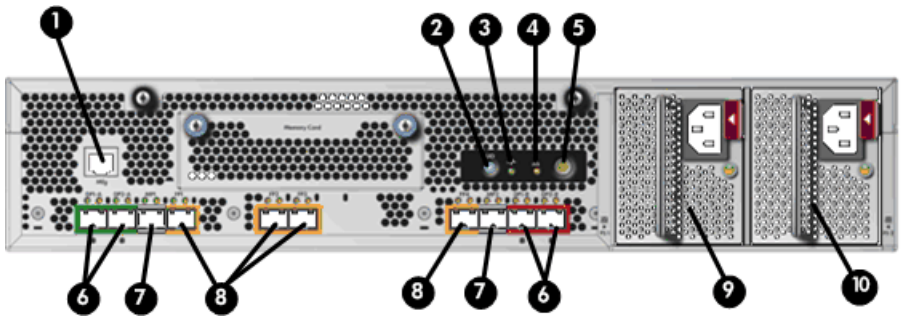
To maintain the proper enclosure air flow, a disk drive or a disk drive blank must be installed in each drive bay. The disk drive blank maintains proper airflow within the disk enclosure.

## Controller enclosures

This section describes the major features, purpose, and function of the HSV400 and HSV450 controllers. Each Enterprise Virtual Array has a pair of these controllers. Figure 8 (page 13) shows the HSV400 controller rear view and Figure 9 (page 14) shows the HSV450 controller rear view. The front of the HSV400 and HSV450 is shown in Figure 10 (page 14).

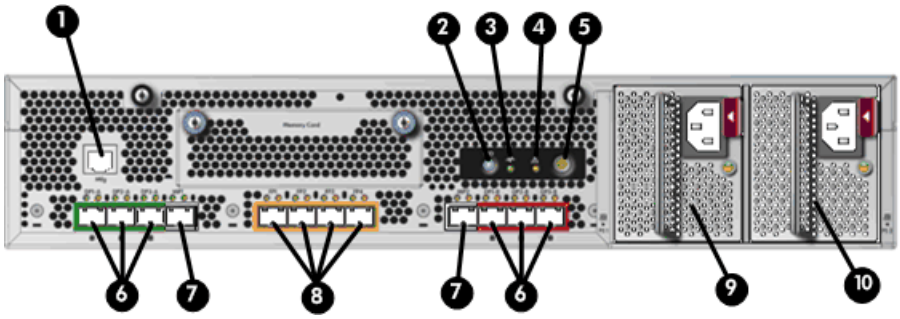
**NOTE:** Some controller enclosure modules have a cache battery located behind the OCP.

**Figure 8 HSV400 controller rear view**



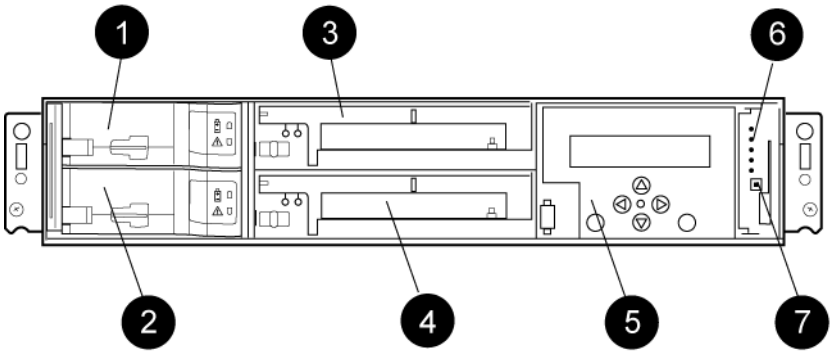

1. Serial port
2. Unit ID
3. Controller health
4. Fault indicator
5. Power
6. DPI ports
7. Mirror ports
8. Fiber ports
9. Power supply 1
10. Power supply 2

### Figure 9 HSV450 controller rear view




1. Serial port
2. Unit ID
3. Controller health
4. Fault indicator
5. Power
6. DPI ports
7. Mirror ports
8. Fiber ports
9. Power supply 1
10. Power supply 2

### Figure 10 Controller front view




1. Battery 1
2. Battery 2
3. Blower 1
4. Blower 2
5. Operator Control Panel (OCP)
6. Status indicators
7. Unit ID

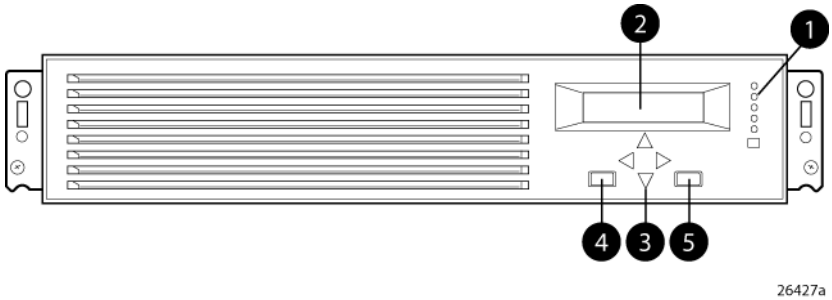
## Operator control panel

The operator control panel (OCP) provides a direct interface to each controller. From the OCP you can display storage system status and configuration information, shut down the storage system, and manage the password.

The OCP includes a 40-character LCD alphanumeric display, six push-buttons, and five status indicators. See Figure 11 (page 15).

HP P6000 Command View is the tool you will typically use to display storage system status and configuration information or perform the tasks available from the OCP. However, if HP P6000 Command View is not available, the OCP can be used to perform these tasks.

### Figure 11 Controller OCP




1. Status indicators (see Table 4 (page 15)) and UID button
2. 40-character alphanumeric display
3. Left, right, top, and bottom push-buttons
4. Esc
5. Enter

## Status indicators

The status indicators display the operational status of the controller. The function of each indicator is described in Table 4 (page 15). During initial setup, the status indicators might not be fully operational.

The following sections define the alphanumeric display modes, including the possible displays, the valid status indicator displays, and the pushbutton functions.

### Table 4 Controller status indicators

| Indicator | Description |
|---|---|
| Fault | When the indicator is a solid amber, it means there was a boot failure. When it flashes, the controller is inoperative. Check either HP P6000 Command View or the LCD Fault Management displays for a definition of the problem and recommended corrective action. |
| Controller | When the indicator is flashing green slowly, the controller is booting up. When the indicator turns to solid green, boot is successful and the controller is operating normally. |
| Physical link to hosts established | When this indicator is green, there is at least one physical link between the storage system and hosts that is active and functioning normally. When this indicator is amber, there are no links between the storage system and hosts that are active and functioning normally. |
| Virtual disks presented to hosts | When this indicator is green, all virtual disks that are presented to hosts are healthy and functioning normally. When this indicator is amber, at least one virtual disk is not functioning normally. When this indicator is off, there are no virtual disks presented to hosts and this indicates a problem with the virtual disk on the array. |
| Battery | When this indicator is green, the battery is working properly. When this indicator is amber, there is a battery failure. |
| Unit ID UID | Press to turn on (solid blue); press again to turn it off. This LED mimics the function of the UID on the back of the controller.This indicator comes on in response to a Locate command issued by HP P6000 Command View. |

Each port on the rear of the controller has an associated status indicator located directly above it. Table 5 (page 16) lists the port and its status description.

### Table 5 Controller port status indicators

| Port | Status indicator description |
|---|---|
| Fibre Channel host ports | • Green—Normal operation<br>• Amber—No signal detected<br>• Off—No SFP[1] detected or the Direct Connect OCP setting is incorrect |
| Fibre Channel device ports | • Green—Normal operation<br>• Amber—No signal detected or the controller has failed the port<br>• Off—No SFP[1] detected |
| Fibre Channel cache mirror ports | • Green—Normal operation<br>• Amber—No signal detected or the controller has failed the port<br>• Off—No SFP[1] detected |

[1] On copper Fibre Channel cables, the SFP is integrated into the cable connector.

## Navigation buttons

The operation of the navigation buttons is determined by the current display and location in the menu structure. Table 6 (page 16) defines the basic push button functions when navigating the menus and options.

To simplify presentation and to avoid confusion, the pushbutton reference names, regardless of labels, are left, right, top, and bottom.

### Table 6 Navigation button functions

| Button | Function |
|---|---|
| ▼ | Moves down through the available menus and options |
| ▲ | Moves up through the available menus and options |
| ▶ | Selects the displayed menu or option. |
| ◀ | Returns to the previous menu. |
| Esc | Used for “No” selections and to return to the default display. |
| Enter | Used for “Yes” selections and to progress through menu items. |

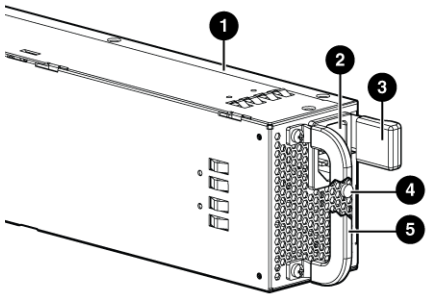
## Alphanumeric display

The alphanumeric display uses two LCD rows, each capable of displaying up to 20 alphanumeric characters. By default, the alphanumeric display alternates between displaying the Storage System Name and the World Wide Name. An active (flashing) display, an error condition message, or a user entry (pressing a push-button) overrides the default display. When none of these conditions exist, the default display returns after approximately 10 seconds.

# Power supplies

Two power supplies provide the necessary operating voltages to all controller enclosure components. If one power supply fails, the remaining supply is capable of operating the enclosure.

### Figure 12 Power supply

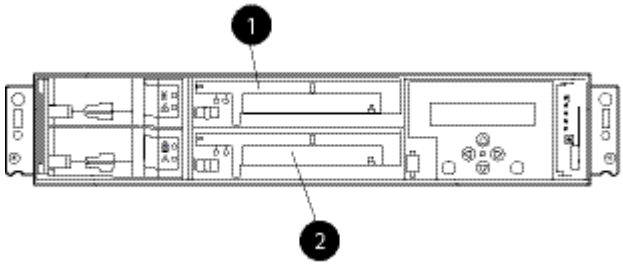



1. Power supply
2. AC input connector
3. Latch
4. Status indicator (solid green on—normal operation; solid amber—failure or no power)
5. Handle

## Blower module

Fan modules provide the cooling necessary to maintain the proper operating temperature within the controller enclosure. If one fan fails, the remaining fan is capable of cooling the enclosure.

### Figure 13 Blower module pulled out




1. Blower 1
2. Blower 2

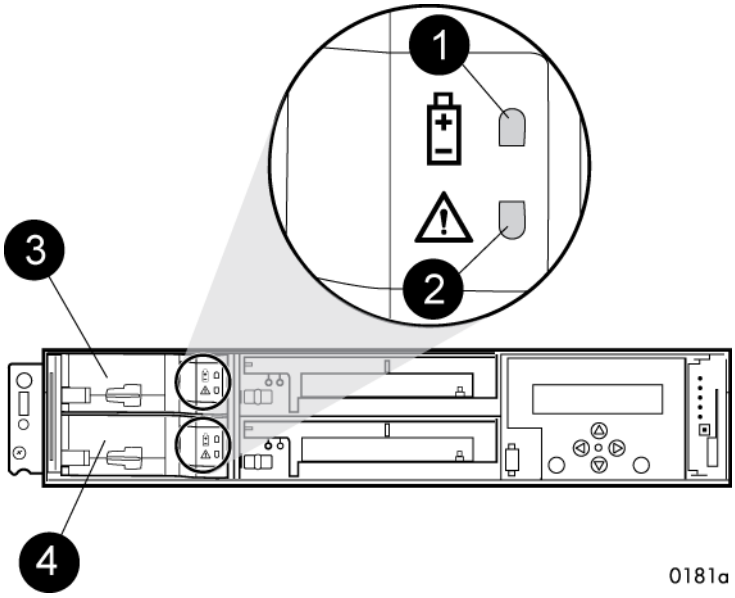
### Table 7 Fan status indicators

| Status indicator | Fault indicator | Description |
|---|---|---|
| Green | Solid green | Normal operation. |
| | Blinking | Maintenance in progress. |
| | Off | Amber is on or blinking, or the enclosure is powered down. |
| Amber | On | Fan failure. Green will be off. (Green and amber are not on simultaneously except for a few seconds after power-up.) |

## Battery module

Batteries provide backup power to maintain the contents of the controller cache when AC power is lost and the storage system has not been shutdown properly. When fully charged the batteries can sustain the cache contents for to 96 hours. Three batteries are used on the EVA8400 and two batteries are used on the EVA6400. Figure 14 (page 18) illustrates the location of the cache batteries and the battery status indicators. See Table 8 (page 18) for additional information on the status indicators.

**Figure 14 Battery module**




1. Status indicator
2. Fault indicator
3. Battery 0
4. Battery 1

The table below describes the battery status indicators. When a battery is first installed, the fault indicator goes on (solid) for approximately 30 seconds while the system discovers the new battery. Then, the battery status indicators display the battery status as described in the table below.

**Table 8 Battery status indicators**

| Status indicator | Fault indicator | Description |
|---|---|---|
| On | Off | Normal operation. A maintenance charge process keeps the battery fully charged. |
| Flashing | Off | Battery is undergoing a full charging process. This is the indication you typically see after installing a new battery. |
| Off | On | Battery fault. The battery has failed and should be replaced. |
| Off | Flashing | The battery has experienced an over temperature fault. |
| Flashing (fast) | Flashing (fast) | Battery code is being updated. When a new battery is installed, it may be necessary for the controllers to update the code on the battery to the correct version. Both indicators flash rapidly for approximately 30 seconds. |
| Flashing | Flashing | Battery is undergoing a scheduled battery load test, during which the battery is discharged and then recharged to ensure it is working properly. During the discharge cycle, you will see this display. The load test occurs infrequently and takes several hours. |

# HSV controller cabling

All data cables and power cables attach to the rear of the controller. Adjacent to each data connector is a two-colored link status indicator. Table 5 (page 16) identifies the status conditions presented by these indicators.

**NOTE:** These indicators do not indicate whether there is communication on the link, only whether the link can transmit and receive data.

The data connections are the interfaces to the disk drive enclosures or loop switches (depending on your configuration), the other controller, and the fabric. Fiber optic cables link the controllers to the fabric, and, if an expansion cabinet is part of the configuration, link the expansion cabinet drive enclosures to the loop is in the main cabinet. Copper cables are used between the controllers (mirror port) and between the controllers and the drive enclosures or loop switches.

## Storage system racks

All storage system components are mounted in a rack. Each configuration includes one enclosure holding both controllers (the controller pair), FC cables the controller and the disk enclosures. Each controller pair and all the associated drive enclosures form a single storage system.

The rack provides the capability for mounting 483 mm (19 inch) wide controller and drive enclosures.

**NOTE:** Racks and rack-mountable components are typically described using "U" measurements. "U" measurements are used to designate panel or enclosure heights. The "U" measurement is a standard of 41 mm (1.6 inch).

The racks provide the following:

- Unique frame and rail design—Allows fast assembly, easy mounting, and outstanding structural integrity.
- Thermal integrity—Front-to-back natural convection cooling is greatly enhanced by the innovative multi-angled design of the front door.
- Security provisions—The front and rear door are lockable, which prevents unauthorized entry.
- Flexibility—Provides easy access to hardware components for operation monitoring.
- Custom expandability—Several options allow for quick and easy expansion of the racks to create a custom solution.

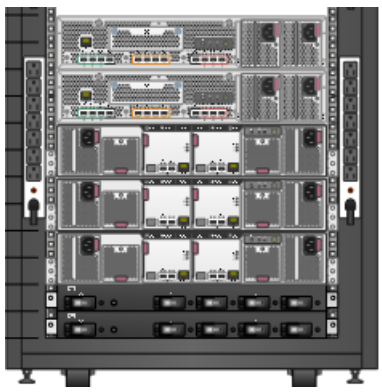
## Rack configurations

Each system configuration contains several disk enclosures included in the storage system. See Figure 15 (page 19) for a typical EVA6400/8400 rack configuration. The standard rack is the 42U HP 10000 Intelligent Series rack. The EVA6400/8400 is also supported with 22U, 36U, 42U 5642, and 47U racks. The 42U 5643 is a field-installed option and the 47U rack must be assembled onsite because the cabinet height creates shipping difficulties.

For more information on HP rack offerings for the EVA6400/8400, see:

http://h18004.www1.hp.com/products/servers/proliantstorage/racks/index.html

**Figure 15 Storage system hardware components – back view**



# Power distribution–Modular PDUs

**NOTE:** This section describes the most common power distribution system for EVA6400/8400s. For information about other options, see the HP power distribution units website:

http://h18004.www1.hp.com/products/servers/proliantstorage/power-protection/pdu.html

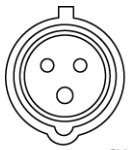
AC power is distributed to the rack through a dual Power Distribution Unit (PDU) assembly mounted at the bottom rear of the rack. The characteristics of the fully-redundant rack power configuration are as follows:

- Each PDU is connected to a separate circuit breaker-protected, 30-A AC site power source (100–127 VAC or 220–240 VAC ±10%, 50 or 60-Hz, ±5%). The following figures illustrate the most common compatible 60-Hz and 50-Hz wall receptacles.

CXO7549A

NEMA L6-30R receptacle, 3-wire, 30-A, 60-Hz

NEMA L5-30R receptacle, 3-wire, 30-A, 60-Hz



CXO5409B

IEC 309 receptacle, 3-wire, 30-A, 50-Hz

- The standard power configuration for any Enterprise Virtual Array rack is the fully redundant configuration. Implementing this configuration requires:
  - Two separate circuit breaker-protected, 30-A site power sources with a compatible wall receptacle.
  - One dual PDU assembly. Each PDU connects to a different wall receptacle.
  - Four to eight (depending on the rack) Power Distribution Modules (PDM) per rack. PDMs are split evenly on both sides of the rack. Each set of PDMs connects to a different PDU.
    - Eight PDMs for 42U, 47U, and 42U 5642 racks
    - Six PDMs for 36U racks
    - Four PDMs for 22U racks
  - The drive enclosure power supplies on the left (PS 1) connect to the PDMs on the left with a gray, 66 cm (26 inch) power cord.
  - The drive enclosure power supplies on the right (PS 2) connect to the PDMs on the right with a black, 66 cm (26 inch) power cord.
  - Each controller has a left and right power supply. The left power supplies of each should be connected to the left PDMs and the right power supplies should be connected to the right PDMs.

**NOTE:** Drive enclosures, when purchased separately, include one 50 cm black cable and one 50 cm gray cable.

The configuration provides complete power redundancy and eliminates all single points of failure for both the AC and DC power distribution.

**CAUTION:** Operating the array with a single PDU will result in the following conditions:

- No redundancy
- Louder controllers and disk enclosures due to increased fan speed
- HP P6000 Command View will continuously display a warning condition, making issue monitoring a labor-intensive task

Although the array is capable of doing so, HP strongly recommends that an array operating with a single PDU should not:

- Be put into production
- Remain in this state for more than 24 hours

## PDUs

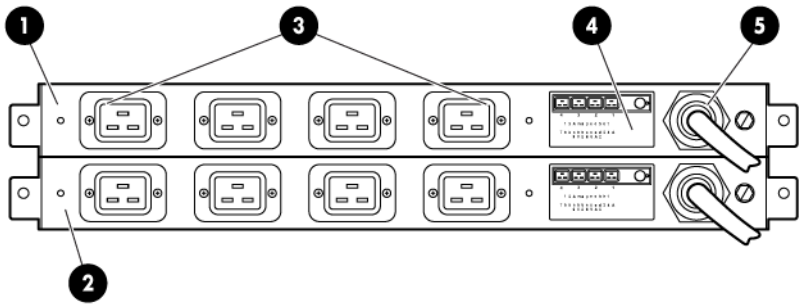
Each Enterprise Virtual Array rack has either a 50- or 60-Hz, dual PDU mounted at the bottom rear of the rack. The PDU placement is back-to-back, plugs facing toward the front (Figure 16 (page 21)), with circuit breaker switches facing the back (Figure 17 (page 22)).

- The standard 50-Hz PDU cable has an IEC 309, 3-wire, 30-A, 50-Hz connector.
- The standard 60-Hz PDU cable has a NEMA L6-30P, 3-wire, 30-A, 60-Hz connector.

If these connectors are not compatible with the site power distribution, you must replace the PDU power cord cable connector. One option is the NEMA L5-30R receptacle, 3-wire, 30-A, 60-Hz connector.

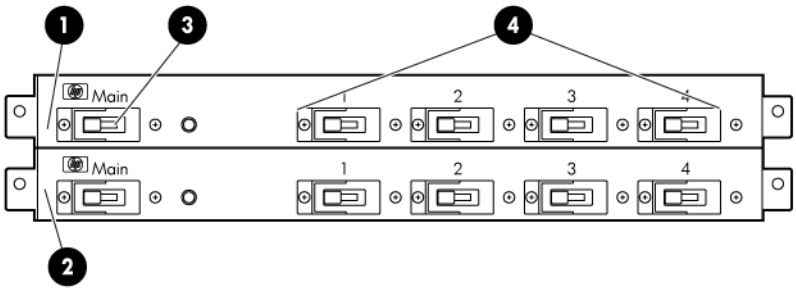
Each of the two PDU power cables has an AC power source specific connector. The circuit breaker-controlled PDU outputs are routed to a group of four AC receptacles. The voltages are then routed to PDMs, sometimes called AC power strips, mounted on the two vertical rails in the rear of the rack.

**Figure 16 Dual PDU—front view**




1. PDU B
2. PDU A
3. AC receptacles
4. Power receptacle schematic
5. Power cord

**Figure 17 Dual PDU—rear view**




1. PDU B
2. PDU A
3. Main circuit breaker
4. Circuit breakers

## PDU A

PDU A connects to AC PDM A1–A4.

A PDU A failure:

- Disables the power distribution circuit
- Removes power from from the left side of the rack
- Disables disk enclosure PS 1
- Disables the left power supplies in the controllers

## PDU B

PDU B connects to AC PDM B1–B4.

A PDU B failure:

- Disables the power distribution circuit
- Removes power from the right side of the rack
- Disables disk enclosure PS 2
- Disables the right power supplies in the controllers

## PDMs

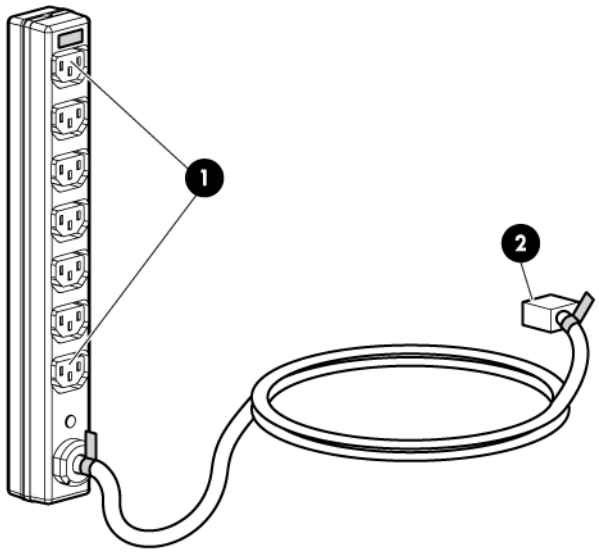
Depending on the rack, there can be up to eight PDMs mounted in the rear of the rack:

- The PDMs on the left vertical rail connect to PDU A
- The PDMs on the right vertical rail connect to PDU B

Each PDM has seven AC receptacles. The PDMs distribute the AC power from the PDUs to the enclosures. Two power sources exist for each controller pair and disk enclosure. If a PDU fails, the system will remain operational.

△ **CAUTION:** The AC power distribution within a rack ensures a balanced load to each PDU and reduces the possibility of an overload condition. Changing the cabling to or from a PDM could cause an overload condition. HP supports only the AC power distributions defined in this user guide.

**Figure 18 Rack PDM**




1. Power receptacles
2. AC power connector

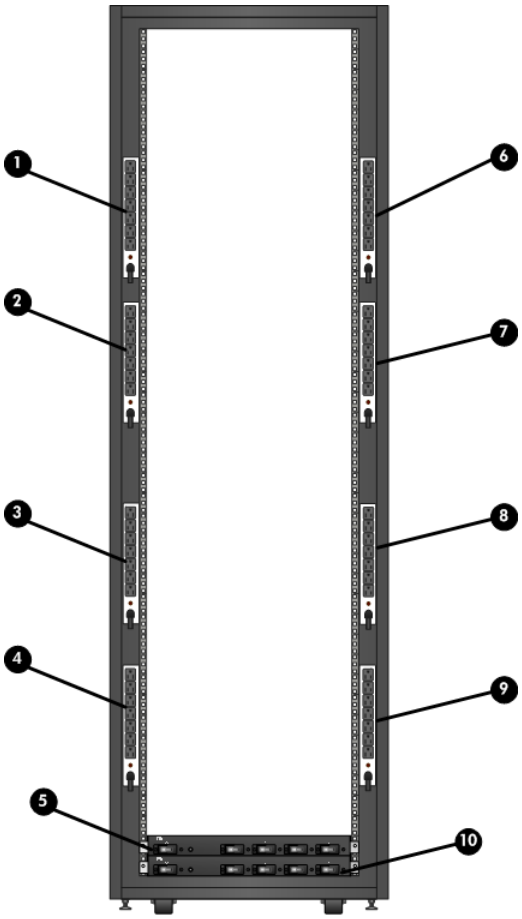
## Rack AC power distribution

The power distribution in an Enterprise Virtual Array rack is the same for all variants. The site AC input voltage is routed to the dual PDU assembly mounted in the rack lower rear. Each PDU distributes AC to a maximum of four PDMs mounted on the left and right vertical rails (see Figure 19 (page 24)).

- PDMs A1 through A4 connect to receptacles A through D on PDU A. Power cords connect these PDMs to the left power supplies on the disk enclosures and to the left power supplies on the controllers.
- PDMs B1 through B4 connect to receptacles A through D on PDU B. Power cords connect these PDMs to the right power supplies on the disk enclosures and to the right power supplies on the controllers.

**NOTE:** The locations of the PDUs and the PDMs are the same in all racks.

**Figure 19 Rack AC power distribution**




1. PDM 1
2. PDM 2
3. PDM 3
4. PDM 4
5. PDU 1
6. PDM 5
7. PDM 6
8. PDM 7
9. PDM 8
10. PDU 2

## Rack System/E power distribution components

AC power is distributed to the Rack System/E rack through Power Distribution Units (PDU) mounted on the two vertical rails in the rear of the rack. Up to four PDUs can be mounted in the rack—two mounted on the right side of the cabinet and two mounted on the left side.

Each of the PDU power cables has an AC power source specific connector. The circuit breaker-controlled PDU outputs are routed to a group of ten AC receptacles. The storage system components plug directly into the PDUs.

### Rack AC power distribution

The power distribution configuration in a Rack System/E rack depends on the number of storage systems installed in the rack. If one storage system is installed, only two PDUs are required. If multiple storage systems are installed, four PDUs are required.

The site AC input voltage is routed to each PDU mounted in the rack. Each PDU distributes AC through ten receptacles directly to the storage system components.

- PDUs 1 and 3 (optional) are mounted on the left side of the cabinet. Power cords connect these PDUs to the number 1 disk enclosure power supplies and to the controllers.
- PDUs 2 and 4 (optional) are mounted on the right side of the cabinet. Power cords connect these PDUs to the number 2 disk enclosure power supplies and to the controllers.

For additional information on power distribution support, see the following website:

http://h18004.www1.hp.com/products/servers/proliantstorage/power-protection/pdu.html

# Moving and stabilizing a rack

**WARNING!** The physical size and weight of the rack requires a minimum of two people to move. If one person tries to move the rack, injury may occur.

To ensure stability of the rack, always push on the lower half of the rack. Be especially careful when moving the rack over any bump (such as door sills, ramp edges, carpet edges, or elevator openings). When the rack is moved over a bump, there is a potential for it to tip over.

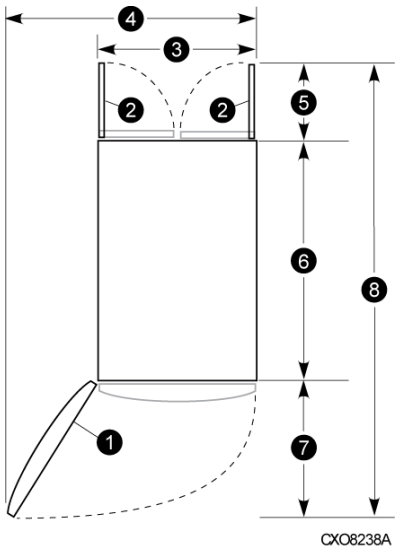
Moving the rack requires a clear, uncarpeted pathway that is at least 80 cm (31.5 inch) wide for the 60.3 cm (23.7 inch) wide, 42U rack. A vertical clearance of 203.2 cm (80 inch) should ensure sufficient clearance for the 200 cm (78.7 inch) high, 42U rack.

**CAUTION:** Ensure that no vertical or horizontal restrictions exist that would prevent rack movement without damaging the rack.

Make sure that all four leveler feet are in the fully raised position. This process will ensure that the casters support the rack weight and the feet do not impede movement.

Each rack requires an area 600 mm (23.62 inch) wide and 1000 mm (39.37 inch) deep (see Figure 20 (page 25)).

**Figure 20 Single rack configuration floor space requirements**

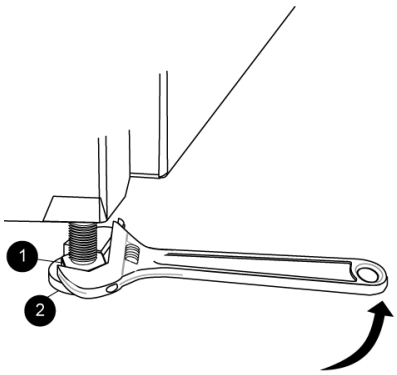



1. Front door
2. Rear door
3. Rack width 600 mm
4. Service area width 813 mm
5. Rear service area depth 300 mm
6. Rack depth 1000 mm
7. Front service area depth 406 mm
8. Total rack depth 1706 mm

If the feet are not fully raised, complete the following procedure:

1. Raise one foot by turning the leveler foot hex nut counterclockwise until the weight of the rack is fully on the caster (see Figure 21 (page 26)).
2. Repeat Step 1 for the other feet.

**Figure 21 Raising a leveler foot**




CXO7589A

1. Hex nut
2. Leveler foot

3. Carefully move the rack to the installation area and position it to provide the necessary service areas (see Figure 20 (page 25)).

To stabilize the rack when it is in the final installation location:

1. Use a wrench to lower the foot by turning the leveler foot hex nut clockwise until the caster does not touch the floor. Repeat for the other feet.
2. After lowering the feet, check the rack to ensure it is stable and level.
3. Adjust the feet as necessary to ensure the rack is stable and level.

# 2 Enterprise Virtual Array startup

This chapter describes the procedures to install and configure the Enterprise Virtual Array. When these procedures are complete, you can begin using your storage system.

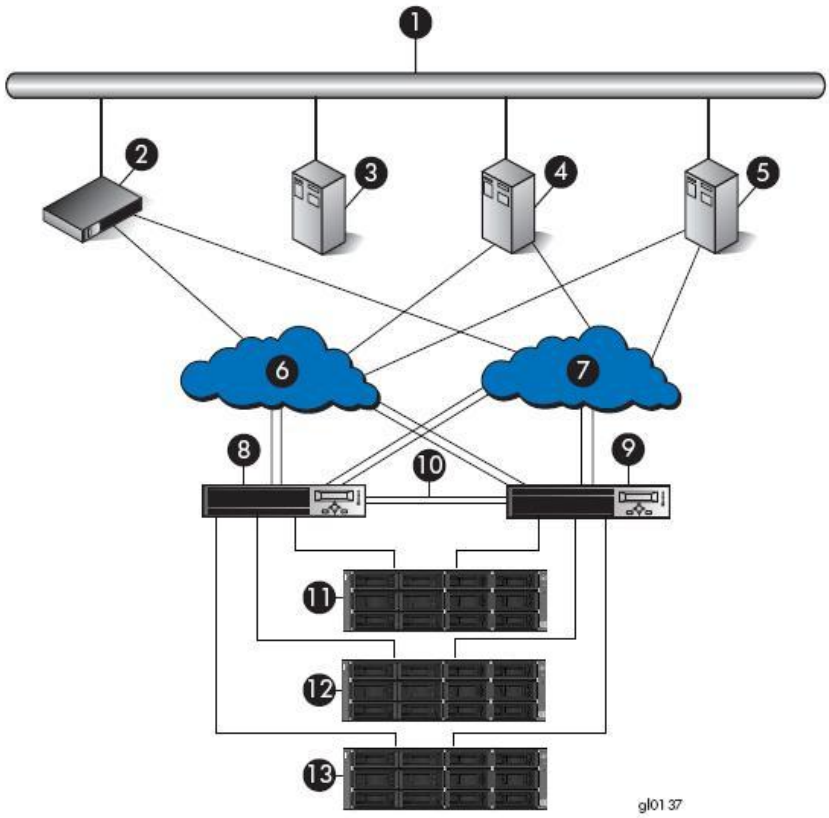
**NOTE:** Installation of the Enterprise Virtual Array should be done only by an HP authorized service representative. The information in this chapter provides an overview of the steps involved in the installation and configuration of the storage system.

## EVA8400 storage system connections

Figure 22 (page 27) shows how the storage system is connected to other components of the storage solution.

- The HSV450 controllers connect via four host ports (FP1, FP2, FP3, and FP4) to the Fibre Channel fabrics. The hosts that will access the storage system are connected to the same fabrics.
- The HP P6000 Command View management server also connects to the fabric.
- The controllers connect through two loop pairs to the drive enclosures. Each loop pair consists of two independent loops, each capable of managing all the disks should one loop fail.

**Figure 22 EVA8400 configuration**



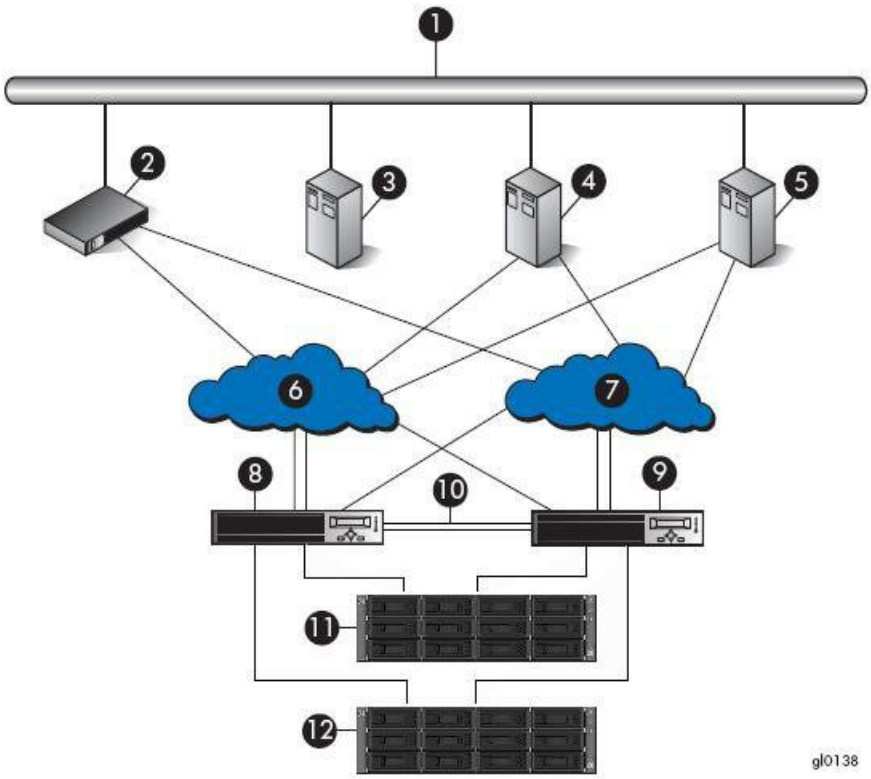

1. Network interconnection
2. Management server
3. Non-host
4. Host A
5. Host B
6. Fabric 1
7. Fabric 2
8. Controller A
9. Controller B
10. Cache mirror ports
11. Drive enclosure 1
12. Drive enclosure 2
13. Drive enclosure 3

# EVA6400 storage system connections

Figure 23 (page 28) shows a typical EVA6400 SAN topology:

- The HSV400 controllers connect via four host ports (FP1, FP2, FP3, and FP4) to the Fibre Channel fabrics. The hosts that will access the storage system are connected to the same fabrics.
- The HP P6000 Command View management server also connects to both fabrics.
- The controllers connect through one loop pair to the drive enclosures. The loop pair consists of two independent loops, each capable of managing all the disks should one loop fail.

**Figure 23 EVA6400 configuration**




1. Network interconnection
2. Management server
3. Non-host
4. Host A
5. Host B
6. Fabric 1
7. Fabric 2
8. Controller A
9. Controller B
10. Cache mirror ports
11. Drive enclosure 1
12. Drive enclosure 2

# Direct connect

**NOTE:** Direct connect is supported on Microsoft Windows only.

Direct connect provides a lower cost solution for smaller configurations. When using direct connect, the storage system controllers are connected directly to the hosts, not to SAN Fibre Channel switches. Make sure the following requirements are met when configuring your environment for direct connect:

- A management server running HP P6000 Command View must be connected to one port on each EVA controller. The management host must use dual HBAs for redundancy.
- To provide redundancy, it is recommended that dual HBAs be used for each additional host connected to the storage system. Using this configuration, up to four hosts (including the management host) can be connected to an EVA6400/8400.

- The Host Port Configuration must be set to Direct Connect using the OCP.
- HP P6000 Continuous Access cannot be used with direct connect configurations.
- The HSV controller firmware cannot differentiate between an empty host port and a failed host port in a direct connect configuration. As a result, the Connection state dialog box on the Controller Properties window displays `Connection failed for an empty host port`. To fix this problem, insert an optical loop-back connector into the empty host port; the Connection state will display *Connected*. For more information about optical loop-back connectors, contact your HP-authorized service provider.

# iSCSI connection configurations

The EVA6400/8400 support iSCSI attach configurations using the HP MPX100. Both fabric connect and direct connect are supported for iSCSI configurations. For complete information on iSCSI configurations, go to the following website:

http://h18006.www1.hp.com/products/storageworks/evaiscsiconnect/index.html

**NOTE:** An iSCSI connection configuration supports mixed direct connect and fabric connect.

## Fabric connect iSCSI

Fabric connect provides an iSCSI solution for EVA Fibre Channel configurations that want to continue to use all EVA ports on FC or if the EVA is also used for HP P6000 Continuous Access.

Make sure the following requirements are met when configuring your MPX100 environment for fabric connect:

- A maximum of two MPX100s per storage system are supported
- Each storage system port can connect to a maximum of two MPX100 FC ports.
- Each MPX100 FC port can connect to a maximum of one storage system port.
- In a single MPX100 configuration, if both MPX100 FC ports are used, each port must be connected to one storage system controller.
- In a dual MPX100 configuration, at least one FC port from each MPX100 must be connected to one storage system controller.
- The Host Port Configuration must be set to Fabric Connect using the OCP.
- HP P6000 Continuous Access is supported on the same storage system connected in MPX100 fabric connect configurations.

## Direct connect iSCSI

Direct connect provides a lower cost solution for configurations that want to dedicate controller ports to iSCSI I/O. When using direct connect, the storage system controllers are connected directly to the MPX100s, not to SAN Fibre Channel switches.

Make sure the following requirements are met when configuring your MPX100 environment for direct connect:

- A maximum two MPX100s per storage system are supported.
- In a single MPX100 configuration, if both MPX100 FC ports are used each port must be connected to one storage system controller.
- In a dual MPX100 configuration, at least one FC port from each MPX100 must be connected to one storage system controller.
- The Host Port Configuration must be set to Direct Connect using the OCP.

- HP P6000 Continuous Access cannot be used with direct connect configurations.
- EVAs cannot be directly connected to each other to create HP P6000 Continuous Access configuration. However, hosts can be direct connected to the EVA in a HP P6000 Continuous Access configuration. At least one port from each array in an HP P6000 Continuous Access configuration must be connected to a Fabric connection for remote array connectivity.

# Procedures for getting started

| Step | Responsibility |
|---|---|
| 1. Gather information and identify all related storage documentation. | Customer |
| 2. Contact an authorized service representative for hardware configuration information. | Customer |
| 3. Enter the World Wide Name (WWN) into the OCP. | HP Service Engineer |
| 4. Configure HP P6000 Command View. | HP Service Engineer |
| 5. Prepare the hosts. | Customer |
| 6. Configure the system through HP P6000 Command View. | HP Service Engineer |
| 7. Make virtual disks available to their hosts. See the storage system software documentation for each host's operating system. | HP Service Engineer |

## Gathering information

The following items should be available when installing and configuring an Enterprise Virtual Array. They provide information necessary to set up the storage system successfully.

- *HP 6400/8400 Enterprise Virtual Array World Wide Name label*, (shipped with the storage system)
- *HP Enterprise Virtual Array Release Notes*

Locate these items and keep them handy. You will need them for the procedures in this manual.

### Host information

Make a list of information for each host computer that will be accessing the storage system. You will need the following information for each host:

- The LAN name of the host
- A list of World Wide Names of the FC adapters, also called host bus adapters, through which the host will connect to the fabric that provides access to the storage system, or to the storage system directly if using direct connect.
- Operating system type
- Available LUN numbers

## Setting up a controller pair using the OCP

**NOTE:** This procedure should be performed by an HP authorized service representative.

Two pieces of data must be entered during initial setup using the controller OCP:

- World Wide Name (WWN) — Required to complete setup. This procedure should be performed by an HP authorized service representative.
- Storage system password — Optional. A password provides security allowing only specific instances of HP P6000 Command View to access the storage system.

The OCP on either controller can be used to input the WWN and password data. For more information about the OCP, see "Operator Control Panel" (page 14).

Table 9 (page 31) lists the push-button functions when entering the WWN, WWN checksum, and password data.

**Table 9 Push button functions**

| Button | Function |
|---|---|
| ▲ | Selects a character by scrolling up through the character list one character at a time. |
| ▶ | Moves forward one character. If you accept an incorrect character, you can move through all 16 characters, one character at a time, until you display the incorrect character. You can then change the character. |
| ▼ | Selects a character by scrolling down through the character list one character at a time. |
| ◀ | Moves backward one character. |
| ESC | Returns to the default display. |
| ENTER | Accepts all the characters entered. |

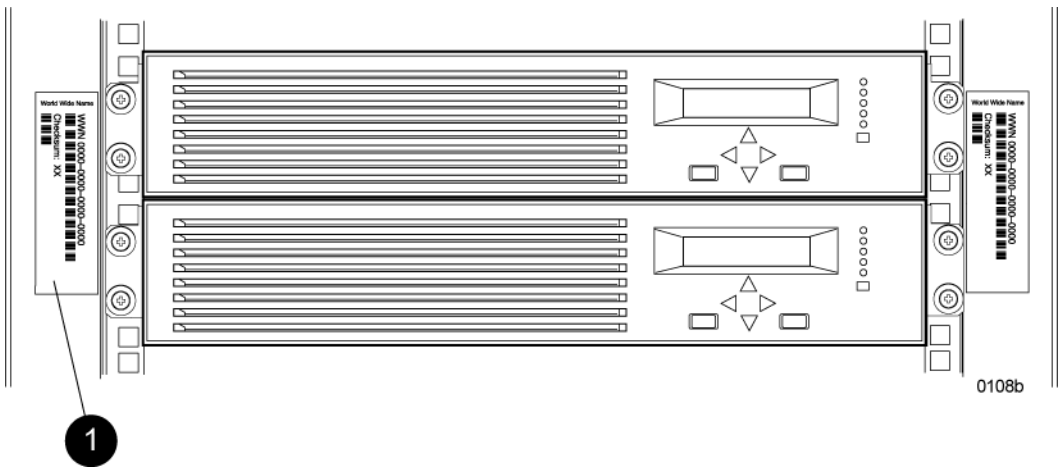
## Entering the WWN

Fibre Channel protocol requires that each controller pair have a unique WWN. This 16-character alphanumeric name identifies the controller pair on the storage system. Two WWN labels attached to the rack identify the storage system WWN and checksum. See Figure 24 (page 31).

**NOTE:**

- The WWN is unique to a controller pair and cannot be used for any other controller pair or device anywhere on the network.
- This is the only WWN applicable to any controller installed in a specific physical location, even a replacement controller.
- Once a WWN is assigned to a controller, you cannot change the WWN while the controller is part of the same storage system.

**Figure 24 Location of the World Wide Name labels**




1. World Wide Name labels

Complete the following procedure to assign the WWN to each pair of controllers.

1. Turn the power switches on both controllers off.
2. Apply power to the rack.

3. Turn the power switch on both controllers on.

**NOTE:** Notifications of the startup test steps that have been executed are displayed while the controller is booting. It may take up to two minutes for the steps to display. The default WWN entry display has a 0 in each of the 16 positions.

4. Press ▲ or ▼ until the first character of the WWN is displayed. Press ▶ to accept this character and select the next.
5. Repeat Step 4 to enter the remaining characters.
6. Press **Enter** to accept the WWN and select the checksum entry mode.

### Entering the WWN checksum

The second part of the WWN entry procedure is to enter the two-character checksum, as follows.

1. Verify that the initial WWN checksum displays 0 in both positions.
2. Press ▲ or ▼ until the first checksum character is displayed. Press ▶ to accept this character and select the second character.
3. Press ▲ or ▼ until the second character is displayed. Press **Enter** to accept the checksum and exit.
4. Verify that the default display is automatically selected. This indicates that the checksum is valid.

**NOTE:** If you enter an incorrect WWN or checksum, the system will reject the data and you must repeat the procedure.

### Entering the storage system password

The storage system password feature enables you to restrict management access to the storage system. The password must meet the following requirements:

- 8 to 16 characters in length
- Can include upper or lower case letters
- Can include numbers 0 - 9
- Can include the following characters: ! " # $ % & ' ( ) * + , - . / : ; < = > ? @ [ ] ^ _ ` { | }
- Cannot include the following characters: space ~ \

Complete the following procedure to enter the password:

1. Select a unique password of 8 to 16 characters.
2. With the default menu displayed, press ▼ three times to display *System Password*.
3. Press ▶ to display *Change Password?*
4. Press **Enter** for yes.

   The default password, *AAAAAAAA~~~~~~~~*, is displayed.
5. Press ▼ or ▲ to select the desired character.
6. Press ▶ to accept this character and select the next character.
7. Repeat the process to enter the remaining password characters.
8. Press **Enter** to enter the password and return to the default display.

## Installing HP P6000 Command View

HP P6000 Command View is installed on a management server. Installation can be skipped if the latest version of HP P6000 Command View is running. Verify the latest version at the HP website:

http://h18006.www1.hp.com/products/storage/software/cmdvieweva/index.html

See the *HP P6000 Command View Installation Guide* for more information.

## Installing optional EVA software licenses

If you purchased optional EVA software, you must install the license. Optional software available for the Enterprise Virtual Array includes HP P6000 Business Copy and HP P6000 Continuous Access. Installation instructions are included with the license.

# 3 EVA6400/8400 operation

## Best practices

For useful information on managing and configuring your storage system, see the *HP 4400 and 6400/8400 Enterprise Virtual Array configuration best practices* white paper available at:

http://h18006.www1.hp.com/storage/arraywhitepapers.html

## Operating tips and information

### Reserving adequate free space

To ensure efficient storage system operation, a certain amount of unallocated capacity, or free space, should be reserved in each disk group. The recommended amount of free space is influenced by your system configuration. For guidance on how much free space to reserve, see the *HP 4400 and 6400/8400 Enterprise Virtual Array configuration best practices* white paper. See "Best practices" (page 34).

### Using FATA disk drives

FATA drives are designed for lower duty cycle applications such as near online data replication for backup. These drives should not be used as a replacement for EVA's high performance, standard duty cycle, Fibre Channel drives. Doing so could shorten the life of the drive.

For useful information on managing and configuring your storage system, see the *HP 4400 and 6400/8400 Enterprise Virtual Array configuration best practices* white paper. See "Best practices" (page 34).

### Using solid state disk drives

The following requirements apply to solid state disk (SSD) drives:

- Supported in the EVA4400 and EVA6400/8400 only, running a minimum controller software version of 09500000 for the 72 GB drive and 09534000 for the 200 GB and 400 GB drives
- SSD drives must be in a separate disk group
- The SSD disk group supports a minimum of 6 and a maximum of 8 drives per array
- SSD drives can only be configured with Vraid5 or Vraid1 (Vraid1 requires controller software version 09534000 or later)
- Supported with HP P6000 Business Copy
- Not supported with HP P6000 Continuous Access
- Dynamic Capacity Management extend and shrink features are not supported

Use of these devices in unsupported configurations can lead to unpredictable results, including unstable array operation or data loss.

### QLogic HBA speed setting

In a Linux direct connect environment with QLogic 4 Gb/s HBAs, auto speed negotiation is not supported. The QLogic HBA speed setting must be set to 4 Gb/s.

### EVA6400/8400 host port negotiates to incorrect speed

The EVA6400/8400 might not correctly negotiate to 4 Gb/s when connected to an HP M-Series 4400, 4700, or 6140 switch with ports set to autonegotiate. The workaround is to set the switch port to 4 Gb/s.

## Creating 16 TB or greater virtual disks in Windows 2008

When creating a virtual disk that is 16 TB or greater in Windows 2008, ensure that the Allocation unit size field is set to something other than Default in the Windows New Simple Volume wizard. The recommended setting is 16K. If this field is set to Default, you will receive the following error message:

```
The format operation did not complete because the cluster count is
higher than expected.
```

## Importing Windows dynamic disk volumes

If you create a snapshot, snapclone, or mirrorclone with a Windows 2003 RAID-spanned dynamic volume on the source virtual disk, and then try to import the copy to a Windows 2003 x64 (64-bit) system, it will import with Dynamic Foreign status. The following message displays in the DiskPart utility:

```
The disk management services could not complete the operation.
```

This error occurs because the 64-bit version of DiskPart fails to import dynamic RAID sets on a new server.

To avoid this issue, use the 32-bit version of DiskPart instead of the 64-bit version. Copy DiskPart from a 32-bit x86 Windows system, located in `C:\WINDOWS\system32`. Place the DiskPart utility in a temporary folder on the 64-bit x64 Windows system.

## Losing a path to a dynamic disk

If you are using Windows 2003 with dynamic disks and a path to the EVA virtual disk is temporarily lost, the Logical Disk Manager (LDM) will erroneously show a failed dynamic volume. For more information, see the following issue on the Microsoft knowledge base website:

http://support.microsoft.com/kb/816307

To resolve the issue, reboot the Windows 2003 server to restore the dynamic volume.

## Microsoft Windows 2003 MSCS cluster installation

The MSCS cluster installation wizard on Windows 2003 can fail to find the shared quorum device and disk resources might not be auto-created by the cluster setup wizard. This is a known Windows Cluster Setup issue that has existed since Windows 2003 was released.

There are two possible workarounds for this problem:

- Follow the workaround recommendation described in the Microsoft support article entitled *Shared disks are missing or are marked as "Failed" when you create a server cluster in Windows Server 2003* (ID 886807), available for download on the Microsoft website:

  http://support.microsoft.com/default.aspx?scid=KB;EN-US;886807

- Use the MPIO DSM CLI to set the load balancing policy for each LUN to `NLB`.

Microsoft is currently working on a resolution to address this issue.

## Managing unused ports

When you have unused ports on an EVA, perform the following steps:

1. Place a loopback plug on all unused ports.
2. Change the mode on unused ports from fabric to direct connect.

## Changing the host port connectivity

To change the host port connectivity:

1. Disconnect any connected cable.

   **NOTE:** Failing to disconnect the cable prior to making the change will require a controller restart to clear the condition.

2. Use the OCP and navigate to the host port to be changed.
3. Select **fabric** for an FC switch connection or **direct** for direct attachment to an HBA.
4. Reconnect cables.

# Failback preference setting for HSV controllers

Table 10 (page 37) describes the failback preference behavior for the controllers.

**Table 10 Failback preference behavior**

| Setting | Point in time | Behavior |
|---|---|---|
| No preference | At initial presentation | The units are alternately brought online to Controller A or to Controller B. |
| | On dual boot or controller resynch | If cache data for a LUN exists on a particular controller, the unit will be brought online there. Otherwise, the units are alternately brought online to Controller A or to Controller B. |
| | On controller failover | All LUNs are brought online to the surviving controller. |
| | On controller failback | All LUNs remain on the surviving controller. There is no failback except if a host moves the LUN using SCSI commands. |
| Path A - Failover Only | At initial presentation | The units are brought online to Controller A. |
| | On dual boot or controller resynch | If cache data for a LUN exists on a particular controller, the unit will be brought online there. Otherwise, the units are brought online to Controller A. |
| | On controller failover | All LUNs are brought online to the surviving controller. |
| | On controller failback | All LUNs remain on the surviving controller. There is no failback except if a host moves the LUN using SCSI commands. |
| Path B - Failover Only | At initial presentation | The units are brought online to Controller B. |
| | On dual boot or controller resynch | If cache data for a LUN exists on a particular controller, the unit will be brought online there. Otherwise, the units are brought online to Controller B. |
| | On controller failover | All LUNs are brought online to the surviving controller. |
| | On controller failback | All LUNs remain on the surviving controller. There is no failback except if a host moves the LUN using SCSI commands. |
| Path A - Failover/Failback | At initial presentation | The units are brought online to Controller A. |
| | On dual boot or controller resynch | If cache data for a LUN exists on a particular controller, the unit will be brought online there. Otherwise, the units are brought online to Controller A. |
| | On controller failover | All LUNs are brought online to the surviving controller. |
| | On controller failback | All LUNs remain on the surviving controller. After controller restoration, the units that are online to Controller B and set to Path A are brought online to Controller A. This is a one time occurrence. If the host then moves the LUN using SCSI commands, the LUN will remain where moved. |
| Path B - Failover/Failback | At initial presentation | The units are brought online to Controller B. |

### Table 10 Failback preference behavior *(continued)*

| Setting | Point in time | Behavior |
|---|---|---|
| | On dual boot or controller resynch | If cache data for a LUN exists on a particular controller, the unit will be brought online there. Otherwise, the units are brought online to Controller B. |
| | On controller failover | All LUNs are brought online to the surviving controller. |
| | On controller failback | All LUNs remain on the surviving controller. After controller restoration, the units that are online to Controller A and set to Path B are brought online to Controller B. This is a one time occurrence. If the host then moves the LUN using SCSI commands, the LUN will remain where moved. |

Table 11 (page 38) describes the failback default behavior and supported settings when ALUA-compliant multipath software is running with each operating system. Recommended settings may vary depending on your configuration or environment.

### Table 11 Failback settings by operating system

| Operating system | Default behavior | Supported settings |
|---|---|---|
| HP-UX | Host follows the unit[1] | No Preference<br>Path A/B – Failover Only<br>Path A/B – Failover/Failback |
| IBM AIX | Host follows the unit[1] | No Preference<br>Path A/B – Failover Only<br>Path A/B – Failover/Failback |
| Linux | Host follows the unit [1] | No Preference<br>Path A/B – Failover Only<br>Path A/B – Failover/Failback |
| OpenVMS | Host follows the unit | No Preference<br>Path A/B – Failover Only<br>Path A/B – Failover/Failback (recommended) |
| Sun Solaris | Host follows the unit[1] | No Preference<br>Path A/B – Failover Only<br>Path A/B – Failover/Failback |
| Tru64 UNIX | Host follows the unit | No Preference<br>Path A/B – Failover Only<br>Path A/B – Failover/Failback (recommended) |
| VMware | Host follows the unit[1] | No Preference<br>Path A/B – Failover Only<br>Path A/B – Failover/Failback |
| Windows | Failback performed on the host | No Preference<br>Path A/B – Failover Only<br>Path A/B – Failover/Failback |

[1] If preference has been configured to ensure a more balanced controller configuration, the Path A/B – Failover/Failback setting is required to maintain the configuration after a single controller reboot.

## Changing virtual disk failover/failback setting

Changing the failover/failback setting of a virtual disk may impact which controller presents the disk. Table 12 (page 39) identifies the presentation behavior that results when the failover/failback setting for a virtual disk is changed.

**NOTE:** If the new setting causes the presentation of the virtual disk to move to a new controller, any snapshots or snapclones associated with the virtual disk will also be moved.

**Table 12 Impact on virtual disk presentation when changing failover/failback setting**

| New setting | Impact on virtual disk presentation |
|---|---|
| No Preference | None. The disk maintains its original presentation. |
| Path A Failover | If the disk is currently presented on controller B, it is moved to controller A. If the disk is on controller A, it remains there. |
| Path B Failover | If the disk is currently presented on controller A, it is moved to controller B. If the disk is on controller B, it remains there. |
| Path A Failover/Failback | If the disk is currently presented on controller B, it is moved to controller A. If the disk is on controller A, it remains there. |
| Path B Failover/Failback | If the disk is currently presented on controller A, it is moved to controller B. If the disk is on controller B, it remains there. |

## Implicit LUN transition

Implicit LUN transition automatically transfers management of a virtual disk to the array controller that receives the most read requests for that virtual disk. This improves performance by reducing the overhead incurred when servicing read I/Os on the non-managing controller. Implicit LUN transition is enabled in XCS.

When creating a virtual disk, one controller is selected to manage the virtual disk. Only this managing controller can issue I/Os to a virtual disk in response to a host read or write request. If a read I/O request arrives on the non-managing controller, the read request must be transferred to the managing controller for servicing. The managing controller issues the I/O request, caches the read data, and mirrors that data to the cache on the non-managing controller, which then transfers the read data to the host. Because this type of transaction, called a proxy read, requires additional overhead, it provides less than optimal performance. (There is little impact on a write request because all writes are mirrored in both controllers' caches for fault protection.)

With implicit LUN transition, when the array detects that a majority of read requests for a virtual disk are proxy reads, the array transitions management of the virtual disk to the non-managing controller. This improves performance because the controller receiving most of the read requests becomes the managing controller, reducing proxy read overhead for subsequent I/Os.

Implicit LUN transition is disabled for all members of an HP P6000 Continuous Access DR group. Because HP P6000 Continuous Access requires that all members of a DR group be managed by the same controller, it would be necessary to move all members of the DR group if excessive proxy reads were detected on any virtual disk in the group. This would impact performance and create a proxy read situation for the other virtual disks in the DR group. Not implementing implicit LUN transition on a DR group may cause a virtual disk in the DR group to have excessive proxy reads.

# Storage system shutdown and startup

The storage system is shut down using HP P6000 Command View. The shutdown process performs the following functions in the indicated order:

1. Flushes cache
2. Removes power from the controllers
3. Disables cache battery power
4. Removes power from the drive enclosures
5. Disconnects the system from HP P6000 Command View

**NOTE:** The storage system may take a long time to complete the necessary cache flush during controller shutdown when snapshots are being used. The delay may be particularly long if multiple child snapshots are used, or if there has been a large amount of write activity to the snapshot source virtual disk.

## Shutting down the storage system

To shut the storage system down, perform the following steps:

1. Start HP P6000 Command View.
2. Select the appropriate storage system in the Navigation pane.

   The Initialized Storage System Properties window for the selected storage system opens.
3. Click **Shut down**.

   The Shutdown Options window opens.
4. Under System Shutdown click **Power Down**. If you want to delay the initiation of the shutdown, enter the number of minutes in the Shutdown delay field.

   The controllers complete an orderly shutdown and then power off. The disk enclosures then power off. Wait for the shutdown to complete.

## Starting the storage system

To start a storage system, perform the following steps:

1. Verify that each fabric Fibre Channel switch to which the HSV controllers are connected is powered up and fully booted. The power indicator on each switch should be on.

   If you must power up the SAN switches, wait for them to complete their power-on boot process before proceeding. This may take several minutes.
2. Power on the circuit breakers on both EVA rack PDUs, which powers on the controller enclosures and disk enclosures. Verify that all enclosures are operating properly. The status indicator and the power indicator should be on (green).
3. Wait three minutes and then verify that all disk drives are ready. The drive ready indicator and the drive online indicator should be on (green).
4. Verify that the Operator Control Panel (OCP) display on each controller displays the storage system name and the EVA WWN.
5. Start HP P6000 Command View and verify connection to the storage system. If the storage system is not visible, click **HSV Storage Network** in the navigation pane, and then click **Discover** in the Content pane to discover the array.

   **NOTE:** If the storage system is still not visible, reboot the management server to re-establish the communication link.
6. Check the storage system status using HP P6000 Command View to ensure everything is operating properly. If any status indicator is not normal, check the log files or contact your HP-authorized service provider for assistance.

# Saving storage system configuration data

As part of an overall data protection strategy, storage system configuration data should be saved during initial installation, and whenever major configuration changes are made to the storage

system. This includes adding or removing disk drives, creating or deleting disk groups, and adding or deleting virtual disks. The saved configuration data can save substantial time should it ever become necessary to re-initialize the storage system. The configuration data is saved to a series of files stored in a location other than on the storage system.

This procedure can be performed from the management server where HP P6000 Command View is installed, or any host that can run HP Storage System Scripting Utility (SSSU) to communicate with HP P6000 Command View.

**NOTE:** For more information about using HP SSSU, see the *HP Storage System Scripting Utility Reference*. See "Documents" (page 80).

1. Double-click the HP SSSU desktop icon to run the application. When prompted, enter Manager (management server name or IP address), User name, and Password.
2. Enter `LS SYSTEM` to display the EVA storage systems managed by the management server.
3. Enter `SELECT SYSTEM system name`, where *system name* is the name of the storage system.

   The storage system name is case sensitive. If there are spaces between the letters in the name, quotes must enclose the name: for example, `SELECT SYSTEM "Large EVA"`.
4. Enter `CAPTURE CONFIGURATION`, specifying the full path and filename of the output files for the configuration data.

   The configuration data is stored in a series of from one to five files, which are SSSU scripts. The file names begin with the name you select, with the restore step appended. For example, if you specify a file name of `LargeEVA.txt`, the resulting configuration files would be `LargeEVA_Step1A.txt, LargeEVA_Step1B`, and so on.

   The contents of the configuration files can be viewed with a text editor.

**NOTE:** If the storage system contains disk drives of different capacities, the HP SSSU procedures used do not guarantee that disk drives of the same capacity will be exclusively added to the same disk group. If you need to restore an array configuration that contains disks of different sizes and types, you must manually recreate these disk groups. The controller software and the `CAPTURE CONFIGURATION` command are not designed to automatically restore this type of configuration. For more information, see the *HP Storage System Scripting Utility Reference*.

### Example 1 Saving configuration data using HP SSSU on a Windows host

To save the storage system configuration:

1. Double-click the HP SSSU desktop icon to run the application. When prompted, enter Manager (management server name or IP address), User name, and Password.
2. Enter `LS SYSTEM` to display the EVA storage systems managed by the management server.
3. Enter `SELECT SYSTEM` *`system name`*, where *system name* is the name of the storage system.
4. Enter `CAPTURE CONFIGURATION` *`pathname\filename`*, where *pathname* identifies the location where the configuration files will be saved, and `filename` is the name used as the prefix for the configurations files: for example, `CAPTURE CONFIGURATION c:\EVAConfig\LargeEVA`
5. Enter `EXIT` to close the command window.

### Example 2 Restoring configuration data using HP SSSU on a Windows host

To restore the storage system configuration:

1. Double-click the HP SSSU desktop icon to run the application.
2. Enter `FILE pathname\filename`, where *pathname* identifies the location where the configuration files are to be saved and *filename* is the name of the first configuration file: for example, `FILE c:\EVAConfig\LargeEVA_Step1A.txt`
3. Repeat the preceding step for each configuration file.

## Adding disk drives to the storage system

As your storage requirements grow, you may be adding disk drives to your storage system. Adding new disk drives is the easiest way to increase the storage capacity of the storage system. Disk drives can be added online without impacting storage system operation.

Consider the following best practices to improve availability when adding disks to an array:

- Set the add disk option to manual.
- Add disks one at a time, waiting a minimum of 60 seconds between disks.
- Distribute disks vertically and as evenly as possible to all disk enclosures.
- Unless otherwise indicated, use the `SET DISK_GROUP` command in the HP Storage System Scripting Utility to add new disks to existing disk groups.
- Add disks in groups of eight.
- For growing existing applications, if the operating system supports virtual disk growth, increase virtual disk size. Otherwise, use a software volume manager to add new virtual disks to applications.

See the disk drive replacement instructions for the steps to add a disk drive. See "Replacement instructions" (page 79) for a link to this document.

### Creating disk groups

The new disks you add will typically be used to create new disk groups. Although you cannot select which disks will be part of a disk group, you can control this by building the disk groups sequentially.

Add the disk drives required for the first disk group, and then create a disk group using these disk drives. Now add the disk drives for the second disk group, and then create that disk group. This process gives you control over which disk drives are included in each disk group.

**NOTE:** Standard and FATA disk drives must be in separate disk groups. Disk drives of different capacities and spindle speeds can be included in the same disk group, but you may want to consider separating them into separate disk groups.

# Handling fiber optic cables

This section provides protection and cleaning methods for fiber optic connectors.

Contamination of the fiber optic connectors on either a transceiver or a cable connector can impede the transmission of data. Therefore, protecting the connector tips against contamination or damage is imperative. The tips can be contaminated by touching them, by dust, or by debris. They can be damaged when dropped. To protect the connectors against contamination or damage, use the dust covers or dust caps provided by the manufacturer. These covers are removed during installation, and are installed whenever the transceivers or cables are disconnected. Cleaning the connectors should remove contamination.

The transceiver dust caps protect the transceivers from contamination. **Do not discard the dust covers.**

△ **CAUTION:** To avoid damage to the connectors, always install the dust covers or dust caps whenever a transceiver or a fiber cable is disconnected. Remove the dust covers or dust caps from transceivers or fiber cable connectors only when they are connected. **Do not discard the dust covers.**

To minimize the risk of contamination or damage, do the following:

- **Dust covers** — Remove and set aside the dust covers and dust caps when installing an I/O module, a transceiver or a cable. Install the dust covers when disconnecting a transceiver or cable.
- **When to clean** — If a connector may be contaminated, or if a connector has not been protected by a dust cover for an extended period of time, clean it.
- **How to clean**:
  1. Wipe the connector with a lint-free tissue soaked with 100% isopropyl alcohol.
  2. Wipe the connector with a dry, lint-free tissue.
  3. Dry the connector with moisture-free compressed air.

One of the many sources for cleaning equipment specifically designed for fiber optic connectors is:

Alcoa Fujikura Ltd.

1-888-385-4587 (North America)

011-1-770-956-7200 (International)

# Using the OCP

## Displaying the OCP menu tree

The Storage System Menu Tree lets you select information to be displayed, configuration settings to change, or procedures to implement. To enter the menu tree, press any navigation push-button when the default display is active.

The menu tree is organized into the following major menus:

- System Info—displays information and configuration settings.
- Fault Management—displays fault information. Information about the Fault Management menu is included in "Controller fault management" (page 107).

- Shutdown Options—initiates the procedure for shutting down the system in a logical, sequential manner. Using the shutdown procedures maintains data integrity and avoids the possibility of losing or corrupting data.
- System Password—create a system password to ensure that only authorized personnel can manage the storage system using HP P6000 Command View.

To enter and navigate the storage system menu tree:

1. Press any push-button while the default display is in view. System Information becomes the active display.
2. Press ▼ to sequence down through the menus.

   Press ▲ to sequence up through the menus.

   Press ▶ to select the displayed menu.

   Press ◀ to return to the previous menu.

**NOTE:** To exit any menu, press **Esc** or wait ten seconds for the OCP display to return to the default display.

Table 13 (page 44) identifies all the menu options available within the OCP display.

△ **CAUTION:** Many of the configuration settings available through the OCP impact the operating characteristics of the storage system. You should not change any setting unless you understand how it will impact system operation. For more information on the OCP settings, contact your HP-authorized service representative.

**Table 13 Menu options within the OCP display**

| System Information | Fault Management | Shutdown Options | System Password |
|---|---|---|---|
| Versions | Last Fault | Restart | Change Password |
| Host Port Config (Sets Fabric or Direct Connect) | Detail View | Power Off | Clear Password |
| Device Port Config (Enables/disables device ports) | | Uninitialize System | Current Password (Set or not) |
| I/O Module Config (Enables/disables auto-bypass) | | | |
| Loop Recovery Config (Enables/disables recoveries) | | | |
| Unbypass Devices | | | |
| UUID Unique Half | | | |
| Debug Flags | | | |
| Print Flags | | | |
| Mastership Status (Displays controller role — master or slave) | | | |

## Displaying system information

**NOTE:** The purpose of this information is to assist the HP-authorized service representative when servicing your system.

The system information displays show the system configuration, including the XCS version, the OCP firmware and application programming interface (API) versions, and the enclosure address bus programmable integrated circuit (PIC) configuration. You can only view, not change, this information.

## Displaying versions system information

When you press ▼, the active display is Versions. From the Versions display you can determine the:

- OCP firmware version
- Controller version
- XCS version

**NOTE:** The terms PPC, Sprite, Glue, SDC, CBIC, and Atlantis are for development purposes and have no significance for normal operation.

**NOTE:** When viewing the software or firmware version information, pressing ◀ displays the Versions Menu tree.

To display System Information:

1. The default display alternates between the Storage System Name display and the World Wide Name display.

   Press any push-button to display the Storage System Menu Tree.
2. Press ▼ until the desired Versions Menu option appears, and then press ▼ or ▶ to move to submenu items.

## Shutting down the system

**CAUTION:** To power off the system for more than 96 hours, use HP P6000 Command View.

You can use the Shutdown System function to implement the shutdown methods listed below. These shutdown methods are explained in Table 14 (page 45).

- Shutting down the controller (see "Shutting the controller down" (page 46)).
- Restarting the system (see "Restarting the system" (page 46)).
- Uninitializing the system (see "Uninitializing the system" (page 46)).

To ensure that you do not mistakenly activate a shutdown procedure, the default state is always NO, indicating *do not implement this procedure*. As a safeguard, implementing any shutdown method requires you to complete at least two actions.

**Table 14 Shutdown methods**

| LCD prompt | Description |
|---|---|
| Restart System? | Implementing this procedure establishes communications between the storage system and HP P6000 Command View. This procedure is used to restore the controller to an operational state where it can communicate with HP P6000 Command View. |
| Power off system? | Implementing this procedure initiates the sequential removal of controller power. This ensures no data is lost. The reasons for implementing this procedure include replacing a drive enclosure. |
| Uninitialize? | Implementing this procedure will cause the loss of all data. For a detailed discussion of this procedure, see "Uninitializing the system" (page 46). |

## Shutting the controller down

Use the following procedure to access the *Shutdown System* display and execute a shutdown procedure.

△ **CAUTION:** If you decide NOT to power off while working in the Power Off menu, *Power Off System NO* must be displayed before you press **Esc**. This reduces the risk of accidentally powering down.

**NOTE:** HP P6000 Command View is the preferred method for shutting down the controller. Shut down the controller from the OCP only if HP P6000 Command View cannot communicate with the controller.

Shutting down the controller from the OCP removes power from the controller on which the procedure is performed only. To restore power, toggle the controller's power.

1. Press ▼ three times to scroll to the Shutdown Options menu.
2. Press ▶ to display *Restart*.
3. Press ▼ to scroll to **Power Off**.
4. Press ▶ to select **Power Off**.
5. *Power off system* is displayed. Press **Enter** to power off the system.

## Restarting the system

To restore the controller to an operational state, use the following procedure to restart the system.

1. Press ▼ three times to scroll to the Shutdown Options menu.
2. Press ▶ to select **Restart**.
3. Press ▶ to display *Restart system?*
4. Press **Enter** to go to Startup.

   No user input is required. The system will automatically initiate the startup procedure and proceed to load the Storage System Name and World Wide Name information from the operational controller.

## Uninitializing the system

Uninitializing the system is another way to shut down the system. This action causes the loss of all storage system data. Because HP P6000 Command View cannot communicate with the disk drive enclosures, the stored data cannot be accessed.

△ **CAUTION:** Uninitializing the system destroys all user data. The WWN will remain in the controller unless both controllers are powered off. The password will be lost. If the controllers remain powered on until you create another storage system (initialize via GUI), you will not have to re-enter the WWN.

Use the following procedure to uninitialize the system.

1. Press ▼ three times to scroll to the Shutdown Options menu.
2. Press ▶ to display *Restart*.
3. Press ▼ twice to display *Uninitialize System*.
4. Press ▶ to display *Uninitialize?*
5. Select **Yes** and press **Enter**.

   The system displays `Delete all data? Enter DELETE:_____`

6. Press the arrow keys to navigate to the open field and type **DELETE** and then press **ENTER**.
   The system uninitializes.

   **NOTE:** If you do not enter the word DELETE or if you press **ESC**, the system does not uninitialize. The bottom OCP line displays `Uninit cancelled`.

## Password options

The password entry options are:

- Entering a password during storage system initialization (see "Entering the storage system password" (page 32)).
- Displaying the current password.
- Changing a password (see "Changing a password" (page 47)).
- Removing password protection (see "Clearing a password" (page 47)).

## Changing a password

For security reasons, you may need to change a storage system password. The password must contain eight to 16 characters consisting of any combination of alpha, numeric, or special. See "Entering the storage system password" (page 32) for more information on valid password characters.

Use the following procedure to change the password.

**NOTE:** Changing a system password on the controller requires changing the password on any HP P6000 Command View with access to the storage system.

1. Select a unique password of 8 to 16 characters.
2. With the default menu displayed, press ▼ three times to display *System Password*.
3. Press ▶ to display *Change Password?*
4. Press **Enter** for yes.
   The default password, *AAAAAAAA~~~~~~~~*, is displayed.
5. Press ▼ or ▲ to select the desired character.
6. Press ▶ to accept this character and select the next character.
7. Repeat the process to enter the remaining password characters.
8. Press **Enter** to enter the password and return to the default display.

## Clearing a password

Use the following procedure to remove storage system password protection.

**NOTE:** Changing a system password on the controller requires changing the password on any HP P6000 Command View with access to the storage system.

1. Press ▼ four times to scroll to the System Password menu.
2. Press ▶ to display *Change Password?*
3. Press ▼ to scroll to *Clear Password*.
4. Press ▶ to display *Clear Password*.
5. Press **Enter** to clear the password.
   The *Password cleared* message will be displayed.

# 4 Configuring application servers

## Overview

This chapter provides general connectivity information for all supported operating systems. Where applicable, an OS-specific section is included to provide more information.

## Clustering

Clustering is connecting two or more computers together so that they behave like a single computer. Clustering may also be used for parallel processing, load balancing, and fault tolerance.

See the Single Point of Connectivity Knowledge (SPOCK) website (http://www.hp.com/storage/spock) for the clustering software supported on each operating system.

**NOTE:** For OpenVMS, you must make the Console LUN ID and OS unit IDs unique throughout the entire SAN, not just the controller subsystem.

## Multipathing

Multipathing software provides a multiple-path environment for your operating system. See the following website for more information:

http://h18006.www1.hp.com/products/sanworks/multipathoptions/index.html

See the Single Point of Connectivity Knowledge (SPOCK) website (http://www.hp.com/storage/spock) for the multipathing software supported on each operating system.

## Installing Fibre Channel adapters

For all operating systems, supported Fibre Channel adapters (FCAs) must be installed in the host server in order to communicate with the EVA.

**NOTE:** Traditionally, the adapter that connects the host server to the fabric is called a host bus adapter (HBA). The server HBA used with the EVA6400/8400 is called a Fibre Channel adapter (FCA). You might also see the adapter called a Fibre Channel host bus adapter (Fibre Channel HBA) in other related documents.

Follow the hardware installation rules and conventions for your server type. The FCA is shipped with its own documentation for installation. See that documentation for complete instructions. You need the following items to begin:

- FCA boards and the manufacturer's installation instructions
- Server hardware manual for instructions on installing adapters
- Tools to service your server

The FCA board plugs into a compatible I/O slot (PCI, PCI-X, PCI-E) in the host system. For instructions on plugging in boards, see the hardware manual.

You can download the latest FCA firmware from the following website http://www.hp.com/support/downloads. Enter HBA in the **Search Products** box and then select your product. For supported FCAs by operating system, see the SPOCK website http://www.hp.com/storage/spock.

# Testing connections to the EVA

After installing the FCAs, you can create and test connections between the host server and the EVA. For all operating systems, you must:

- Add hosts
- Create and present virtual disks
- Verify virtual disks from the hosts

The following sections provide information that applies to all operating systems. For OS-specific details, see the applicable operating system section.

# Adding hosts

To add hosts using HP P6000 Command View:

1. Retrieve and note the worldwide names (WWNs) for each FCA on your host.

   You need this information to select the host FCAs in HP P6000 Command View.
2. Use HP P6000 Command View to add the host and each FCA installed in the host system.

   **NOTE:** To add hosts using HP P6000 Command View, you must add each FCA installed in the host. Select **Add Host** to add the first adapter. To add subsequent adapters, select **Add Port**. Ensure that you add a port for each active FCA.
3. Select the applicable operating system for the host mode.

   **Table 15 Select the host mode for the applicable operating system**

| Operating System | Host mode selection |
|---|---|
| HP-UX | HP-UX |
| IBM AIX | IBM AIX |
| Linux | Linux |
| Mac OS X | Linux |
| OpenVMS | OVMS |
| Oracle Solaris | Sun Solaris |
| VMware | VMware |
| Windows | Microsoft Windows<br>Microsoft Windows 2008<br>Microsoft Windows 2012 |
| Citrix Xen Server | Linux |

4. Check the Host folder in the navigation pane of HP P6000 Command View to verify that the host FCAs are added.

   **NOTE:** More information about HP P6000 Command View is available at http://www.hp.com/support/manuals. Click **Storage Software** under Storage, and then select **HP P6000 Command View software** under Storage Device Management Software.

# Creating and presenting virtual disks

To create and present virtual disks to the host server:

1. From HP P6000 Command View, create a virtual disk on the EVA6400/8400.
2. Specify values for the following parameters:
   - Virtual disk name
   - Vraid level
   - Size
3. Present the virtual disk to the host you added.
4. If applicable (OpenVMS), select a LUN number if you chose a specific LUN on the Virtual Disk Properties window.

## Verifying virtual disk access from the host

To verify that the host can access the newly presented virtual disks, restart the host or scan the bus.

If you are unable to access the virtual disk:

- Verify that all cabling to the switch, EVA, and host is properly connected.
- Verify all firmware levels. For more information, see the Enterprise Virtual Array QuickSpecs and associated release notes.
- Ensure that you are running a supported version of the host operating system. For more information, see the *HP P6000 Enterprise Virtual Array Compatibility Reference*.
- Ensure that the correct host is selected as the operating system for the virtual disk in HP P6000 Command View.
- Ensure that the host WWN number is set correctly (to the host you selected).
- Verify the FCA switch settings.
- Verify that the virtual disk is presented to the host.
- Verify zoning.

## Configuring virtual disks from the host

After you create the virtual disks on the EVA6400/8400 and rescan or restart the host, follow the host-specific conventions for configuring these new disk resources. For instructions, see the documentation included with your server.

# HP-UX

## Scanning the bus

To scan the FCA bus and display information about the EVA6400/8400 devices:

1. Enter the `# ioscan -fnCdisk` command to start the rescan.

   All new virtual disks become visible to the host.
2. Assign device special files to the new virtual disks using the `insf` command.

   **`# insf -e`**

   **NOTE:** Uppercase *E* reassigns device special files to all devices. Lowercase *e* assigns device special files only to the new devices—in this case, the virtual disks.

The following is a sample output from an `ioscan` command:

```
# ioscan -fnCdisk
# ioscan -fnCdisk
Class     I  H/W Patch           Driver    S/W      H/W Type    Description
                State
==========================================================================================
ba        3  0/6                    lba       CLAIMED  BUS_NEXUS  Local PCI Bus
```

```
                                                          Adapter (782)
fc       2  0/6/0/0               td        CLAIMED  INTERFACE  HP Tachyon XL@ 2 FC
                                                          Mass Stor Adap /dev/td2
fcp      0  0/6/0/0.39            fcp       CLAIMED  INTERFACE  FCP Domain
ext_bus  4  0/6/00.39.13.0.0      fcparray  CLAIMED  INTERFACE  FCP Array Interface
target   5  0/6/0/0.39.13.0.0.0    tgt       CLAIMED  DEVICE
ctl      4  0/6/0/0.39.13.0.0.0.0  sctl      CLAIMED  DEVICE     HP  HSV400  /dev/rscsi/c4t0d0
disk     22 0/6/0/0.39.13.0.0.0.1  sdisk     CLAIMED  DEVICE     HP  HSV400  /dev/dsk/c4t0d1
                                                                              /dev/rdsk/c4t0d
ext_bus  5  0/6/0/0.39.13.255.0    fcpdev    CLAIMED  INTERFACE  FCP Device Interface
target   8  0/6/0/0.39.13.255.0.0   tgt       CLAIMED  DEVICE
ctl      20 0/6/0/0.39.13.255.0.0.0  sctl      CLAIMED  DEVICE     HP HSV400 /dev/rscsi/c5t0d0
ext_bus  10 0/6/0/0.39.28.0.0       fcparray  CLAIMED  INTERFACE  FCP Array Interface
target   9  0/6/0/0.39.28.0.0.0     tgt       CLAIMED  DEVICE
ctl      40 0/6/0/0.39.28.0.0.0.0   sctl      CLAIMED  DEVICE     HP HSV400 /dev/rscsi/c10t0d0
disk     46 0/6/0/0.39.28.0.0.0.2   sdisk     CLAIMED  DEVICE     HP HSV400 /dev/dsk/c10t0d2
                                                                              /dev/rdsk/c10t0d2
disk     47 0/6/0/0.39.28.0.0.0.3   sdisk     CLAIMED  DEVICE     HP HSV400 /dev/dsk/c10t0d3
                                                                              /dev/rdsk/c10t0d3
disk     48 0/6/0/0.39.28.0.0.0.4   sdisk     CLAIMED  DEVICE     HP HSV400 /dev/dsk/c10t0d4
                                                                              /dev/rdsk/c10t0d4
disk     49 0/6/0/0.39.28.0.0.0.5   sdisk     CLAIMED  DEVICE     HP HSV400 /dev/dsk/c10t0d5
                                                                              /dev/rdsk/c10t0d5
disk     50 0/6/0/0.39.28.0.0.0.6   sdisk     CLAIMED  DEVICE     HP HSV400 /dev/dsk/c10t0d
                                                                              /dev/rdsk/c10t0d6
disk     51 0/6/0/0.39.28.0.0.0.7   sdisk     CLAIMED  DEVICE     HP HSV400 /dev/dsk/c10t0d7
                                                                              /dev/rdsk/c10t0d7
```

## Creating volume groups on a virtual disk using vgcreate

You can create a volume group on a virtual disk by issuing a `vgcreate` command. This builds the virtual group block data, allowing HP-UX to access the virtual disk. See the `pvcreate`, `vgcreate`, and `lvcreate` man pages for more information about creating disks and file systems. Use the following procedure to create a volume group on a virtual disk:

**NOTE:** Italicized text is for example only.

1. To create the physical volume on a virtual disk, enter a command similar to the following:

   `# pvcreate -f /dev/rdsk/`*`c32t0d1`*

2. To create the volume group directory for a virtual disk, enter a command similar to the following:

   `# mkdir /dev/`*`vg01`*

3. To create the volume group node for a virtual disk, enter a command similar to the following:

   `# mknod /dev/vg01/group c 64 0x010000`

   The designation *64* is the major number that equates to the 64-bit mode. The *0x01* is the minor number in hex, which must be unique for each volume group.

4. To create the volume group for a virtual disk, enter a command similar to the following:

   `# vgcreate –f /dev/`*`vg01`* `/dev/dsk/`*`c32t0d1`*

5. To create the logical volume for a virtual disk, enter a command similar to the following:

   `# lvcreate -L1000 /dev/`*`vg01/lvol1`*

   In this example, a 1-Gb logical volume `(lvol1)` is created.

6. Create a file system for the new logical volume by creating a file system directory name and inserting a mount tap entry into `/etc/fstab`.
7. Run the `mkfs` command on the new logical volume. The new file system is ready to mount.

# IBM AIX

## Accessing IBM AIX utilities

You can access IBM AIX utilities such as the Object Data Manager (ODM), on the following website:

http://www.hp.com/support/downloads

In the Search products box, enter **MPIO**, and then click **AIX MPIO PCMA for HP Arrays**. Select **IBM AIX**, and then select your software storage product.

## Adding hosts

To determine the active FCAs on the IBM AIX host, enter:

```
# lsdev -Cc adapter |grep fcs
```

Output similar to the following appears:

```
fcs0      Available 1H-08    FC Adapter
fcs1      Available 1V-08    FC Adapter
# lscfg -vl
fcs0  fcs0            U0.1-P1-I5/Q1  FC Adapter
    Part Number.................80P4543
    EC Level....................A
    Serial Number...............1F4280A419
    Manufacturer................001F
    Feature Code/Marketing ID...280B
    FRU Number..................     80P4544
    Device Specific.(ZM)........3
    Network Address.............10000000C940F529
    ROS Level and ID............02881914
    Device Specific.(Z0)........1001206D
    Device Specific.(Z1)........00000000
    Device Specific.(Z2)........00000000
    Device Specific.(Z3)........03000909
    Device Specific.(Z4)........FF801315
    Device Specific.(Z5)........02881914
    Device Specific.(Z6)........06831914
    Device Specific.(Z7)........07831914
    Device Specific.(Z8)........20000000C940F529
    Device Specific.(Z9)........TS1.90A4
    Device Specific.(ZA)........T1D1.90A4
    Device Specific.(ZB)........T2D1.90A4
    Device Specific.(YL)........U0.1-P1-I5/Q1b.
```

## Creating and presenting virtual disks

When creating and presenting virtual disks to an IBM AIX host, be sure to:

1. Set the OS unit ID to **0**.
2. Set Preferred path/mode to **No Preference**.
3. Select a LUN number if you chose a specific LUN on the Virtual Disk Properties window.

## Verifying virtual disks from the host

To scan the IBM AIX bus, enter: `cfgmgr -v`

The `-v` switch (verbose output) requests a full output.

To list all EVA devices, enter:

Output similar to the following is displayed:

```
hdisk1  Available 1V-08-01     HP HSV400 Enterprise Virtual Array
hdisk2  Available 1V-08-01     HP HSV400 Enterprise Virtual Array
hdisk3  Available 1V-08-01     HP HSV400 Enterprise Virtual Array
```

# Linux

## HBA drivers

For most configurations and the latest version of Linux distributions, native HBA drivers are the supported drivers. *Native driver* means the driver that is included with the OS distribution.

**NOTE:** The term *inbox driver* is also sometimes used and means the same as *native driver*.

However, in some configurations, it may require the use of an out-of-box driver, which typically requires a driver package be downloaded and installed on the host. In those cases, follow the documentation of the driver package for instruction. Driver support information can be found on the Single Point of Connectivity Knowledge (SPOCK) website:

http://www.hp.com/storage/spock

**NOTE:** Registration is required to access SPOCK.

### Verifying virtual disks from the host

To ensure that the LUN is recognized after a virtual disk is presented to the host, do one of the following:

- Reboot the host.
- Enter the following command (where X is the SCSI host enumerator of the HBA):

  ```
  echo "- - -" /sys/class/scsi_host/host[X]/scan
  ```

To verify that the host can access the virtual disks, enter the **`# more /proc/scsi/scsi`** command.

The output lists all SCSI devices detected by the server. An EVA6400/8400 LUN entry looks similar to the following:

```
Host: scsi3 Channel: 00 ID: 00 Lun: 01
Vendor: HP      Model: HSV400        Rev:
Type: Direct-Access                      ANSI SCSI revision: 02
```

## OpenVMS

### Updating the AlphaServer console code, Integrity Server console code, and Fibre Channel FCA firmware

The firmware update procedure varies for the different server types. To update firmware, follow the procedure described in the Installation instructions that accompany the firmware images.

### Verifying the Fibre Channel adapter software installation

A supported FCA should already be installed in the host server. The procedure to verify that the console recognizes the installed FCA varies for the different server types. Follow the procedure described in the Installation instructions that accompany the firmware images.

### Console LUN ID and OS unit ID

HP P6000 Command View software contains a box for the Console LUN ID on the Initialized Storage System Properties window.

It is important that you set the Console LUN ID to a number other than zero. If the Console LUN ID is not set or is set to zero, the OpenVMS host will not recognize the controller pair. The Console LUN ID for a controller pair must be unique within the SAN. Table 16 (page 54) shows an example of the Console LUN ID.

You can set the OS unit ID on the Virtual Disk Properties window. The default setting is 0, which disables the ID field. To enable the ID field, you must specify a value between 1 and 32767,

ensuring that the number you enter is unique within the SAN. An OS Unit ID greater than 9999 is not capable of being served by MSCP.

△ **CAUTION:** It is possible to enter a duplicate Console LUN ID or OS unit ID number. You must ensure that you enter a Console LUN ID and OS Unit ID that is not already in use. A duplicate Console LUN ID or OS Unit ID can allow the OpenVMS host to corrupt data due to confusion about LUN identity. It can also prevent the host from recognizing the controllers.

**Table 16 Comparing console LUN to OS unit ID**

| ID type | System Display |
|---|---|
| Console LUN ID set to 100 | $1$GGA100: |
| OS unit ID set to 50 | $1$DGA50: |

## Adding OpenVMS hosts

To obtain WWNs on AlphaServers, do one of the following:

- Enter the **`show device fg/full`** OVMS command.
- Use the **`WWIDMGR -SHOW PORT`** command at the SRM console.

To obtain WWNs on Integrity servers, do one of the following:

- Enter the **`show device fg/full`** OVMS command.
- Use the following procedure from the server console:
  1. From the EFI boot Manager, select **EFI Shell**.
  2. In the EFI Shell, enter "`Shell> drivers`".

     A list of EFI drivers loaded in the system is displayed.
  3. In the listing, find the line for the FCA for which you want to get the WWN information.

     For a Qlogic HBA, look for `HP 4 Gb Fibre Channel Driver` or `HP 2 Gb Fibre Channel Driver` as the driver name. For example:

```
            T   D
D           Y C I
R           P F A
V  VERSION  E G G #D #C DRIVER NAME                          IMAGE NAME
== ======== = = = == == ================================== ==================
22 00000105 B X X  1  1 HP 4 Gb Fibre Channel Driver        PciROM:0F:01:01:002
```

  4. Note the driver handle in the first column (22 in the example).
  5. Using the driver handle, enter the **`drvdfg`** *`driver_handle`* command to find the Device Handle (`Ctrl`). For example:

```
Shell> drvcfg 22
Configurable Components
Drv[22]  Ctrl[25]  Lang[eng]
```

  6. Using the driver and device handle, enter the **`drvdfg –s`** *`driver_handle device_handle`* command to invoke the EFI Driver configuration utility. For example:

```
Shell> drvcfg -s 22 25
```

  7. From the `Fibre Channel Driver Configuration Utility` list, select item 8 (**`Info`**) to find the WWN for that particular port.

     Output similar to the following appears:

```
Adapter Path:  Acpi(PNP0002,0300)/Pci(01|01)
Adapter WWPN:   50060B00003B478A
Adapter WWNN:   50060B00003B478B
Adapter S/N:    3B478A
```

## Scanning the bus

Enter the following command to scan the bus for the OpenVMS virtual disk:

```
$ MC SYSMAN IO AUTO/LOG
```

A listing of LUNs detected by the scan process is displayed. Verify that the new LUNs appear on the list.

**NOTE:** The EVA6400/8400 console LUN can be seen without any virtual disks presented. The LUN appears as `$1$GGAx` (where *x* represents the console LUN ID on the controller).

After the system scans the fabric for devices, you can verify the devices with the `SHOW DEVICE` command:

```
$ SHOW DEVICE NAME-OF-VIRTUAL-DISK/FULL
```

For example, to display device information on a virtual disk named `$1$DGA50`, enter **`$ SHOW DEVICE $1$DGA50:/FULL`**.

The following output is displayed:

```
Disk $1$DGA50: (BRCK18), device type HSV210, is online, file-oriented device,
    shareable, device has multiple I/O paths, served to cluster via MSCP Server,
    error logging is enabled.

    Error count                    2    Operations completed              4107
    Owner process                 ""    Owner UIC                      [SYSTEM]
    Owner process ID        00000000    Dev Prot            S:RWPL,O:RWPL,G:R,W
    Reference count                0    Default buffer size                512
    Current preferred CPU Id       0    Fastpath                             1
    WWID   01000010:6005-08B4-0010-70C7-0001-2000-2E3E-0000
    Host name                "BRCK18"    Host type, avail AlphaServer DS10 466 MHz, yes
    Alternate host name       "VMS24"    Alt. type, avail HP rx3600  (1.59GHz/9.0MB), yes
    Allocation class               1

  I/O paths to device              9
  Path PGA0.5000-1FE1-0027-0A38 (BRCK18), primary path.
    Error count                    0    Operations completed               145
  Path PGA0.5000-1FE1-0027-0A3A (BRCK18).
    Error count                    0    Operations completed               338
  Path PGA0.5000-1FE1-0027-0A3E (BRCK18).
    Error count                    0    Operations completed               276
  Path PGA0.5000-1FE1-0027-0A3C (BRCK18).
    Error count                    0    Operations completed               282
  Path PGB0.5000-1FE1-0027-0A39 (BRCK18).
    Error count                    0    Operations completed               683
  Path PGB0.5000-1FE1-0027-0A3B (BRCK18).
    Error count                    0    Operations completed               704
  Path PGB0.5000-1FE1-0027-0A3D (BRCK18).
    Error count                    0    Operations completed               853
  Path PGB0.5000-1FE1-0027-0A3F (BRCK18), current path.
    Error count                    2    Operations completed               826
  Path MSCP  (VMS24).
    Error count                    0    Operations completed                 0
```

You can also use the `SHOW DEVICE DG` command to display a list of all Fibre Channel disks presented to the OpenVMS host.

**NOTE:** Restarting the host system shows any newly presented virtual disks because a hardware scan is performed as part of the startup.

If you are unable to access the virtual disk, do the following:

- Check the switch zoning database.
- Use HP P6000 Command View to verify the host presentations.
- Check the SRM console firmware on AlphaServers.
- Ensure that the correct host is selected for this virtual disk and that a unique OS Unit ID is used in HP P6000 Command View.

## Configuring virtual disks from the OpenVMS host

To set up disk resources under OpenVMS, initialize and mount the virtual disk resource as follows:

1. Enter the following command to initialize the virtual disk:

   ```
   $ INITIALIZE name-of-virtual-disk volume-label
   ```

2. Enter the following command to mount the disk:

   ```
   MOUNT/SYSTEM name-of-virtual-disk volume-label
   ```

   **NOTE:** The `/SYSTEM` switch is used for a single stand-alone system, or in clusters if you want to mount the disk only to select nodes. You can use the `/CLUSTER` switch for OpenVMS clusters. However, if you encounter problems in a large cluster environment, HP recommends that you enter a `MOUNT/SYSTEM` command on each cluster node.

3. View the virtual disk's information with the `SHOW DEVICE` command. For example, enter the following command sequence to configure a virtual disk named `data1` in a stand-alone environment:

   ```
   $ INIT $1$DGA1: data1
   $ MOUNT/SYSTEM $1$DGA1: data1
   $ SHOW DEV $1$DGA1: /FULL
   ```

## Setting preferred paths

You can set or change the preferred path used for a virtual disk by using the `SET DEVICE /PATH` command. For example:

```
$ SET DEVICE $1$DGA83: /PATH=PGA0.5000-1FE1-0007-9772/SWITCH
```

This allows you to control which path each virtual disk uses.

You can use the `SHOW DEV/FULL` command to display the path identifiers.

For additional information on using OpenVMS commands, see the OpenVMS help file:

```
$ HELP TOPIC
```

For example, the following command displays help information for the `MOUNT` command:

```
$ HELP MOUNT
```

# Oracle Solaris

**NOTE:** The information in this section applies to both SPARC and x86 versions of the Oracle Solaris operating system.

## Loading the operating system and software

Follow the manufacturer's instructions for loading the operating system (OS) and software onto the host. Load all OS patches and configuration utilities supported by HP and the FCA manufacturer.

## Configuring FCAs with the Oracle SAN driver stack

Sun-branded FCAs are supported only with the Oracle SAN driver stack. The Oracle SAN driver stack is also compatible with current Emulex FCAs and QLogic FCAs. Support information is available on the Oracle website: http://www.oracle.com/technetwork/server-storage/solaris/overview/index-136292.html

To determine which non-Orcle branded FCAs HP supports with the Oracle SAN driver stack, see the latest MPxIO application notes or contact your HP representative.

Update instructions depend on the version of your OS:

- For Solaris 9, install the latest Oracle StorEdge SAN software with associated patches. To locate the software, log in to My Oracle Support:

  https://support.oracle.com/CSP/ui/flash.html

  1. Select the **Patches & Updates** tab and then search for **StorEdge SAN Foundation Software 4.4** (formerly called StorageTek SAN 4.4).
  2. Reboot the host after the required software/patches have been installed. No further activity is required after adding any new LUNs once the array ports have been configured with the `cfgadm -c` command for Solaris 9.

     Examples for two FCAs:

     ```
     cfgadm -c configure c3
     cfgadm -c configure c4
     ```

  3. Increase retry counts and reduce I/O time by adding the following entries to the `/etc/system` file:

     ```
     set ssd:ssd_retry_count=0xa
     set ssd:ssd_io_time=0x1e
     ```

  4. Reboot the system to load the newly added parameters.

- For Solaris 10, go the Oracle Software Downloads website (http://www.oracle.com/technetwork/indexes/downloads/index.html) to install the latest patches. Under Servers and Storage Systems, select **Solaris 10**. Reboot the host once the required software/patches have been installed. No further activity is required after adding new LUNs, as the controller and LUN recognition are automatic for Solaris 10.
  1. For Solaris 10 x86/64, ensure patch 138889-03 or later is installed. For SPARC, ensure patch 138888-03 or later is installed.
  2. Increase the retry counts by adding the following line to the `/kernel/drv/sd.conf` file:

     ```
     sd-config-list="HP HSV","retries-timeout:10";
     ```

  3. Reduce the I/O timeout value to 30 seconds by adding the following line to the /etc/system file:

     ```
     set sd:sd_io_time=0x1e
     ```

  4. Reboot the system to load the newly added parameters.

## Configuring Emulex FCAs with the lpfc driver

To configure Emulex FCAs with the lpfc driver:

1. Ensure that you have the latest supported version of the lpfc driver (see http://www.hp.com/storage/spock).

   You must sign up for an HP Passport to enable access. For more information on how to use SPOCK, see the Getting Started Guide (http://h20272.www2.hp.com/Pages/spock_overview/introduction.html).

2. Edit the following parameters in the `/kernel/drv/lpfc.conf` driver configuration file to set up the FCAs for a SAN infrastructure:

   ```
   topology=2;
   scan-down=0;
   nodev-tmo=60;
   linkdown-tmo=60;
   ```

3. If using a single FCA and no multipathing, edit the following parameter to reduce the risk of data loss in case of a controller reboot:

   ```
   nodev-tmo=120;
   ```

4. If using Veritas Volume Manager (VxVM) DMP for multipathing (single or multiple FCAs), edit the following parameter to ensure proper VxVM behavior:

   ```
   no-device-delay=0;
   ```

5. In a fabric topology, use persistent bindings to bind a SCSI target ID to the world wide port name (WWPN) of an array port. This ensures that the SCSI target IDs remain the same when the system reboots. Set persistent bindings by editing the configuration file or by using the HBA management software.

   **NOTE:** HP recommends that you assign target IDs in sequence, and that the EVA has the same target ID on each host in the SAN.

   The following example for an EVA6400/8400 illustrates the binding of targets 20 and 21 (lpfc instance 2) to WWPNs 50001fe100270938 and 50001fe100270939, and the binding of targets 30 and 31 (lpfc instance 0) to WWPNs 50001fe10027093a and 50001fe10027093b:

   ```
   fcp-bind-WWPN="50001fe100270938:lpfc2t20",
                 "50001fe100270939:lpfc2t21",
                 "50001fe10027093a:lpfc0t30",
                 "50001fe10027093b:lpfc0t31";
   ```

   **NOTE:** Replace the WWPNs in the example with the WWPNs of your array ports.

6. For each LUN that will be accessed, add an entry to the `/kernel/drv/sd.conf` file. For example, if you want to access LUNs 1 and 2 through all four paths, add the following entries to the end of the file:

   ```
   name="sd" parent="lpfc" target=20 lun=1;
   name="sd" parent="lpfc" target=21 lun=1;
   name="sd" parent="lpfc" target=30 lun=1;
   name="sd" parent="lpfc" target=31 lun=1;
   name="sd" parent="lpfc" target=20 lun=2;
   name="sd" parent="lpfc" target=21 lun=2;
   name="sd" parent="lpfc" target=30 lun=2;
   name="sd" parent="lpfc" target=31 lun=2;
   ```

7. Reboot the server to implement the changes to the configuration files.
8. If LUNs have been preconfigured in the `/kernel/drv/sd.conf` file, use the `devfsadm` command to perform LUN rediscovery after configuring the file.

   **NOTE:** The lpfc driver is *not* supported for Oracle StorEdge Traffic Manager/Sun Storage Multipathing. To configure an Emulex FCA using the Oracle SAN driver stack, see "Configuring FCAs with the Oracle SAN driver stack" (page 56).

## Configuring QLogic FCAs with the qla2300 driver

See the latest Enterprise Virtual Array release notes or contact your HP representative to determine which QLogic FCAs and which driver version HP supports with the qla2300 driver. To configure QLogic FCAs with the qla2300 driver:

1. Ensure that you have the latest supported version of the qla2300 driver (see http://www.qlogic.com).

2. You must sign up for an HP Passport to enable access. For more information on how to use SPOCK, see the Getting Started Guide (http://www.qlogic.com).
3. Edit the following parameters in the `/kernel/drv/qla2300.conf` driver configuration file to set up the FCAs for a SAN infrastructure (HBA0 is used in the example, but the parameter edits apply to all HBAs):

   **NOTE:** If you are using a Sun-branded QLogic FCA, the configuration file is `\kernal\drv\qlc.conf`.

   ```
   hba0-connection-options=1;
   hba0-link-down-timeout=60;
   hba0-persistent-binding-configuration=1;
   ```

   **NOTE:** If you are using Solaris 10, editing the persistent binding parameter is not required.

4. If using a single FCA and no multipathing, edit the following parameters to reduce the risk of data loss in case of a controller reboot:

   ```
   hba0-login-retry-count=60;
   hba0-port-down-retry-count=60;
   hba0-port-down-retry-delay=2;
   ```

   The `hba0-port-down-retry-delay` parameter is *not* supported with the 4.13.01 driver; the time between retries is fixed at approximately 2 seconds.
5. In a fabric topology, use persistent bindings to bind a SCSI target ID to the world wide port name (WWPN) of an array port. This ensures that the SCSI target IDs remain the same when the system reboots. Set persistent bindings by editing the configuration file or by using the `SANsurfer` utility.

   **NOTE:** Persistent binding is not required for QLogic FCAs if you are using Solaris 10.

   The following example for an EVA6400/8400 illustrates the binding of targets 20 and 21 (hba instance 0) to WWPNs 50001fe100270938 and 50001fe100270939, and the binding of targets 30 and 31 (hba instance 1) to WWPNs 50001fe10027093a and 50001fe10027093b:

   ```
   hba0-SCSI-target-id-20-fibre-channel-port-name="50001fe100270938";
   hba0-SCSI-target-id-21-fibre-channel-port-name="50001fe10027093a";
   hba1-SCSI-target-id-30-fibre-channel-port-name="50001fe100270939";
   hba1-SCSI-target-id-31-fibre-channel-port-name="50001fe10027093b";
   ```

   **NOTE:** Replace the WWPNs in the example with the WWPNs of your array ports.

6. If the qla2300 driver is version 4.13.01 or earlier, for each LUN that users will access add an entry to the `/kernel/drv/sd.conf` file:

   ```
   name="sd" class="scsi" target=20 lun=1;
   name="sd" class="scsi" target=21 lun=1;
   name="sd" class="scsi" target=30 lun=1;
   name="sd" class="scsi" target=31 lun=1;
   ```

   If LUNs are preconfigured in the `/kernel/drv/sd.conf` file, after changing the configuration file. use the `devfsadm` command to perform LUN rediscovery.
7. If the qla2300 driver is version 4.15 or later, verify that the following or a similar entry is present in the `/kernel/drv/sd.conf` file:

   ```
   name="sd" parent="qla2300" target=2048;
   ```

To perform LUN rediscovery after configuring the LUNs, use the following command:

```
/opt/QLogic_Corporation/drvutil/qla2300/qlreconfig -d qla2300 -s
```

8. Reboot the server to implement the changes to the configuration files.

**NOTE:** The qla2300 driver is *not* supported for Oracle StorEdge Traffic Manager/Sun Storage Multipathing. To configure a QLogic FCA using the Oracle SAN driver stack, see "Configuring FCAs with the Oracle SAN driver stack" (page 56).

## Fabric setup and zoning

To set up the fabric and zoning:

1. Verify that the Fibre Channel cable is connected and firmly inserted at the array ports, host ports, and SAN switch.
2. Through the Telnet connection to the switch or Switch utilities, verify that the WWN of the EVA ports and FCAs are present and online.
3. Create a zone consisting of the WWNs of the EVA ports and FCAs, and then add the zone to the active switch configuration.
4. Enable and then save the new active switch configuration.

**NOTE:** There are variations in the steps required to configure the switch between different vendors. For more information, see the *HP SAN Design Reference Guide*, available for downloading on the HP website: http://www.hp.com/go/sandesign.

## Oracle StorEdge Traffic Manager (MPxIO)/Oracle Storage Multipathing

Oracle StorEdge Traffic Manager (MPxIO)/Sun Storage Multipathing can be used for FCAs configured with the Oracle SAN driver depending on the operating system version, architecture (SPARC/x86), and patch level installed. For configuration details, see the *HP MPxIO application notes*, available on the HP support website: http://www.hp.com/support/manuals.

**NOTE:** MPxIO is included in the SPARC and x86 Oracle SAN driver. A separate installation of MPxIO is not required.

In the `Search products` box, enter **`MPxIO`**, and then click the search symbol. Select the application notes from the search results.

## Configuring with Veritas Volume Manager

The Dynamic Multipathing (DMP) feature of Veritas Volume Manager (VxVM) can be used for all FCAs and all drivers. EVA disk arrays are certified for VxVM support. When you install FCAs, ensure that the driver parameters are set correctly. Failure to do so can result in a loss of path failover in DMP. For information about setting FCA parameters, see "Configuring FCAs with the Oracle SAN driver stack" (page 56) and the FCA manufacturer's instructions.

The DMP feature requires an Array Support Library (ASL) and an Array Policy Module (APM). The ASL/APM enables Asymmetric Logical Unit Access (ALUA). LUNs are accessed through the primary controller. After enablement, use the `vxdisk list <device>` command to determine the primary and secondary paths. For VxVM 4.1 (MP1 or later), you must download the ASL/APM from the Symantec/Veritas support site for installation on the host. This download and installation is *not* required for VxVM 5.0 or later.

To download and install the ASL/APM from the Symantec/Veritas support website:

1. Go to http://support.veritas.com.
2. Enter **Storage Foundation for UNIX/Linux** in the Product Lookup box.
3. Enter **EVA** in the **Enter key words or phrase** box, and then click the search symbol.
4. To further narrow the search, select **Solaris** in the Platform box.
5. Read `TechNotes` and follow the instructions to download and install the ASL/APM.

6. Run `vxdctl enable` to notify VxVM of the changes.
7. Verify the configuration of VxVM as shown in Example 3 "Verifying the VxVM configuration" (the output may be slightly different depending on your VxVM version and the array configuration).

### Example 3 Verifying the VxVM configuration

```
# vxddladm listsupport all | grep HP
libvxhpevale.so    HP  HSV300, HSV400, HSV450

# vxddladm listsupport libname=libvxhpevale.so
ATTR_NAME            ATTR_VALUE
=====================================================================
LIBNAME              libvxhpevale.so
VID                  HP
PID                  HSV300, HSV400, HSV450
ARRAY_TYPE           A/A-A-HP
ARRAY_NAME           EVA4400, EVA6400, EVA8400

# vxdmpadm listapm all | grep HP
dmphpalua          dmphpalua              1        A/A-A-HP          Active
# vxdmpadm listapm dmphpalua
Filename:               dmphpalua
APM name:               dmphpalua
APM version:            1
Feature:                VxVM
VxVM version:           41
Array Types Supported:  A/A-A-HP
Depending Array Types:  A/A-A
State:                  Active

# vxdmpadm listenclosure all
ENCLR_NAME        ENCLR_TYPE     ENCLR_SNO            STATUS       ARRAY_TYPE
=============================================================================
Disk              Disk           DISKS                CONNECTED    Disk
EVA84000          EVA8400        50001FE1002709E0     CONNECTED    A/A-A-HP
```

By default, the EVA I/O policy is set to `Round-Robin`. For VxVM 4.1 MP1, only one path is used for the I/Os with this policy. Therefore, HP recommends that you change the I/O policy to `Adaptive` in order to use all paths to the LUN on the primary controller. Example 4 "Setting the I/O policy" shows the commands you can use to check and change the I/O policy.

### Example 4 Setting the I/O policy

```
# vxdmpadm getattr arrayname EVA8400 iopolicy
ENCLR_NAME      DEFAULT         CURRENT
============================================
EVA84000        Round-Robin     Round-Robin

# vxdmpadm setattr arrayname EVA8400 iopolicy=adaptive

# vxdmpadm getattr arrayname EVA8400 iopolicy
ENCLR_NAME      DEFAULT         CURRENT
============================================
EVA84000        Round-Robin     Adaptive
```

## Configuring virtual disks from the host

The procedure used to configure the LUN path to the array depends on the FCA driver. For more information, see "Installing Fibre Channel adapters" (page 48).

To identify the WWLUN ID assigned to the virtual disk and/or the LUN assigned by the storage administrator:

- Oracle SAN driver, with MPxIO enabled:
  - You can use the `luxadm probe` command to display the array/node WWN and associated array for the devices.
  - The WWLUN ID is part of the device file name. For example:

    ```
    /dev/rdsk/c5t600508B4001030E40000500000B20000d0s2
    ```

  - If you use `luxadm display`, the LUN is displayed after the device address. For example:

    ```
    50001fe1002709e9,5
    ```

- Oracle SAN driver, without MPxIO:
  - The EVA WWPN is part of the file name (which helps you to identify the controller). For example:

    ```
    /dev/rdsk/c3t50001FE1002709E8d5s2
    /dev/rdsk/c3t50001FE1002709ECd5s2
    /dev/rdsk/c4t50001FE1002709E9d5s2
    /dev/rdsk/c4t50001FE1002709EDd5s2
    ```

    If you use `luxadm probe`, the array/node WWN and the associated device files are displayed.

  - You can retrieve the WWLUN ID as part of the `format -e` (scsi, inquiry) output; however, it is cumbersome and hard to read. For example:

    ```
    09 e8 20 04 00 00 00 00 00 00 35 30 30 30 31 46     .........50001F
    45 31 30 30 32 37 30 39 45 30 35 30 30 30 31 46     E1002709E050001F
    45 31 30 30 32 37 30 39 45 38 36 30 30 35 30 38     E1002709E8600508
    42 34 30 30 31 30 33 30 45 34 30 30 30 30 35 30     B4001030E4000050
    30 30 30 30 42 32 30 30 30 30 00 00 00 00 00 00     0000B20000
    ```

  - The assigned LUN is part of the device file name. For example:

    ```
    /dev/rdsk/c3t50001FE1002709E8d5s2
    ```

    You can also retrieve the LUN with `luxadm display`. The LUN is displayed after the device address. For example:

    ```
    50001fe1002709e9,5
    ```

- Emulex (lpfc)/QLogic (qla2300) drivers:
  - You can retrieve the WWPN by checking the assignment in the driver configuration file (the easiest method, because you then know the assigned target) or by using HBA management software.
  - You can retrieve the WWLUN ID by using HBA management software.

    You can also retrieve the WWLUN ID as part of the `format -e` (scsi, inquiry) output; however, it is cumbersome and difficult to read. For example:

    ```
    09 e8 20 04 00 00 00 00 00 00 35 30 30 30 31 46     .........50001F
    45 31 30 30 32 37 30 39 45 30 35 30 30 30 31 46     E1002709E050001F
    45 31 30 30 32 37 30 39 45 38 36 30 30 35 30 38     E1002709E8600508
    42 34 30 30 31 30 33 30 45 34 30 30 30 30 35 30     B4001030E4000050
    30 30 30 30 42 32 30 30 30 30 00 00 00 00 00 00     0000B20000
    ```

  - The assigned LUN is part of the device file name. For example:

    ```
    /dev/dsk/c4t20d5s2
    ```

## Verifying virtual disks from the host

Verify that the host can access virtual disks by using the `format` command. See Example 5 "Format command".

### Example 5 Format command

```
# format
Searching for disks...done
c2t50001FE1002709F8d1: configured with capacity of 1008.00MB
c2t50001FE1002709F8d2: configured with capacity of 1008.00MB
c2t50001FE1002709FCd1: configured with capacity of 1008.00MB
c2t50001FE1002709FCd2: configured with capacity of 1008.00MB
c3t50001FE1002709F9d1: configured with capacity of 1008.00MB
c3t50001FE1002709F9d2: configured with capacity of 1008.00MB
c3t50001FE1002709FDd1: configured with capacity of 1008.00MB
c3t50001FE1002709FDd2: configured with capacity of 1008.00MB

AVAILABLE DISK SELECTIONS:

0. c0t0d0 <SUN18G cyl 7506 alt 2 hd 19 sec 248> /pci@1f,4000/scsi@3/sd@0,0
1. c2t50001FE1002709F8d1 <HP-HSV400-0952 cyl 126 alt 2 hd 128 sec 128>
     /pci@1f,4000/QLGC,qla@4/fp@0,0/ssd@w50001fe1002709f8,1
2. c2t50001FE1002709F8d2 <HP-HSV400-0952 cyl 126 alt 2 hd 128 sec 128>
     /pci@1f,4000/QLGC,qla@4/fp@0,0/ssd@w50001fe1002709f8,2
3. c2t50001FE1002709FCd1 <HP-HSV400-0952 cyl 126 alt 2 hd 128 sec 128>
     /pci@1f,4000/QLGC,qla@4/fp@0,0/ssd@w50001fe1002709fc,1
4. c2t50001FE1002709FCd2 <HP-HSV400-0952 cyl 126 alt 2 hd 128 sec 128>
     /pci@1f,4000/QLGC,qla@4/fp@0,0/ssd@w50001fe1002709fc,2
5. c3t50001FE1002709F9d1 <HP-HSV400-0952 cyl 126 alt 2 hd 128 sec 128>
     /pci@1f,4000/lpfc@5/fp@0,0/ssd@w50001fe1002709f9,1
6. c3t50001FE1002709F9d2 <HP-HSV400-0952 cyl 126 alt 2 hd 128 sec 128>
     /pci@1f,4000/lpfc@5/fp@0,0/ssd@w50001fe1002709f9,2
7. c3t50001FE1002709FDd1 <HP-HSV400-0952 cyl 126 alt 2 hd 128 sec 128>
     /pci@1f,4000/lpfc@5/fp@0,0/ssd@w50001fe1002709fd,1
8. c3t50001FE1002709FDd2 <HP-HSV400-0952 cyl 126 alt 2 hd 128 sec 128>
     /pci@1f,4000/lpfc@5/fp@0,0/ssd@w50001fe1002709fd,2
Specify disk (enter its number):
```

If you cannot access the virtual disks:

- Verify the zoning.
- For Oracle Solaris, verify that the correct WWPNs for the EVA (lpfc, qla2300 driver) have been configured and the target assignment is matched in `/kernel/drv/sd.conf` (lpfc and qla2300 4.13.01).

## Labeling and partitioning the devices

Label and partition the new devices using the Oracle format utility:

△ **CAUTION:** When selecting disk devices, be careful to select the correct disk because using the label/partition commands on disks that have data can cause data loss.

1. Enter the **`format`** command at the root prompt to start the utility.
2. Verify that all new devices are displayed. If not, enter **quit** or press **Ctrl+D** to exit the format utility and verify that the configuration is correct (see "Configuring virtual disks from the host" (page 61)).
3. Record the character-type device file names (for example, c1t2d0) for all new disks.

   You will use this data to create the file systems or to use the file system with the Solaris or Veritas Volume Manager.
4. When prompted to specify the disk, enter the number of the device to be labeled.

5. When prompted to label the disk, enter `Y`.
6. Because the virtual geometry of the presented volume varies with size, select `autoconfigure` as the disk type.
7. If you are not using Veritas Volume Manager, use the `partition` command to create or adjust the partitions.
8. For each new device, use the `disk` command to select another disk, and then repeat Step 1 through Step 5.
9. When you finish labeling the disks, enter **`quit`** or press **Ctrl+D** to exit the format utility.

   For more information, see the *System Administration Guide: Devices and File Systems* for your operating system, available on the Oracle website:

   http://www.oracle/com/technetwork/indexes/documentation/index.html

**NOTE:** Some format commands are not applicable to the EVA storage systems.

# VMware

## Configuring the EVA6400/8400 with VMware host servers

To configure an EVA6400/8400 on a VMware ESX server:

1. Using HP P6000 Command View, configure a host for one ESX server.
2. Verify that the Fibre Channel Adapters (FCAs) are populated in the world wide port name (WWPN) list. Edit the WWPN, if necessary.
3. Set the connection type to `VMware`.
4. To configure additional ports for the ESX server:
   a. Select a host (defined in Step 1).
   b. Select the **Ports** tab in the Host Properties window.
   c. Add additional ports for the ESX server.
5. Perform one of the following tasks to locate the WWPN:
   - From the service console, enter the **`wwpn.pl`** command.

     Output similar to the following is displayed:

     ```
     [root@gnome7 root]# wwpn.plvmhba0: 210000e08b09402b (QLogic)
     6:1:0vmhba1:
     210000e08b0ace2d (QLogic) 6:2:0[root@gnome7 root]#
     ```

   - Check the SCSI device information section of `/proc/scsi/qla2300/`*`X`* directory, where *`X`* is a bus instance number.

     Output similar to the following is displayed:

     ```
     SCSI Device Information:
     scsi-qla0-adapter-node=200000e08b0b0638;
     scsi-qla0-adapter-port=210000e08b0b0638;
     ```

6. Repeat this procedure for each ESX server.

## Configuring an ESX server

This section provides information about configuring the ESX server.

### Loading the FCA NVRAM

The FCA stores configuration information in the non-volatile RAM (NVRAM) cache. You must download the configuration for HP Storage products.

Perform one of the following procedures to load the NVRAM:

- If you have a HP ProLiant blade server:
  1. Download the supported FCA BIOS update, available on http://www.hp.com/support/downloads, to a virtual floppy.

     For instructions on creating and using a virtual floppy, see the *HP Integrated Lights-Out user guide*.
  2. Unzip the file.
  3. Follow the instructions in the readme file to load the NVRAM configuration onto each FCA.
- If you have a blade server other than a ProLiant blade server:
  1. Download the supported FCA BIOS update, available on http://www.hp.com/support/downloads.
  2. Unzip the file.
  3. Follow the instructions in the readme file to load the NVRAM configuration onto each FCA.

## Setting the multipathing policy

You can set the multipathing policy for each LUN or logical drive on the SAN to one of the following:

- Most recently used (MRU)
- Fixed
- Preferred
- Round robin (applicable only for ESX4.x and ESXi5.x)

### ESX 3.x commands

- The `# esxcfg-mpath --policy=mru --lun=vmhba0:0:1` command sets `vmhba0:0:1` with an MRU multipathing policy.
- The `# esxcfg-mpath --policy=fixed --lun=vmhba0:0:1` command sets `vmhba1:0:1` with a Fixed multipathing policy.
- The `# esxcfg-mpath --preferred --path=vmhba2:0:1 --lun=vmhba2:0:1` command sets `vmhba2:0:1` with a Preferred multipathing policy.

### ESX 4.x commands

- The `# esxcli nmp device setpolicy --device naa.6001438002a56f220001100000710000 --psp VMW_PSP_MRU` command sets device `naa.6001438002a56f220001100000710000` with an MRU multipathing policy.
- The `# esxcli nmp device setpolicy --device naa.6001438002a56f220001100000710000 --psp VMW_PSP_FIXED` command sets device `naa.6001438002a56f220001100000710000` with a Fixed multipathing policy.
- The `# esxcli nmp device setpolicy --device naa.6001438002a56f220001100000710000 --psp VMW_PSP_RR` command sets device `naa.6001438002a56f220001100000710000` with a RoundRobin multipathing policy.

**NOTE:** Each LUN can be accessed through both EVA storage controllers at the same time; however, each LUN path is optimized through one controller. To optimize performance, if the LUN multipathing policy is Fixed, all servers must use a path to the same controller.

### ESXi 5.x

- The `# esxcli storage nmp device set --device naa.6001438002a56f220001100000710000 --psp VMW_PSP_MRU` command sets device `naa.6001438002a56f220001100000710000` with an MRU multipathing policy.
- The `# esxcli storage nmp device set --device naa.6001438002a56f220001100000710000 --psp VMW_PSP_FIXED` command sets device `naa.6001438002a56f220001100000710000` with a Fixed multipathing policy.
- The `# esxcli storage nmp device set --device naa.6001438002a56f220001100000710000 --psp VMW_PSP_RR` command sets device `naa.6001438002a56f220001100000710000` with a RoundRobin multipathing policy.

## Specifying DiskMaxLUN

The `DiskMaxLUN` setting specifies the highest-numbered LUN that can be scanned by the ESX server.

- For ESX 2.5.x, the default value is 8. If more than eight LUNs are presented, you must change the setting to an appropriate value. To set `DiskMaxLUN`, select **Options> Advanced Settings** in the MUI, and then enter the highest-numbered LUN.
- For ESX 3.x or ESX 4.x, the default value is set to the Max set value of 256. To set `DiskMaxLun` to a different value, in Virtual Infrastructure Client, select **Configuration> Advance Settings> Disk> Disk.MaxLun**, and then enter the new value.

## Verifying connectivity

To verify proper configuration and connectivity to the SAN:

- For ESX 2.5.x, enter the **`# vmkmultipath -q`** command.
- For ESX 3.x, enter the **`# esxcfg-mpath -l`** command.
- For ESX 4.x or ESXi 5.x, enter the **`# esxcfg-mpath -b`** command.

For each LUN, verify that the multipathing policy is set correctly and that each path is marked `on`. If any paths are marked `dead` or are not listed, check the cable connections and perform a rescan on the appropriate FCA. For example:

- For ESX 2.5.x, enter the **`# cos-rescan.sh vmhba0`** command.
- For ESX 3.x, ESX 4.x, or ESXi 5.x, enter the **`# esxcfg-rescan vmhba0`** command.

If paths or LUNs are still missing, see the VMware or HP Storage documentation for troubleshooting information.

# Verifying virtual disks from the host

To verify that the host can access the virtual disks, enter the **`# more /proc/scsi/scsi`** command.

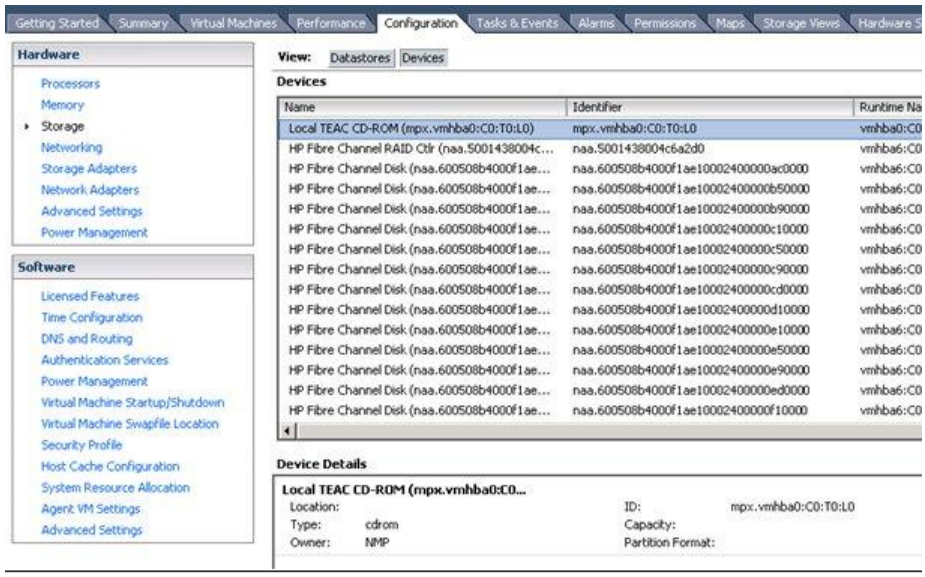
The output lists all SCSI devices detected by the server. An EVA6400/8400 LUN entry looks similar to the following:

```
Host: scsi3 Channel: 00 ID: 00 Lun: 01
Vendor: HP      Model: HS400        Rev:
Type: Direct-Access                      ANSI SCSI revision: 02
```

# Verifying virtual disks from the host

Use the **VMware vCenter management GUI** to check all devices (see Figure 25 (page 67)).

**Figure 25 Verifying virtual disks**




# HP EVA P6000 Software Plug-in for VMware VAAI

The vSphere Storage API for Array Integration (VAAI) is included in VMware vSphere solutions. VAAI can be used to offload certain functions from the target VMware host to the storage array. With the tasks being performed more efficiently by the array instead of the target VMware host, performance can be greatly enhanced.

The HP EVA P6000 Software Plug-in for VMware VAAI (VAAI Plug-in) enables the offloading of the following functions (primitives) to the EVA:

- Full copy—Enables the array to make full copies of data within the array, without the ESX server having to read and write the data.
- Block zeroing—Enables the array to zero out a large number of blocks to speed up provisioning of virtual machines.
- Hardware assisted locking—Provides an alternative means to protect the metadata for VMFS cluster file systems, thereby improving the scalability of large ESX server farms sharing a datastore.

## System prerequisites

| | |
|---|---|
| VMware operating system: | ESX/ESXi 4.1or later |
| VMware management station: | VMware vCenter 4.1 |
| VMware administration tools: | ESX/ESXi 4.1 environments: vCLI 4.1 (Windows or Linux) |
| HP P6000 controller software: | XCS 10100000 or later |

## Enabling vSphere Storage API for Array Integration (VAAI)

To enable the VAAI primitives, do the following:

**NOTE:** By default, the three VAAI primitives are enabled.

**NOTE:** The EVA VAAI Plug-In is required with vSphere 4.1 in order to permit discovery of the EVA VAAI capability. This is not required for vSphere 5.

1. Install the XCS 10100000 controller software.

2. Enable the primitives from the ESX server.

   Enable and disable these primitives through the following advanced settings:

   - DataMover.HardwareAcceleratedMove (full copy)
   - DataMover.HardwareAcceleratedInit (block zeroing)
   - VMFS3.HarwareAccelerated Locking (hardware assisted locking)

   For more information about the vSphere Storage API for Array Integration (VAAI), see the VMware documentation.

3. Install the HP EVA VAAI Plug-in.

   For information about installing the VAAI Plug-in, see "Installing the VAAI Plug-in" (page 68).

## Installing the VAAI Plug-in

Depending on user preference and environment, choose one of the following three methods to install the HP EVA VAAI Plug-in:

- Using ESX host console utilities
- vCLI/vMA
- Using VUM

The following table compares the three VAAI Plug-in installation methods:

**Table 17 Comparison of installation methods**

| Installation method | Required deployment tools | Host Operating System | Client operating system | VMware commands used | Scriptable |
|---|---|---|---|---|---|
| ESX host console utilities—Local console | N/A | ESX 4.1 | N/A | `esxupdate` `esxcli` | Yes (`eva-vaaip.sh`) |
| ESX host console utilities—Remote console | SSH tool, such as PuTTy | | Any computer running SSH | | |
| VMware CLI (vCLI) | VMware vSphere CLI | ESX 4.1, ESXi 4.1 | Windows XPWindows VistaWindows 7Windows Server 2003Windows Server 2008 Linux x86Linux x64 | `vicfg-hostops.pl` `vihostupdate.pl` | Yes (`eva-vaaip.pl`) |
| VM Appliance (vMA) | N/A | | N/A | | |
| VMware Update Manager (VUM) | VMware vSphere ServerVMware Update Manager | ESX 4.1, ESXi 4.1 | Windows Server 2003, Windows Server 2008 | VUM graphical user interface | No |

### Installation overview

Regardless of installation method, key installation tasks include:

1. Obtaining the HP VAAI Plug-in software bundle from the HP website.
2. Extracting files from HP VAAI Plug-in software bundle to a temporary location on the server.
3. Placing the target VMware host in maintenance mode.
4. Invoking the software tool to install the HP VAAI Plug-in.

   Automated installation steps include:

   a. Installing the HP VAAI plug-in driver (`hp_vaaip_p6000`) on the target VMware host.
   b. Adding VIB details to the target VMware host.

c. Creating VAAI claim rules.
d. Loading and executing VAAI claim rules.

5. Restarting the target VMware host.
6. Taking the target VMware host out of maintenance mode.

After installing the HP VAAI Plug-in, the operating system will execute all VAAI claim rules and scan every five minutes to check for any array volumes that may have been added to the target VMware host. If new volumes are detected, they will become VAAI enabled.

### Installing the HP EVA VAAI Plug-in using ESX host console utilities

**NOTE:** This installation method is supported for use only with VAAI Plug-in version 1.00, in ESX/ESXi 4.1 environments. This is required for ESX 4.1, but not for ESX 5i.

1. Obtain the VAAI Plug-in software package and save to a local folder on the target VMware host:
   a. Go to the HP Support Downloads website at http://www.hp.com/support/downloads.
   b. Navigate through the display to locate and then download the HP EVA P6000 Software Plug-in for VMware VAAI to a temporary folder on the server. (Example folder location: `/root/vaaip`)
2. Install the VAAI Plug-in.

   From the ESX service console, enter a command using the following syntax:

   `esxupdate --bundle hp_vaaip_p6000-xxx.zip --maintenancemode update`

   (where `hp_vaaip_p6000-xxx.zip` represents the filename of the VAAI Plug-in.)
3. Restart the target VMware host.

4. Verify the installation:
   a. Check for new HP P6000 claim rules.

      Using the service console, enter:

      ```
      esxcli corestorage claimrule list -c VAAI
      ```

      The return display will be similar to the following:

      ```
      Rule Class  Rule   Class     Type     Plugin            Matches
      VAAI        5001   runtime   vendor   hp_vaaip_p6000    vendor=HP model=HSV
      VAAI        5001   file      vendor   hp_vaaip_p6000    vendor=HP model=HSV
      ```

   b. Check for claimed storage devices.

      Using the service console, enter:

      ```
      esxcli vaai device list
      ```

      The return display will be similar to the following:

      ```
      aa.600c0ff00010e1cbc7523f4d01000000
         Device Display Name: HP iSCSI Disk (naa.600c0ff00010e1cbc7523f4d01000000)
         VAAI Plugin Name: hp_vaaip_P6000

      naa.600c0ff000da030b521bb64b01000000
         Device Display Name: HP Fibre Channel Disk (naa.600c0ff000da030b521bb64b01000000)
         VAAI Plugin Name: hp_vaaip_P6000
      ```

   c. Check the VAAI status on the storage devices.

      Using the service console, enter:

      ```
      esxcfg-scsidevs -l | egrep "Display Name:|VAAI Status:"
      ```

      The return display will be similar to the following:

      ```
      Display Name: Local TEAC CD-ROM (mpx.vmhba5:C0:T0:L0)
      VAAI Status: unknown
      Display Name: HP Serial Attached SCSI Disk (naa.600508b1001052395659314e39440200)
      VAAI Status: unknown
      Display Name: HP Serial Attached SCSI Disk (naa.600c0ff0001087439023704d01000000)
      VAAI Status: supported
      Display Name: HP Serial Attached SCSI Disk (naa.600c0ff0001087d28323704d01000000)
      VAAI Status: supported
      Display Name: HP Fibre Channel Disk (naa.600c0ff000f00186a622b24b01000000)
      VAAI Status: unknown
      ```

**Table 18 VAAI device status values**

| Value | Description |
|---|---|
| Unknown | The array volume is hosted by a non-supported VAAI array. |
| Supported | The array volume is hosted by a supported VAAI array, and all three VAAI commands completed successfully. |
| Not supported | The array volume is hosted by a supported VAAI array, but all three VAAI commands did not complete successfully. |

**NOTE:** VAAI device status will be "Unknown" until all VAAI primitives are attempted by ESX on the device and completed successfully. Upon completion, VAAI device status will be “Supported."

### Installing the HP VAAI Plug-in using vCLI/vMA

**NOTE:** This installation method is supported for use only with VAAI Plug-in version 1.00, in ESX/ESXi 4.1 environments.

1. Obtain the VAAI Plug-in software package and save to a local folder on the target VMware host:
   a. Go to the HP Support Downloads website at http://www.hp.com/support/downloads.
   b. Navigate through the display to locate and then download the HP EVA P6000 Software Plug-in for VMware VAAI to a temporary folder on the server. (Example folder location: `/root/vaaip`)
2. Enter maintenance mode.

   Enter a command using the following syntax:

   ```
   vicfg-hostops.pl --server Host_IP_Address --username
   User_Name--password Account_Password -o enter
   ```
3. Install the VAAI Plug-in using `vihostupdate`.

   Enter a command using the following syntax:

   ```
   vihostupdate.pl --server Host_IP_Address --username User_Name
   --password Account_Password --bundle
   hp_vaaip_p6000_offline-bundle-xyz --install
   ```
4. Restart the target VMware host.

   Enter a command using the following syntax:

   ```
   vicfg-hostops.pl --server Host_IP_Address --username
   User_Name--password Account_Password -o reboot -f
   ```
5. Exit maintenance mode.

   Enter a command using the following syntax:

   ```
   vicfg-hostops.pl --server Host_IP_Address --username
   User_Name--password Account_Password -o exit
   ```
6. Verify the claimed VAAI device.
   a. Check for new HP P6000 claim rules.

      Enter a command using the following syntax:

      ```
      esxcli --server Host_IP_Address --username User_Name --password
      Account_Password corestorage claimrule list –c VAAI
      ```

      The return display will be similar to the following:

      ```
      Rule Class  Rule   Class     Type     Plugin           Matches
      VAAI        5001   runtime   vendor   hp_vaaip_p6000   vendor=HP model=HSV
      VAAI        5001   file      vendor   hp_vaaip_p6000   vendor=HP model=HSV
      ```
   b. Check for claimed storage devices.

      List all devices claimed by the VAAI Plug-in.

      Enter a command using the following syntax:

      ```
      esxcli --server Host_IP_Address --username User_Name --password
      Account_Password vaai device list
      ```

      The return display will be similar to the following:

      ```
      naa.600c0ff00010e1cbc7523f4d01000000
         Device Display Name: HP iSCSI Disk (naa.600c0ff00010e1cbc7523f4d01000000)
         VAAI Plugin Name: hp_vaaip_p6000

      naa.600c0ff000da030b521bb64b01000000
         Device Display Name: HP Fibre Channel Disk (naa.600c0ff000da030b521bb64b01000000)
         VAAI Plugin Name: hp_vaaip_p6000
      ```
   c. Check the VAAI status on the storage devices. Use the vCenter Management Station as listed in the following section.

      See also Table 18 (page 70).

**NOTE:**

- This installation method is supported for use with VAAI Plug-in versions 1.00 and 2.00, in ESX/ESXi 4.1 environments.
- Installing the plug-in using VMware Update Manager is the recommended method.

Installing the VAAI Plug-in using VUM consists of two steps:

1. "Importing the VAAI Plug-in to the vCenter Server" (page 72)
2. "Installing the VAAI Plug-in on each ESX/ESXi host" (page 73)

### Importing the VAAI Plug-in to the vCenter Server

1. Obtain the VAAI Plug-in software package and save it on the system that has VMware vSphere client installed:
   a. Go to the HP Support Downloads website at http://www.hp.com/support/downloads.
   b. Locate the HP EVA P6000 Software Plug-in for VMware VAAI and then download it to a temporary folder on the server.
   c. Expand the contents of the downloaded `.zip` file into the temporary folder and locate the HP EVA VAAI offline bundle file. The filename will be in one of the following formats:

      `hp_vaaip_p6000_offline-bundle_xyz.zip`

      (where `xyz` represents the VAAI Plug-in version.)
2. Open VUM:
   a. Double-click the **VMware vSphere Client** icon on your desktop, and then log in to the vCenter Server using administrator privileges.
   b. Click the **Home** icon in the navigation bar.
   c. In the Solutions and Applications pane, click the **Update Manager** icon to start VUM.

      **NOTE:** If the Solutions and Applications pane is missing, the VUM Plug-in is not installed on your vCenter Client system. Use the vCenter Plug-ins menu to install VUM.
3. Import the Plug-in:
   a. Select the **Patch Repository** tab.
   b. Click **Import Patches** in the upper right corner. The Import Patches dialog window will appear.
   c. Browse to the extracted HP EVA VAAI offline bundle file. The filename will be in the follow format:

      `hp_vaaip_p6000_offline-bundle_xyz.zip`

      (where `xyz` represents the VAAI Plug-in version.)
   d. Wait for the import process to complete.
   e. Click **Finish**.

4. Create a new Baseline set for this offline plug-in:
   a. Select the **Baselines and Groups** tab.
   b. Above the left pane, click **Create**.
   c. In the New Baseline window:
      - Enter a name and a description. (Example: HP P6000 Baseline and VAAI Plug-in for HP EVA)
      - Select **Host Extension**.
      - Click **Next** to proceed to the Extensions window.
   d. In the Extensions window:
      - Select **HP EVA VAAI Plug-in for VMware vSphere *x.x***, where x.x represents the plug-in version.
      - Click the down arrow to add the plug-in in the Extensions to Add panel at the bottom of the display.
      - Click **Next** to proceed.
      - Click **Finish** to complete the task and return to the **Baselines and Groups** tab.

   The HP P6000 Baseline should now be listed in the left pane.

Importing the VAAI Plug-in is complete. To install the plug-in, see "Installing the VAAI Plug-in on each ESX/ESXi host" (page 73).

### Installing the VAAI Plug-in on each ESX/ESXi host

1. From the vCenter Server, click the **Home** icon in the navigation bar.
2. Click the **Hosts and Clusters** icon in the Inventory pane.
3. Click the DataCenter that has the ESX/ESXi hosts that you want to stage.
4. Click the **Update Manager** tab. VUM automatically evaluates the software recipe compliance for all ESX/ESXi Hosts.
5. Above the right pane, click **Attach** to open the **Attach Baseline or Group** dialog window.

   Select the HP P6000 Baseline entry, and then click **Attach**.
6. To ensure that the patch and extensions compliance content is synchronized, again click the DataCenter that has the ESX/ESXi hosts that you want to stage. Then, in the left panel, right-click the **DataCenter** icon and select **Scan for Updates**. When prompted, ensure that Patches and Extensions is selected, and then click **Scan**.
7. Stage the installation:
   a. Click **Stage** to open the Stage Wizard.
   b. Select the target VMware hosts for the extension that you want to install, and then click **Next**.
   c. Click **Finish**.
8. Complete the installation:
   a. Click **Remediate** to open the Remediation Wizard.
   b. Select the target VMware host that you want to remediate, and then click **Next**.
   c. Make sure that the HP EVA VAAI extension is selected, and then click **Next**.
   d. Fill in the related information, and then click **Next**.
   e. Click **Finish**.

Installing the VAAI Plug in is complete. View the display for a summary of which ESX/ESXi hosts are compliant with the vCenter patch repository.

**NOTE:**

- In the Tasks & Events section, the following tasks should have a Completed status: Remediate entry, Install, and Check.
- If any of the above tasks has an error, click the task to view the detail events information.

### Verifying VAAI status

1. From the vCenter Server, click the **Home Navigation** bar, and then click **Hosts and Clusters**.
2. Select the target VMware host from the list, and then click the **Configuration** tab.
3. Click the **Storage Link** under Hardware.

   See also Table 18 (page 70).

## Uninstalling the VAAI Plug-in

Procedures vary, depending on user preference and environment:

### Uninstalling VAAI Plug-in using the automated script (hpeva.pl)

1. Enter maintenance mode.
2. Query the installed VAAI Plug-in to determine the name of the bulletin to uninstall.

   Enter a command using the following syntax:

   ```
   c:\>hpeva.pl --server Host_IP_Address --username User_Name --password
   Account_Password --query
   ```
3. Uninstall the VAAI Plug-in.

   Enter a command using the following syntax:

   ```
   c:\>hpeva.pl --server Host_IP_Address --username User_Name --password
   Account_Password --bulletin Bulletin_Name --remove
   ```
4. Restart the host.
5. Exit maintenance mode.

### Uninstalling VAAI Plug-in using vCLI/vMA (vihostupdate)

1. Enter maintenance mode.
2. Query the installed VAAI Plug-in to determine the name of the VAAI Plug-in bulletin to uninstall.

   Enter a command using the following syntax:

   ```
   c:\>vihostupdate.pl --server Host_IP_Address --username User_Name
   --password Account_Password --query
   ```
3. Uninstall the VAAI Plug-in.

   Enter a command using the following syntax:

   ```
   c:\>vihostupdate.pl --server Host_IP_Address --username User_Name
   --password Account_Password --bulletin
   0-HPQ-ESX-4.1.0-hp-vaaip-p6000-1.0.10 --remove
   ```
4. Restart the host.
5. Exit maintenance mode.

### Uninstalling VAAI Plug-in using VMware native tools (esxupdate)

1. Enter maintenance mode.
2. Query the installed VAAI Plug-in to determine the name of the VAAI Plug-in bulletin to uninstall.

   Enter a command using the following syntax:

   ```
   $host# esxupdate --vib-view query | grep hp-vaaip-p6000
   ```

3. Uninstall the VAAI Plug-in.

   Enter a command using the following syntax:

   ```
   $host# esxupdate remove -b VAAI_Plug_In_Bulletin_Name
   --maintenancemode
   ```

4. Restart the host.
5. Exit maintenance mode.

# Windows

## Verifying virtual disk access from the host

With Windows, you must rescan for new virtual disks to be accessible. After you rescan, you must select the disk type, and then initialize (assign disk signature), partition, format, and assign drive letters or mount points according to standard Windows conventions.

## Setting the Pending Timeout value for large cluster configurations

For clusters, if disk resource counts are greater than 8, HP recommends that you increase the Pending Timeout value for each disk resource from 180 second to 360 seconds. Changing the Pending Timeout value ensures continuous operation of disk resources across the SAN.

To set the Pending Timeout value:

1. Open Microsoft Cluster Administrator.
2. Select a Disk Group resource in the left pane.
3. Right-click a Disk Resource in the right pane and select **Properties**.
4. Click the **Advanced** tab.
5. Change the Pending Timeout value to 360.
6. Click **OK**.
7. Repeat steps 3-6 for each disk resource.

# 5 Customer replaceable units

## Customer self repair (CSR)

Table 13 (page 77) and Table 20 (page 77) identifies which hardware components are customer replaceable. Using HP Insight Remote Support or other diagnostic tools, a support specialist will work with you to diagnose and assess whether a replacement component is required to address a system problem. The specialist will also help you determine whether you can perform the replacement.

### Parts only warranty service

Your HP Limited Warranty may include a parts only warranty service. Under the terms of parts only warranty service, HP will provide replacement parts free of charge.

For parts only warranty service, CSR part replacement is mandatory. If you request HP to replace these parts, you will be charged for travel and labor costs.

## Best practices for replacing hardware components

The following information will help you replace the hardware components on your storage system successfully.

△ **CAUTION:** Removing a component significantly changes the air flow within the enclosure. All components must be installed for the enclosure to cool properly. If a component fails, leave it in place in the enclosure until a new component is available to install.

### Component replacement videos

To assist you in replacing the components, videos have been produced of the procedures. To view the videos, go to the following website and navigate to your product:

http://www.hp.com/go/sml

### Verifying component failure

- Consult HP technical support to verify that the hardware component has failed and that you are authorized to replace it yourself.
- Additional hardware failures can complicate component replacement. Check HP P6000 Command View and/or HP Insight Remote Support as follows to detect any additional hardware problems:
  - When you have confirmed that a component replacement is required, you may want to clear the Real Time Monitoring view. This makes it easier to identify additional hardware problems that may occur while waiting for the replacement part.
  - Before installing the replacement part, check the Real Time Monitoring view for any new hardware problems. If additional hardware problems have occurred, contact HP support before replacing the component.
  - See the HP Insight Remote Support documentation for additional information.

### Identifying the spare part

Parts have a nine-character spare component number on their label (Figure 26 (page 77)). For some spare parts, the part number will be available in HP P6000 Command View. Alternatively, the HP call center will assist in identifying the correct spare part number.

### Figure 26 Typical product label


1. Spare part number

# Replaceable parts

This product contains the replaceable parts listed in Table 13 (page 77) and Table 20 (page 77). Parts that are available for customer self repair (CSR) are indicated as follows:

✓ Mandatory CSR where geography permits. Order the part directly from HP and repair the product yourself. On-site or return-to-depot repair is not provided under warranty.

• Optional CSR. You can order the part directly from HP and repair the product yourself, or you can request that HP repair the product. If you request repair from HP, you may be charged for the repair depending on the product warranty.

-- No CSR. The replaceable part is not available for self repair. For assistance, contact an HP-authorized service provider.

### Table 13 Controller enclosure replacement parts

| Description | Spare part number | CSR status |
|---|---|---|
| 10 port controller, 4GB total cache (HSV400) | 512730–001 | • |
| 12 port controller, 7GB Total Cache (HSV450) | 512731–001 | • |
| 12 port t controller, 11GB Total Cache (HSV450) | 512732–001 | • |
| Array battery | 512735-001 | ✓ |
| Array power supply | 489883–001 | ✓ |
| Array fan module | 483017–001 | ✓ |
| OCP module | 508563–001 | ✓ |
| Memory board: cache line flush 10 port | 512733–001 | -- |
| Memory board: cache line flush 12 port | 512734–001 | -- |

### Table 20 M6412-A disk enclosure replaceable parts

| Description | Spare part number | CSR status |
|---|---|---|
| 4 Gb FC disk shelf midplane | 461492–005 | • |
| 4 Gb FC disk shelf backplane | 461493–005 | • |
| SPS-BD Front UID | 399053–001 | • |
| SPS-BD Power UID with cable | 399054–001 | • |
| SPS-BD Front UID Interconnect PCA with cable | 399055–001 | • |
| 4 Gb FC disk shelf I/O module | 461494–005 | • |

**Table 20 M6412-A disk enclosure replaceable parts** *(continued)*

| Description | Spare part number | CSR status |
|---|---|---|
| FC disk shelf fan module | 468715–001 | ✓ |
| FC disk shelf power supply | 405914–001 | ✓ |
| Disk drive 300 GB, 10K, EVA M6412–A Enclosure, Fibre Channel | 537582-001 | ✓ |
| Disk drive 450 GB, 10K, EVA M6412–A Enclosure, Fibre Channel | 518734-001 | ✓ |
| Disk drive 600 GB, 10K, EVA M6412–A Enclosure, Fibre Channel | 518735-001 | ✓ |
| Disk drive 146 GB, 15K, EVA M6412–A Enclosure, Fibre Channel | 454410–001 | ✓ |
| Disk drive 300 GB, 15K, EVA M6412–A Enclosure, Fibre Channel | 454411–001 | ✓ |
| Disk drive 400 GB, 15K, EVA M6412–A Enclosure, Fibre Channel | 466277–001 | ✓ |
| Disk drive 450 GB, 15K, EVA M6412–A Enclosure, Fibre Channel | 454412–001 | ✓ |
| Disk drive 600 GB, 15K, EVA M6412–A Enclosure, Fibre Channel | 495808-001 | ✓ |
| Disk drive 1 TB, 7.2K, EVA M6412-A Enclosure, FATA | 454414–001 | ✓ |
| Disk drive 72 GB, EVA M6412–A Enclosure, SSD | 515189–001 | ✓ |
| Disk drive 200 GB, EVA M6412–A Enclosure, SSD | 595336-001 | ✓ |
| Disk drive 400 GB, EVA M6412–A Enclosure, SSD | 595337-001 | ✓ |
| SPS-CABLE ASSY, 4Gb COPPER, FC, 2.0m | 432374-001 | • |
| SPS-CABLE ASSY, 4Gb COPPER, FC, 0.6m | 432375-001 | • |
| SPS-CABLE ASSY, 4Gb COPPER, FC, 0.41m | 496917-001 | • |

For more information about CSR, contact your local service provider. For North America, see the CSR website:

http://www.hp.com/go/selfrepair

To determine the warranty service provided for this product, see the warranty information website:

http://www.hp.com/go/storagewarranty

To order a replacement part, contact an HP-authorized service provider or see the HP Parts Store online:

http://www.hp.com/buy/parts

# Replacing the failed component

**CAUTION:** Components can be damaged by electrostatic discharge. Use proper anti-static protection.

- Always transport and store CRUs in an ESD protective enclosure.
- Do not remove the CRU from the ESD protective enclosure until you are ready to install it.
- Always use ESD precautions, such as a wrist strap, heel straps on conductive flooring, and an ESD protective smock when handling ESD sensitive equipment.
- Avoid touching the CRU connector pins, leads, or circuitry.
- Do not place ESD generating material such as paper or non anti-static (pink) plastic in an ESD protective enclosure with ESD sensitive equipment.

- HP recommends waiting until periods of low storage system activity to replace a component.
- When replacing components at the rear of the rack, cabling may obstruct access to the component. Carefully move any cables out of the way to avoid loosening any connections. In particular, avoid cable damage that may be caused by:
  - Kinking or bending.
  - Disconnecting cables without capping. If uncapped, cable performance may be impaired by contact with dust, metal or other surfaces.
  - Placing removed cables on the floor or other surfaces, where they may be walked on or otherwise compressed.

## Replacement instructions

Printed instructions are shipped with the replacement part. Instructions for all replaceable components are also included on the documentation CD that ships with the EVA6400/8400 and posted on the web. For the latest information, HP recommends that you obtain the instructions from the web.

Go to the following website: http://www.hp.com/support/manuals. Under Storage, select **Disk Storage Systems**, then select **HP 6400/8400 Enterprise Virtual Arrays** under P6000/EVA Disk Arrays. The manuals page for the EVA6400/8400 appears. Scroll to the Service and maintenance information section where the replacement instructions are posted.

- HP controller enclosure replacement instructions
- HP cache battery replacement instructions
- HP controller blower replacement instructions
- HP power supply replacement instructions
- HP operator control panel replacement instructions
- HP disk enclosure backplane replacement instructions
- HP disk enclosure fan module replacement instructions
- HP disk enclosure front UID interconnect board (with cable) replacement instructions
- HP disk enclosure front UID replacement instructions
- HP disk enclosure I/O module replacement instructions
- HP disk enclosure midplane replacement instructions
- HP disk enclosure power supply replacement instructions

# 6 Support and other resources

## Contacting HP

For worldwide technical support information, see the HP support website:

http://www.hp.com/support

Before contacting HP, collect the following information:

- Product model names and numbers
- Technical support registration number (if applicable)
- Product serial numbers
- Error messages
- Operating system type and revision level
- Detailed questions

## Subscription service

HP recommends that you register your product at the Subscriber's Choice for Business website:

http://www.hp.com/go/e-updates

After registering, you will receive e-mail notification of product enhancements, new driver versions, firmware updates, and other product resources.

## Documentation feedback

HP welcomes your feedback.

To make comments and suggestions about product documentation, please send a message to **storagedocsFeedback@hp.com**. All submissions become the property of HP.

# Related information

## Documents

TYou can find the documents referenced in this guide on the Manuals page of the Business Support Center website:

http://www.hp.com/support/manuals

In the Storage section, click **Disk Storage Systems** or **Storage Software** and then select your product.

## HP websites

For additional information, see the following HP websites:

- HP:
  http://www.hp.com
- HP Storage:
  http://www.hp.com/go/storage
- HP Partner Locator:
  http://www.hp.com/service_locator
- HP Software Downloads:
  http://www.hp.com/support/downloads

- HP Software Depot:
  http://www.software.hp.com
- HP Single Point of Connectivity Knowledge (SPOCK):
  http://www.hp.com/storage/spock
- HP SAN manuals:
  http://www.hp.com/go/sdgmanuals

# Typographic conventions

**Table 21 Document conventions**

| Convention | Element |
|---|---|
| Blue text: Table 21 (page 81) | Cross-reference links |
| Blue, underlined text: http://www.hp.com | Website addresses |
| **Bold** text | • Keys that are pressed<br>• Text typed into a GUI element, such as a box<br>• GUI elements that are clicked or selected, such as menu and list items, buttons, tabs, and check boxes |
| *Italic* text | Text emphasis |
| `Monospace` text | • File and directory names<br>• System output<br>• Code<br>• Commands, their arguments, and argument values |
| *`Monospace, italic`* text | • Code variables<br>• Command variables |
| **`Monospace, bold`** text | Emphasized monospace text |
| .<br>.<br>. | Indication that the example continues |
| **WARNING!** | An alert that calls attention to important information that if not understood or followed can result in personal injury. |
| **CAUTION:** | An alert that calls attention to important information that if not understood or followed can result in data loss, data corruption, or damage to hardware or software. |
| **IMPORTANT:** | An alert that calls attention to essential information. |
| **NOTE:** | An alert that calls attention to additional or supplementary information. |
| **TIP:** | An alert that calls attention to helpful hints and shortcuts. |

## Rack stability

Rack stability protects personnel and equipment.

⚠ **WARNING!** To reduce the risk of personal injury or damage to equipment:

- Extend leveling jacks to the floor.
- Ensure that the full weight of the rack rests on the leveling jacks.
- Install stabilizing feet on the rack.
- In multiple-rack installations, fasten racks together securely.
- Extend only one rack component at a time. Racks can become unstable if more than one component is extended.

## Customer self repair

HP customer self repair (CSR) programs allow you to repair your product. If a CSR part needs replacing, HP ships the part directly to you so that you can install it at your convenience. Some parts do not qualify for CSR. Your HP-authorized service provider will determine whether a repair can be accomplished by CSR.

For more information about CSR, contact your local service provider, or see the CSR website:

http://www.hp.com/go/selfrepair

# A Regulatory compliance notices

## Regulatory compliance identification numbers

For the purpose of regulatory compliance certifications and identification, this product has been assigned a unique regulatory model number. The regulatory model number can be found on the product nameplate label, along with all required approval markings and information. When requesting compliance information for this product, always refer to this regulatory model number. The regulatory model number is not the marketing name or model number of the product.

**Product specific information:**

HP _____

Regulatory model number: _____

FCC and CISPR classification: _____

These products contain laser components. See Class 1 laser statement in the "Laser compliance notices" (page 87) section.

## Federal Communications Commission notice

Part 15 of the Federal Communications Commission (FCC) Rules and Regulations has established Radio Frequency (RF) emission limits to provide an interference-free radio frequency spectrum. Many electronic devices, including computers, generate RF energy incidental to their intended function and are, therefore, covered by these rules. These rules place computers and related peripheral devices into two classes, A and B, depending upon their intended installation. Class A devices are those that may reasonably be expected to be installed in a business or commercial environment. Class B devices are those that may reasonably be expected to be installed in a residential environment (for example, personal computers). The FCC requires devices in both classes to bear a label indicating the interference potential of the device as well as additional operating instructions for the user.

## FCC rating label

The FCC rating label on the device shows the classification (A or B) of the equipment. Class B devices have an FCC logo or ID on the label. Class A devices do not have an FCC logo or ID on the label. After you determine the class of the device, refer to the corresponding statement.

### Class A equipment

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at personal expense.

### Class B equipment

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment

off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit that is different from that to which the receiver is connected.
- Consult the dealer or an experienced radio or television technician for help.

### Declaration of Conformity for products marked with the FCC logo, United States only

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

For questions regarding this FCC declaration, contact us by mail or telephone:

- Hewlett-Packard Company P.O. Box 692000, Mail Stop 510101 Houston, Texas 77269-2000
- Or call 1-281-514-3333

### Modification

The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by Hewlett-Packard Company may void the user's authority to operate the equipment.

### Cables

When provided, connections to this device must be made with shielded cables with metallic RFI/EMI connector hoods in order to maintain compliance with FCC Rules and Regulations.

## Canadian notice (Avis Canadien)

### Class A equipment

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la class A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

### Class B equipment

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la class B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

## European Union notice

This product complies with the following EU directives:

- Low Voltage Directive 2006/95/EC
- EMC Directive 2004/108/EC

Compliance with these directives implies conformity to applicable harmonized European standards (European Norms) which are listed on the EU Declaration of Conformity issued by Hewlett-Packard for this product or product family.

This compliance is indicated by the following conformity marking placed on the product:

| | |
|---|---|
| CE | This marking is valid for non-Telecom products and EU harmonized Telecom products (e.g., Bluetooth). |

Certificates can be obtained from http://www.hp.com/go/certificates.
Hewlett-Packard GmbH, HQ-TRE, Herrenberger Strasse 140, 71034 Boeblingen, Germany

# Japanese notices

## Japanese VCCI-A notice

この装置は，クラスA情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。 VCCI－A

## Japanese VCCI-B notice

この装置は，クラスB情報技術装置です。この装置は，家庭環境で使用することを目的としていますが，この装置がラジオやテレビジョン受信機に近接して使用されると，受信障害を引き起こすことがあります。
取扱説明書に従って正しい取り扱いをして下さい。 VCCI－B

## Japanese VCCI marking


## Japanese power cord statement

製品には、同梱された電源コードをお使い下さい。
同梱された電源コードは、他の製品では使用出来ません。

Please use the attached power cord.
The attached power cord is not allowed to use with other product.

# Korean notices

## Class A equipment

A급 기기 (업무용 정보통신기기)

이 기기는 업무용으로 전자파적합등록을 한 기기이오니 판매자 또는 사용자는 이 점을 주의하시기 바라며, 만약 잘못판매 또는 구입하였을 때에는 가정용으로 교환하시기 바랍니다.

## Class B equipment

B급 기기 (가정용 정보통신기기)

이 기기는 가정용으로 전자파적합등록을 한 기기로서 주거지역에서는 물론 모든지역에서 사용할 수 있습니다.

# Taiwanese notices

## BSMI Class A notice

警告使用者:

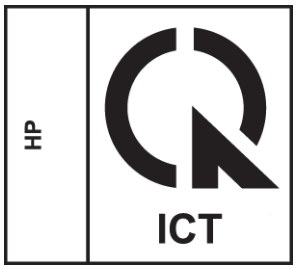
這是甲類的資訊產品，在居住的環境中使用時，可能會造成射頻干擾，在這種情況下，使用者會被要求採取某些適當的對策。

## Taiwan battery recycle statement


## Turkish recycling notice

Türkiye Cumhuriyeti: EEE Yönetmeliğine Uygundur

## Vietnamese Information Technology and Communications compliance marking



# Laser compliance notices

## English laser notice

This device may contain a laser that is classified as a Class 1 Laser Product in accordance with U.S. FDA regulations and the IEC 60825-1. The product does not emit hazardous laser radiation.

⚠ **WARNING!** Use of controls or adjustments or performance of procedures other than those specified herein or in the laser product's installation guide may result in hazardous radiation exposure. To reduce the risk of exposure to hazardous radiation:

- Do not try to open the module enclosure. There are no user-serviceable components inside.
- Do not operate controls, make adjustments, or perform procedures to the laser device other than those specified herein.
- Allow only HP Authorized Service technicians to repair the unit.

The Center for Devices and Radiological Health (CDRH) of the U.S. Food and Drug Administration implemented regulations for laser products on August 2, 1976. These regulations apply to laser products manufactured from August 1, 1976. Compliance is mandatory for products marketed in the United States.

## Dutch laser notice

**WAARSCHUWING:** dit apparaat bevat mogelijk een laser die is geclassificeerd als een laserproduct van Klasse 1 overeenkomstig de bepalingen van de Amerikaanse FDA en de richtlijn IEC 60825-1. Dit product geeft geen gevaarlijke laserstraling af.

Als u bedieningselementen gebruikt, instellingen aanpast of procedures uitvoert op een andere manier dan in deze publicatie of in de installatiehandleiding van het laserproduct wordt aangegeven, loopt u het risico te worden blootgesteld aan gevaarlijke straling. Het risico van blootstelling aan gevaarlijke straling beperkt u als volgt:

- Probeer de behuizing van de module niet te openen. U mag zelf geen onderdelen repareren.
- Gebruik voor de laserapparatuur geen andere knoppen of instellingen en voer geen andere aanpassingen of procedures uit dan die in deze handleiding worden beschreven.
- Alleen door HP geautoriseerde technici mogen het apparaat repareren.

## French laser notice

**AVERTISSEMENT :** cet appareil peut être équipé d'un laser classé en tant que Produit laser de classe 1 et conforme à la réglementation de la FDA américaine et à la norme 60825-1 de l'IEC. Ce produit n'émet pas de rayonnement dangereux.

L'utilisation de commandes, de réglages ou de procédures autres que ceux qui sont indiqués ici ou dans le manuel d'installation du produit laser peut exposer l'utilisateur à des rayonnements dangereux. Pour réduire le risque d'exposition à des rayonnements dangereux :

- Ne tentez pas d'ouvrir le boîtier renfermant l'appareil laser. Il ne contient aucune pièce dont la maintenance puisse être effectuée par l'utilisateur.
- Tout contrôle, réglage ou procédure autre que ceux décrits dans ce chapitre ne doivent pas être effectués par l'utilisateur.
- Seuls les Mainteneurs Agréés HP sont habilités à réparer l'appareil laser.

## German laser notice

**VORSICHT:** Dieses Gerät enthält möglicherweise einen Laser, der nach den US-amerikanischen FDA-Bestimmungen und nach IEC 60825-1 als Laserprodukt der Klasse 1 zertifiziert ist. Gesundheitsschädliche Laserstrahlen werden nicht emittiert.

Die Anleitungen in diesem Dokument müssen befolgt werden. Bei Einstellungen oder Durchführung sonstiger Verfahren, die über die Anleitungen in diesem Dokument bzw. im Installationshandbuch des Lasergeräts hinausgehen, kann es zum Austritt gefährlicher Strahlung kommen. Zur Vermeidung der Freisetzung gefährlicher Strahlungen sind die folgenden Punkte zu beachten:

- Versuchen Sie nicht, die Abdeckung des Lasermoduls zu öffnen. Im Inneren befinden sich keine Komponenten, die vom Benutzer gewartet werden können.
- Benutzen Sie das Lasergerät ausschließlich gemäß den Anleitungen und Hinweisen in diesem Dokument.
- Lassen Sie das Gerät nur von einem HP Servicepartner reparieren.

## Italian laser notice

**AVVERTENZA:** AVVERTENZA Questo dispositivo può contenere un laser classificato come prodotto laser di Classe 1 in conformità alle normative US FDA e IEC 60825-1. Questo prodotto non emette radiazioni laser pericolose.

L'eventuale esecuzione di comandi, regolazioni o procedure difformi a quanto specificato nella presente documentazione o nella guida di installazione del prodotto può causare l'esposizione a radiazioni nocive. Per ridurre i rischi di esposizione a radiazioni pericolose, attenersi alle seguenti precauzioni:

- Non cercare di aprire il contenitore del modulo. All'interno non vi sono componenti soggetti a manutenzione da parte dell'utente.
- Non eseguire operazioni di controllo, regolazione o di altro genere su un dispositivo laser ad eccezione di quelle specificate da queste istruzioni.
- Affidare gli interventi di riparazione dell'unità esclusivamente ai tecnici dell'Assistenza autorizzata HP.

## Japanese laser notice

警告：本製品には、US FDA規則およびIEC 60825-1に基づくClass 1レーザー製品が含まれている場合があります。本製品は人体に危険なレーザー光は発しません。

本書およびレーザー製品のインストール ガイドに示されている以外の方法で制御、調整、使用した場合、人体に危険な光線にさらされる場合があります。人体に危険な光線にさらされないため、以下の項目を守ってください。

- モジュール エンクロージャを開けないでください。ユーザーが取り扱えるコンポーネントは含まれていません。
- 本書に示されている以外の方法で、レーザー デバイスを制御、調整、使用しないでください。
- HPの正規サービス技術者のみが本ユニットの修理を許可されています。

## Spanish laser notice

**ADVERTENCIA:** Este dispositivo podría contener un láser clasificado como producto de láser de Clase 1 de acuerdo con la normativa de la FDA de EE.UU. e IEC 60825-1. El producto no emite radiaciones láser peligrosas.

El uso de controles, ajustes o manipulaciones distintos de los especificados aquí o en la guía de instalación del producto de láser puede producir una exposición peligrosa a las radiaciones. Para evitar el riesgo de exposición a radiaciones peligrosas:

- No intente abrir la cubierta del módulo. Dentro no hay componentes que el usuario pueda reparar.
- No realice más operaciones de control, ajustes o manipulaciones en el dispositivo láser que los aquí especificados.
- Sólo permita reparar la unidad a los agentes del servicio técnico autorizado HP.

# Recycling notices

## English recycling notice

**Disposal of waste equipment by users in private household in the European Union**

This symbol means do not dispose of your product with your other household waste. Instead, you should protect human health and the environment by handing over your waste equipment to a designated collection point for the recycling of waste electrical and electronic equipment. For more information, please contact your household waste disposal service

## Bulgarian recycling notice

### Изхвърляне на отпадъчно оборудване от потребители в частни домакинства в Европейския съюз

Този символ върху продукта или опаковката му показва, че продуктът не трябва да се изхвърля заедно с другите битови отпадъци. Вместо това, трябва да предпазите човешкото здраве и околната среда, като предадете отпадъчното оборудване в предназначен за събирането му пункт за рециклиране на неизползваемо електрическо и електронно борудване. За допълнителна информация се свържете с фирмата по чистота, чиито услуги използвате.

## Czech recycling notice

### Likvidace zařízení v domácnostech v Evropské unii

Tento symbol znamená, že nesmíte tento produkt likvidovat spolu s jiným domovním odpadem. Místo toho byste měli chránit lidské zdraví a životní prostředí tím, že jej předáte na k tomu určené sběrné pracoviště, kde se zabývají recyklací elektrického a elektronického vybavení. Pro více informací kontaktujte společnost zabývající se sběrem a svozem domovního odpadu.

## Danish recycling notice

### Bortskaffelse af brugt udstyr hos brugere i private hjem i EU

Dette symbol betyder, at produktet ikke må bortskaffes sammen med andet husholdningsaffald. Du skal i stedet den menneskelige sundhed og miljøet ved at afl evere dit brugte udstyr på et dertil beregnet indsamlingssted for af brugt, elektrisk og elektronisk udstyr. Kontakt nærmeste renovationsafdeling for yderligere oplysninger.

## Dutch recycling notice

### Inzameling van afgedankte apparatuur van particuliere huishoudens in de Europese Unie

Dit symbool betekent dat het product niet mag worden gedeponeerd bij het overige huishoudelijke afval. Bescherm de gezondheid en het milieu door afgedankte apparatuur in te leveren bij een hiervoor bestemd inzamelpunt voor recycling van afgedankte elektrische en elektronische apparatuur. Neem voor meer informatie contact op met uw gemeentereinigingsdienst.

## Estonian recycling notice

### Äravisatavate seadmete likvideerimine Euroopa Liidu eramajapidamistes

See märk näitab, et seadet ei tohi visata olmeprügi hulka. Inimeste tervise ja keskkonna säästmise nimel tuleb äravisatav toode tuua elektriliste ja elektrooniliste seadmete käitlemisega egelevasse kogumispunkti. Küsimuste korral pöörduge kohaliku prügikäitlusettevõtte poole.

## Finnish recycling notice

### Kotitalousjätteiden hävittäminen Euroopan unionin alueella

Tämä symboli merkitsee, että laitetta ei saa hävittää muiden kotitalousjätteiden mukana. Sen sijaan sinun on suojattava ihmisten terveyttä ja ympäristöä toimittamalla käytöstä poistettu laite sähkö- tai elektroniikkajätteen kierrätyspisteeseen. Lisätietoja saat jätehuoltoyhtiöltä.

## French recycling notice

### Mise au rebut d'équipement par les utilisateurs privés dans l'Union Européenne

Ce symbole indique que vous ne devez pas jeter votre produit avec les ordures ménagères. Il est de votre responsabilité de protéger la santé et l'environnement et de vous débarrasser de votre équipement en le remettant à une déchetterie effectuant le recyclage des équipements électriques et électroniques. Pour de plus amples informations, prenez contact avec votre service d'élimination des ordures ménagères.

## German recycling notice

### Entsorgung von Altgeräten von Benutzern in privaten Haushalten in der EU

Dieses Symbol besagt, dass dieses Produkt nicht mit dem Haushaltsmüll entsorgt werden darf. Zum Schutze der Gesundheit und der Umwelt sollten Sie stattdessen Ihre Altgeräte zur Entsorgung einer dafür vorgesehenen Recyclingstelle für elektrische und elektronische Geräte übergeben. Weitere Informationen erhalten Sie von Ihrem Entsorgungsunternehmen für Hausmüll.

## Greek recycling notice

### Απόρριψη άχρηστου εξοπλισμού από ιδιώτες χρήστες στην Ευρωπαϊκή 'Ενωση

Αυτό το σύμβολο σημαίνει ότι δεν πρέπει να απορρίψετε το προϊόν με τα λοιπά οικιακά απορρίμματα. Αντίθετα, πρέπει να προστατέψετε την ανθρώπινη υγεία και το περιβάλλον παραδίδοντας τον άχρηστο εξοπλισμό σας σε εξουσιοδοτημένο σημείο συλλογής για την ανακύκλωση άχρηστου ηλεκτρικού και ηλεκτρονικού εξοπλισμού. Για περισσότερες πληροφορίες, επικοινωνήστε με την υπηρεσία απόρριψης απορριμμάτων της περιοχής σας.

## Hungarian recycling notice

### A hulladék anyagok megsemmisítése az Európai Unió háztartásaiban

Ez a szimbólum azt jelzi, hogy a készüléket nem szabad a háztartási hulladékkal együtt kidobni. Ehelyett a leselejtezett berendezéseknek az elektromos vagy elektronikus hulladék átvételére kijelölt helyen történő beszolgáltatásával megóvja az emberi egészséget és a környezetet.További információt a helyi köztisztasági vállalattól kaphat.

## Italian recycling notice

### Smaltimento di apparecchiature usate da parte di utenti privati nell'Unione Europea

Questo simbolo avvisa di non smaltire il prodotto con i normali rifi uti domestici. Rispettare la salute umana e l'ambiente conferendo l'apparecchiatura dismessa a un centro di raccolta designato per il riciclo di apparecchiature elettroniche ed elettriche. Per ulteriori informazioni, rivolgersi al servizio per lo smaltimento dei rifi uti domestici.

## Latvian recycling notice

### Europos Sąjungos namų ūkio vartotojų įrangos atliekų šalinimas

Šis simbolis nurodo, kad gaminio negalima išmesti kartu su kitomis buitinėmis atliekomis. Kad apsaugotumėte žmonių sveikatą ir aplinką, pasenusią nenaudojamą įrangą turite nuvežti į elektrinių ir elektroninių atliekų surinkimo punktą. Daugiau informacijos teiraukitės buitinių atliekų surinkimo tarnybos.

## Lithuanian recycling notice

### Nolietotu iekārtu iznīcināšanas noteikumi lietotājiem Eiropas Savienības privātajās mājsaimniecībās

Šis simbols norāda, ka ierīci nedrīkst utilizēt kopā ar citiem mājsaimniecības atkritumiem. Jums jārūpējas par cilvēku veselības un vides aizsardzību, nododot lietoto aprīkojumu otrreizējai pārstrādei īpašā lietotu elektrisko un elektronisko ierīču savākšanas punktā. Lai iegūtu plašāku informāciju, lūdzu, sazinieties ar savu mājsaimniecības atkritumu likvidēšanas dienestu.

## Polish recycling notice

### Utylizacja zużytego sprzętu przez użytkowników w prywatnych gospodarstwach domowych w krajach Unii Europejskiej

Ten symbol oznacza, że nie wolno wyrzucać produktu wraz z innymi domowymi odpadkami. Obowiązkiem użytkownika jest ochrona zdrowa ludzkiego i środowiska przez przekazanie zużytego sprzętu do wyznaczonego punktu zajmującego się recyklingiem odpadów powstałych ze sprzętu elektrycznego i elektronicznego. Więcej informacji można uzyskać od lokalnej firmy zajmującej wywozem nieczystości.

## Portuguese recycling notice

### Descarte de equipamentos usados por utilizadores domésticos na União Europeia

Este símbolo indica que não deve descartar o seu produto juntamente com os outros lixos domiciliares. Ao invés disso, deve proteger a saúde humana e o meio ambiente levando o seu equipamento para descarte em um ponto de recolha destinado à reciclagem de resíduos de equipamentos eléctricos e electrónicos. Para obter mais informações, contacte o seu serviço de tratamento de resíduos domésticos.

## Romanian recycling notice

### Casarea echipamentului uzat de către utilizatorii casnici din Uniunea Europeană

Acest simbol înseamnă să nu se arunce produsul cu alte deșeuri menajere. În schimb, trebuie să protejați sănătatea umană și mediul predând echipamentul uzat la un punct de colectare desemnat pentru reciclarea echipamentelor electrice și electronice uzate. Pentru informații suplimentare, vă rugăm să contactați serviciul de eliminare a deșeurilor menajere local.

## Slovak recycling notice

**Likvidácia vyradených zariadení používateľmi v domácnostiach v Európskej únii**

Tento symbol znamená, že tento produkt sa nemá likvidovať s ostatným domovým odpadom. Namiesto toho by ste mali chrániť ľudské zdravie a životné prostredie odovzdaním odpadového zariadenia na zbernom mieste, ktoré je určené na recykláciu odpadových elektrických a elektronických zariadení. Ďalšie informácie získate od spoločnosti zaoberajúcej sa likvidáciou domového odpadu.

## Spanish recycling notice

**Eliminación de los equipos que ya no se utilizan en entornos domésticos de la Unión Europea**

Este símbolo indica que este producto no debe eliminarse con los residuos domésticos. En lugar de ello, debe evitar causar daños a la salud de las personas y al medio ambiente llevando los equipos que no utilice a un punto de recogida designado para el reciclaje de equipos eléctricos y electrónicos que ya no se utilizan. Para obtener más información, póngase en contacto con el servicio de recogida de residuos domésticos.

## Swedish recycling notice

**Hantering av elektroniskt avfall för hemanvändare inom EU**

Den här symbolen innebär att du inte ska kasta din produkt i hushållsavfallet. Värna i stället om natur och miljö genom att lämna in uttjänt utrustning på anvisad insamlingsplats. Allt elektriskt och elektroniskt avfall går sedan vidare till återvinning. Kontakta ditt återvinningsföretag för mer information.

# Battery replacement notices

## Dutch battery notice

### Verklaring betreffende de batterij

**WAARSCHUWING:** dit apparaat bevat mogelijk een batterij.

- Probeer de batterijen na het verwijderen niet op te laden.
- Stel de batterijen niet bloot aan water of temperaturen boven 60° C.
- De batterijen mogen niet worden beschadigd, gedemonteerd, geplet of doorboord.
- Zorg dat u geen kortsluiting veroorzaakt tussen de externe contactpunten en laat de batterijen niet in aanraking komen met water of vuur.
- Gebruik ter vervanging alleen door HP goedgekeurde batterijen.

Batterijen, accu's en accumulators mogen niet worden gedeponeerd bij het normale huishoudelijke afval. Als u de batterijen/accu's wilt inleveren voor hergebruik of op de juiste manier wilt vernietigen, kunt u gebruik maken van het openbare inzamelingssysteem voor klein chemisch afval of ze terugsturen naar HP of een geautoriseerde HP Business of Service Partner.

Neem contact op met een geautoriseerde leverancier of een Business of Service Partner voor meer informatie over het vervangen of op de juiste manier vernietigen van accu's.

## French battery notice

### Avis relatif aux piles

**AVERTISSEMENT :** cet appareil peut contenir des piles.

- N'essayez pas de recharger les piles après les avoir retirées.
- Évitez de les mettre en contact avec de l'eau ou de les soumettre à des températures supérieures à 60°C.
- N'essayez pas de démonter, d'écraser ou de percer les piles.
- N'essayez pas de court-circuiter les bornes de la pile ou de jeter cette dernière dans le feu ou l'eau.
- Remplacez les piles exclusivement par des pièces de rechange HP prévues pour ce produit.

Les piles, modules de batteries et accumulateurs ne doivent pas être jetés avec les déchets ménagers. Pour permettre leur recyclage ou leur élimination, veuillez utiliser les systèmes de collecte publique ou renvoyez-les à HP, à votre Partenaire Agréé HP ou aux agents agréés.

Contactez un Revendeur Agréé ou Mainteneur Agréé pour savoir comment remplacer et jeter vos piles.

## German battery notice

### Hinweise zu Batterien und Akkus

**VORSICHT:** Dieses Produkt enthält unter Umständen eine Batterie oder einen Akku.

- Versuchen Sie nicht, Batterien und Akkus außerhalb des Gerätes wieder aufzuladen.
- Schützen Sie Batterien und Akkus vor Feuchtigkeit und Temperaturen über 60°.
- Verwenden Sie Batterien und Akkus nicht missbräuchlich, nehmen Sie sie nicht auseinander und vermeiden Sie mechanische Beschädigungen jeglicher Art.
- Vermeiden Sie Kurzschlüsse, und setzen Sie Batterien und Akkus weder Wasser noch Feuer aus.
- Ersetzen Sie Batterien und Akkus nur durch die von HP vorgesehenen Ersatzteile.

Batterien und Akkus dürfen nicht über den normalen Hausmüll entsorgt werden. Um sie der Wiederverwertung oder dem Sondermüll zuzuführen, nutzen Sie die öffentlichen Sammelstellen, oder setzen Sie sich bezüglich der Entsorgung mit einem HP Partner in Verbindung.

Weitere Informationen zum Austausch von Batterien und Akkus oder zur sachgemäßen Entsorgung erhalten Sie bei Ihrem HP Partner oder Servicepartner.

## Italian battery notice

### Istruzioni per la batteria

**AVVERTENZA:** Questo dispositivo può contenere una batteria.

- Non tentare di ricaricare le batterie se rimosse.
- Evitare che le batterie entrino in contatto con l'acqua o siano esposte a temperature superiori a 60° C.
- Non smontare, schiacciare, forare o utilizzare in modo improprio la batteria.
- Non accorciare i contatti esterni o gettare in acqua o sul fuoco la batteria.
- Sostituire la batteria solo con i ricambi HP previsti a questo scopo.

Le batterie e gli accumulatori non devono essere smaltiti insieme ai rifiuti domestici. Per procedere al riciclaggio o al corretto smaltimento, utilizzare il sistema di raccolta pubblico dei rifiuti o restituirli a HP, ai Partner Ufficiali HP o ai relativi rappresentanti.

Per ulteriori informazioni sulla sostituzione e sullo smaltimento delle batterie, contattare un Partner Ufficiale o un Centro di assistenza autorizzato.

## Japanese battery notice

### バッテリに関する注意

警告:本製品はバッテリを内蔵している場合があります。

- バッテリを取り外している場合は、充電しないでください。
- バッテリを水にさらしたり、60℃ (140°F) 以上の温度にさらさないでください。
- バッテリを誤用、分解、破壊したり、穴をあけたりしないでください。
- 外部極を短絡させたり、火や水に投棄しないでください。
- バッテリを交換する際は、HP指定の製品と交換してください。

バッテリ、バッテリ パック、蓄電池は一般の家庭廃棄物と一緒に廃棄しないでください。リサイクルまたは適切に廃棄するため、公共の収集システム、HP、HPパートナー、またはHPパートナーの代理店にお送りください。

バッテリ交換および適切な廃棄方法についての情報は、HPのサポート窓口にお問い合わせください。

## Spanish battery notice

# Declaración sobre las baterías

**ADVERTENCIA:** Este dispositivo podría contener una batería.

- No intente recargar las baterías si las extrae.
- Evite el contacto de las baterías con agua y no las exponga a temperaturas superiores a los 60 °C (140 °F).
- No utilice incorrectamente, ni desmonte, aplaste o pinche las baterías.
- No cortocircuite los contactos externos ni la arroje al fuego o al agua.
- Sustituya las baterías sólo por el repuesto designado por HP.

Las baterías, los paquetes de baterías y los acumuladores no se deben eliminar junto con los desperdicios generales de la casa. Con el fin de tirarlos al contenedor de reciclaje adecuado, utilice los sistemas públicos de recogida o devuélvalas a HP, un distribuidor autorizado de HP o sus agentes.

Para obtener más información sobre la sustitución de la batería o su eliminación correcta, consulte con su distribuidor o servicio técnico autorizado.

# B Error messages

This list of error messages is in order by status code value, 0 to xxx.

**Table 22 Error Messages**

| Status Code Value | Meaning | How to Correct |
|---|---|---|
| 0<br>Successful Status | The SCMI command completed successfully. | No corrective action required. |
| 1<br>Object Already Exists | The object or relationship already exists. | Delete the associated object and try the operation again. Several situations can cause this message:<br>Presenting a LUN to a host:<br>• Delete the current association or specify a different LUN number.<br>Storage cell initialize:<br>• Remove or erase disk volumes before the storage cell can be successfully created.<br>Adding a port WWN to a host:<br>• Specify a different port WWN.<br>Adding a disk to a disk group:<br>• Delete the specified disk volume before creating a new disk volume. |
| 2<br>Supplied Buffer Too Small | The command or response buffer is not large enough to hold the specified number of items. This can be caused by a user or program error. | Report the error to product support. |
| 3<br>Object Already Assigned | The handle is already assigned to an existing object. This can be caused by a user or program error. | Report the error to product support. |
| 4<br>Insufficient Available Data Storage | There is insufficient storage available to perform the request. | Reclaim some logical space or add physical hardware. |
| 5<br>Internal Error | An unexpected condition was encountered while processing a request. | Report the error to product support. |
| 6<br>Invalid status for logical disk | This error is no longer supported. | Report the error to product support. |
| 7<br>Invalid Class | The supplied class code is of an unknown type. This can be caused by a user or program error. | Report the error to product support. |
| 8<br>Invalid Function | The function code specified with the class code is of an unknown type. | Report the error to product support. |
| 9<br>Invalid Logical Disk Block State | The specified command supplied unrecognized values. This can indicate a user or program error. | Report the error to product support. |
| 10<br>Invalid Loop Configuration | The specified request supplied an invalid loop configuration. | Verify the hardware configuration and retry the request. |
| 11<br>Invalid parameter | There are insufficient resources to fulfill the request, the requested value is not supported, or the parameters supplied are invalid. This can indicate a user or program error. | Report the error to product support. |

## Table 22 Error Messages *(continued)*

| Status Code Value | Meaning | How to Correct |
|---|---|---|
| 12<br>Invalid Parameter handle | The supplied handle is invalid. This can indicate a user error, program error, or a storage cell in an uninitialized state.<br>In the following cases, the storage cell is in an uninitialized state, but no action is required:<br>Storage cell discard (informational message):<br>Storage cell look up object count (informational message):<br>Storage cell look up object (informational message): | In the following cases, the message can occur because the operation is not allowed when the storage cell is in an uninitialized state. If you see these messages, initialize the storage cell and retry the operation.<br>Storage cell set device addition policy<br>Storage cell set name<br>Storage cell set time<br>Storage cell set volume replacement delay<br>Storage cell free command lock<br>Storage cell set console lun id |
| 13<br>Invalid Parameter Id | The supplied identifier is invalid. This can indicate a user or program error. | Report the error to product support. |
| 14<br>Invalid Quorum Configuration | Quorum disks from multiple storage systems are present. | Report the error to product support. |
| 15<br>Invalid Target Handle | The supplied target handle is invalid. This can indicate a user or program error (Case 1),<br>or<br>Volume set requested usage (Case 2):<br>The operation could not be completed because the disk has never belonged to a disk group and therefore cannot be added to a disk group. | Case 1: Report the error to product support.<br>Case 2: To add additional capacity to the disk group, use the management software to add disks by count or capacity. |
| 16<br>Invalid Target Id | The supplied target identifier is invalid. This can indicate a user or program error. | Report the error to product support. |
| 17<br>Invalid Time | The time value specified is invalid. This can indicate a user or program error. | Report the error to product support. |
| 18<br>Media is Inaccessible | The operation could not be completed because one or more of the disk media was inaccessible. | Report the error to product support. |
| 19<br>No Fibre Channel Port | The Fibre Channel port specified is not valid. This can indicate a user or program error. | Report the error to product support. |
| 20<br>No Image | There is no firmware image stored for the specified image number. | Report the error to product support. |
| 21<br>No Permission | The disk device is not in a state to allow the specified operation. | The disk device must be in either maintenance mode or in a reserved state for the specified operation to proceed. |
| 22<br>Storage system not initialized | The operation requires a storage cell to exist. | Create a storage cell and retry the operation. |
| 23<br>Not a Loop Port | The Fibre Channel port specified is either not a loop port or is invalid. This can indicate a user or program error. | Report the error to product support. |
| 24<br>Not a Participating Controller | The controller must be participating in the storage cell to perform the operation. | Verify that the controller is a participating member of the storage cell. |

## Table 22 Error Messages *(continued)*

| Status Code Value | Meaning | How to Correct |
|---|---|---|
| 25<br>Objects in your system are in use, and their state prevents the operation you wish to perform. | Several states can cause this message:<br>Case 1: The operation cannot be performed because an association exists a related object, or the object is in a progress state.<br>Derived unit create: Case 2: The supplied virtual disk handle is already an attribute of another derived unit. This may indicate a programming error<br>Derived unit discard: Case 3: One or more LUNs are presented to EVA hosts that are based on this virtual disk.<br>Case 4: Logical disk clear data lost: The virtual disk is in the non-mirrored delay window.<br>Case 5: LDAD discard: The operation cannot be performed because one or more virtual disks still exist, the disk group still may be recovering its capacity, or this is the last disk group that exists.<br>Case 6: LDAD resolve condition: The disk group contains a disk volume that is in a data-lost state. This condition cannot be resolved.<br>Case 7: Physical Store erase volume: The disk is a part of a disk group and cannot be erased.<br>Case 8: Storage cell discard: The storage cell contains one or more virtual disks or LUN presentations.<br>Case 9: Storage cell client discard: = The EVA host contains one or more LUN presentations.<br>Case 10: SCVD discard: The virtual disk contains one or more derived units and cannot be discarded. This may indicate a programming error.<br>Case 11: SCVD set capacity: The capacity cannot be modified because the virtual disk has a dependency on either a snapshot or snapclone.<br>Case 12: SCVD set disk cache policy: The virtual disk cache policy cannot be modified while the virtual disk is presented and enabled.<br>Case 13: SCVD set logical disk: The logical disk attribute is already set, or the supplied logical disk is already a member of another virtual disk.<br>Case 14: VOLUME set requested usage: The disk volume is already a member of a disk group or is in the state of being removed from a disk group.<br>Case 15: GROUP discard: The Continuous Access group cannot be discarded as one or more virtual disk members exist. | Case 1: Either delete the associated object or resolve the in progress state.<br>Case 2: . Report the error to product support.<br>Case 3: Unpresent the LUNs before deleting this virtual disk.<br>Case 4: Resolve the delay before performing the operation.<br>Case 5: Delete any remaining virtual disks or wait for the used capacity to reach zero before the disk group can be deleted. If this is the last remaining disk group, uninitialize the storage cell to remove it.<br>Case 6: Report the error to product support.<br>Case 7: The disk must be in a reserved state before it can be erased.<br>Case 8: Delete the virtual disks or LUN presentations before uninitializing the storage cell.<br>Case 9: Delete the LUN presentations before deleting the EVA host.<br>Case 10: Report the error to product support.<br>Case 11: Resolve the situation before attempting the operation again.<br>Case 12: Resolve the situation before attempting the operation again.<br>Case 13: This may indicate a programming error. Report the error to product support.<br>Case 14: Select another disk or remove the disk from the disk group before making it a member of a different disk group.<br>Case 15: Remove the virtual disks from the group and retry the operation. |

## Table 22 Error Messages *(continued)*

| Status Code Value | Meaning | How to Correct |
|---|---|---|
| 26<br>Parameter Object Does Not Exist | The operation cannot be performed because the object does not exist. This can indicate a user or program error.<br>VOLUME set requested usage: The disk volume set requested usage cannot be performed because the disk group does not exist. This can indicate a user or program error. | Report the error to product support. |
| 27<br>Target Object Does Not Exist | Case 1: The operation cannot be performed because the object does not exist. This can indicate a user or program error.<br>Case 2: DERIVED UNIT discard: The operation cannot be performed because the virtual disk, snapshot, or snapclone does not exist or is still being created.<br>Case 3: VOLUME set requested usage: The operation cannot be performed because the target disk volume does not exist. This can indicate a user or program error.<br>Case 4: GROUP get name: The operation cannot be performed because the Continuous Access group does not exist. This can indicate a user or program error. | Case 1: Report the error to product support.<br>Case 2: Retry the request at a later time.<br>Case 3: Report the error to product support.<br>Case 4: Report the error to product support. |
| 28<br>Timeout | A timeout has occurred in processing the request. | Verify the hardware connections and that communication to the device is successful. |
| 29<br>Unknown Id | The supplied storage cell identifier is invalid. This can indicate a user or program error. | Report the error to product support. |
| 30<br>Unknown Parameter Handle | The supplied parameter handle is unknown. This can indicate a user or program error. | Report the error to product support. |
| 31<br>Unrecoverable Media Error | The operation could not be completed because one or more of the disk media had an unrecoverable error. | Report the error to product support. |
| 32<br>Invalid State | This error is no longer supported. | Report the error to product support. |
| 33<br>Transport Error | A SCMI transport error has occurred. | Verify the hardware connections, communication to the device, and that the management software is operating successfully. |
| 34<br>Volume is Missing | The operation could not be completed because the drive volume is in a missing state. | Resolve the condition and retry the request. Report the error to product support. |
| 35<br>Invalid Cursor | The supplied cursor or sequence number is invalid. This may indicate a user or program error. | Report the error to product support. |
| 36<br>Invalid Target for the Operation | The specified target logical disk already has an existing data sharing relationship. This can indicate a user or program error. | Report the error to product support. |
| 37<br>No More Events | There are no more events to retrieve. (This message is informational only.) | No action required. |
| 38<br>Lock Busy | The command lock is busy and being held by another process. | Retry the request at a later time. |

## Table 22 Error Messages *(continued)*

| Status Code Value | Meaning | How to Correct |
|---|---|---|
| 39<br>Time Not Set | The storage system time is not set. The storage system time is set automatically by the management software. | Report the error to product support. |
| 40<br>Not a Supported Version | The requested operation is not supported by this firmware version. This can indicate a user or program error. | Report the error to product support. |
| 41<br>No Logical Disk for Vdisk | The specified SCVD does not have a logical disk associated with it. This can indicate a user or program error. | Report the error to product support. |
| 42<br>Logical disk Presented | The virtual disk specified is already presented to the client and the requested operation is not allowed. | Delete the associated presentation(s) and retry the request. |
| 43<br>Operation Denied On Slave | The request is not allowed on the slave controller. This can indicate a user or program error. | Report the error to product support. |
| 44<br>Not licensed for data replication | This error is no longer supported. | Report the error to product support. |
| 45<br>Not DR group member | The operation cannot be performed because the virtual disk is not a member of a Continuous Access group. | Configure the virtual disk to be a member of a Continuous Access group and retry the request. |
| 46<br>Invalid DR mode | The operation cannot be performed because the Continuous Access group is not in the required mode. | Configure the Continuous Access group correctly and retry the request. |
| 47<br>The target DR member is in full copy, operation rejected | The operation cannot be performed because at least one of the virtual disk members is in a copying state. | Wait for the copying state to complete and retry the request. |
| 48<br>Security credentials needed. Please update your system's ID and password in the Storage System Access menu. | The management software is unable to log in to the storage system. The storage system password has been configured. | Use the management software to save the password specified so communication can proceed. |
| 49<br>Security credentials supplied were invalid. Please update your system's ID and password in the Storage System Access menu. | The management software is unable to login to the device. The storage system password may have been re-configured or removed. | Use the management software to set the password to match the device so communication can proceed. |
| 50<br>Security credentials supplied were invalid. Please update your system's ID and password in the Storage System Access menu. | The management software is already logged in to the device. (This message is informational only.) | No action required. |
| 51<br>Storage system connection down | The Continuous Access group is not functioning.<br>. | Verify that devices are powered on and that device hardware connections are functioning correctly. |
| 52<br>DR group empty | No virtual disks are members of the Continuous Access group. | Add one or more virtual disks as members and retry the request. |
| 53<br>Incompatible attribute | The request cannot be performed because one or more of the attributes specified is incompatible. | Retry the request with valid attributes for the operation. |
| 54<br>Vdisk is a DR group member | The requested operation cannot be performed on a virtual disk that is already a member of a data replication group. | Remove the virtual disk as a member of a data replication group and retry the request. |

## Table 22 Error Messages *(continued)*

| Status Code Value | Meaning | How to Correct |
|---|---|---|
| 55<br>Vdisk is a DR log unit | The requested operation cannot be performed on a virtual disk that is a log unit. | No action required. |
| 56<br>Cache batteries failed or missing. | The battery system is missing or discharged. | Report the error to product support. |
| 57<br>Vdisk is not presented | The virtual disk member is not presented to a client. | The virtual disk member must be presented to a client before this operation can be performed. |
| 58<br>Other controller failed | Invalid status for logical disk. This error is no longer supported. | Report the error to product support. |
| 59<br>Maximum Number of Objects Exceeded. | Case 1: The maximum number of items allowed has been reached.<br>Case 2: The maximum number of EVA hosts has been reached.<br>Case 3: The maximum number of port WWNs has been reached. | Case 1: If this operation is still desired, delete one or more of the items and retry the operation.<br>Case 2: If this operation is still desired, delete one or more of the EVA hosts and retry the operation.<br>Case 3: If this operation is still desired, delete one or more of the port WWNs and retry the operation. |
| 60<br>Max size exceeded | Case 1: The maximum number of items already exist on the destination storage cell.<br>Case 2: The size specified exceeds the maximum size allowed.<br>Case 3: The presented user space exceeds the maximum size allowed.<br>Case 4: The presented user space exceeds the maximum size allowed.<br>Case 5: The size specified exceeds the maximum size allowed.<br>Case 6: The maximum number of EVA hosts already exist on the destination storage cell.<br>Case 7: The maximum number of EVA hosts already exist on the destination storage cell.<br>Case 8: The maximum number of Continuous Access groups already exist. | Case 1: If this operation is still desired, delete one or more of the items on the destination storage cell and retry the operation.<br>Case 2: Use a smaller size and retry the operation.<br>Case 3: No action required.<br>Case 4: No action required.<br>Case 5: Use a smaller size and try this operation again.<br>Case 6: If this operation is still desired, delete one or more of the EVA hosts and retry the operation.<br>Case 7: If this operation is still desired, delete one or more of the virtual disks on the destination storage cell and retry the operation.<br>Case 8: If this operation is still desired, delete one or more of the groups and retry the operation. |
| 61<br>Password mismatch. Please update your system's password in the Storage System Access menu. Continued attempts to access this storage system with an incorrect password will disable management of this storage system. | The login password entered on the controllers does not match. | Reconfigure one of the storage system controller passwords, then use the management software to set the password to match the device so communication can proceed. |
| 62<br>DR group is merging | The operation cannot be performed because the Continuous Access connection is currently merging. | Wait for the merge operation to complete and retry the request. |
| 63<br>DR group is logging | The operation cannot be performed because the Continuous Access connection is currently logging. | Wait for the logging operation to complete and retry the request. |

## Table 22 Error Messages *(continued)*

| Status Code Value | Meaning | How to Correct |
|---|---|---|
| 64<br>Connection is suspended | The operation cannot be performed because the Continuous Access connection is currently suspended | Resolve the suspended mode and retry the request. |
| 65<br>Bad image header | The firmware image file has a header checksum error. | Retrieve a valid firmware image file and retry the request. |
| 66<br>Bad image | The firmware image file has a checksum error. | Retrieve a valid firmware image file and retry the request. |
| 67 The firmware image file is too large.<br>Image too large | Invalid status for logical disk. This error is no longer supported. | Retrieve a valid firmware image file and retry the request. |
| 70<br>Image incompatible with system configuration. Version conflict in upgrade or downgrade not allowed. | The firmware image file is incompatible with the current firmware. | Retrieve a valid firmware image file and retry the request |
| 71<br>Bad image segment | The firmware image download process has failed because of a corrupted image segment. | Verify that the firmware image is not corrupted and retry the firmware download process. |
| 72<br>Image already loaded | The firmware version already exists on the device. | No action required. |
| 73<br>Image Write Error | The firmware image download process has failed because of a failed write operation. | Verify that the firmware image is not corrupted and retry the firmware download process. |
| 74<br>Logical Disk Sharing | Case 1: The operation cannot be performed because the virtual disk or snapshot is part of a snapshot group.<br>Case 2: The operation may be prevented because a snapclone or snapshot operation is in progress. If a snapclone operation is in progress, the parent virtual disk should be discarded automatically after the operation completes. If the parent virtual disk has snapshots, then you must delete the snapshots before the parent virtual disk can be deleted.<br>Case 3: The operation cannot be performed because either the previous snapclone operation is still in progress, or the virtual disk is already part of a snapshot group.<br>Case 4: A capacity change is not allowed on a virtual disk or snapshot that is a part of a snapshot group.<br>Case 5: The operation cannot be performed because the virtual disk or snapshot is a part of a snapshot group. | Case 1: No action required.<br>Case 2: No action required.<br>Case 3: If a snapclone operation is in progress, wait until the snapclone operation has completed and retry the operation. Otherwise, the operation cannot be performed on this virtual disk.<br>Case 4: No action required.<br>Case 5: No action required. |
| 75<br>Bad Image Size | The firmware image file is not the correct size. | Retrieve a valid firmware image file and retry the request. |
| 76<br>The controller is temporarily busy and it cannot process the request. Retry the request later. | The controller is currently processing a firmware download. Retry the request once the firmware download process is complete. | Retry the request once the firmware download process is complete. |
| 77<br>Volume Failure Predicted | The disk volume specified is in a predictive failed state. | Report the error to product support. |

## Table 22 Error Messages *(continued)*

| Status Code Value | Meaning | How to Correct |
|---|---|---|
| 78<br>Invalid object condition for this command. | The current condition or state is preventing the request from completing successfully. | Resolve the condition and retry the request. |
| 79<br>Snapshot (or snapclone) deletion in progress. The requested operation is currently not allowed. Please try again later. | The current condition of the snapshot, snapclone or parent virtual disk is preventing the request from completing successfully. | Wait for the operation to complete and retry the request. |
| 80<br>Invalid Volume Usage | Case 1: The disk volume is already a part of a disk group. | Resolve the condition by setting the usage to a reserved state and 80 retry the request. Invalid Volume Usage |
| | Case 2: The disk volume usage cannot be modified, as the minimum number of disks exist in the disk group. | Report the error to product support. |
| 81<br>Minimum Volumes In Disk Group | The disk volume usage cannot be modified, as the minimum number of disks exist in the disk group. | Resolve the condition by adding additional disks and retry the request. |
| 82<br>Shutdown In Progress | The controller is currently shutting down. | No action required. |
| 83<br>Controller API Not Ready, Try Again Later | The device is not ready to process the request. | Retry the request at a later time. |
| 84<br>Is Snapshot | This is a snapshot virtual disk and cannot be a member of a Continuous Access group. | No action required. |
| 85<br>Cannot add or remove DR group member. Mirror cache must be active for this Vdisk. Check controller cache condition. | An incompatible mirror policy of the virtual disk is preventing it from becoming a member of a Continuous Access group. | Modify the mirror policy and retry the request. |
| 86<br>Command View EVA has detected this array as inoperative. Contact HP Service for assistance. | Case 1: A virtual disk is in an inoperative state and the request cannot be processed. | Report the error to product support. |
| | Case 2: The snapclone cannot be associated with a virtual disk that is in an inoperative state. 86 Command View EVA has detected this array as inoperative. Contact HP Service for assistance. | |
| | Case 3: The snapshot cannot be associated with a virtual disk that is in an inoperative state. Report the error to product support. | |
| 87<br>Disk group inoperative or disks in group less than minimum. | The disk group is in an inoperative state and cannot process the request. | Report the error to product support. |
| 88<br>Storage system inoperative | The storage system is inoperative and cannot process the request. | Report the error to product support. |
| 89<br>Failsafe Locked | The request cannot be performed because the Continuous Access group is in a failsafe locked state. | Resolve the condition and retry the request. |
| 90<br>Data Flush Incomplete | The disk cache data need to be flushed before the condition can be resolved. | Retry the request later. |

## Table 22 Error Messages *(continued)*

| Status Code Value | Meaning | How to Correct |
|---|---|---|
| 91<br>Redundancy Mirrored Inoperative | The disk group is in a redundancy mirrored inoperative state and the request cannot be completed. | Report the error to product support. |
| 92<br>Duplicate LUN | The LUN number is already in use by another client of the storage system. | Select another LUN number and retry the request. |
| 93<br>Other remote controller failed | While the request was being performed, the remote storage system controller failed. | Resolve the condition and retry the request. Report the error to product support. |
| 94<br>Unknown remote Vdisk | The remote storage system specified does not exist. | Correctly select the remote storage system and retry the request. |
| 95<br>Unknown remote DR group | The remote Continuous Access group specified does not exist. | Correctly select the remote Continuous Access group retry the request. |
| 96<br>PLDMC failed | The disk metadata was unable to be updated. | Resolve the condition and retry the request. Report the error to product support. |
| 97<br>Storage system could not be locked. System busy. Try command again. | Another process has already taken the SCMI lock on the storage system. | Retry the request later. |
| 98<br>Error on remote storage system. | While the request was being performed, an error occurred on the remote storage system. | 'Resolve the condition and retry the request |
| 99<br>The DR operation can only be completed when the source-destination connection is down. If you are doing a destination DR deletion, make sure the connection link to the source DR system is down or do a failover operation to make this system the source. | The request failed because the operation cannot be performed on a Continuous Access connection that is up. | Resolve the condition and retry the request. |
| 100<br>Login required - password changed. | The management software is unable to log into the device as the password has changed. | The storage system password may have been re-configured or removed. The management software must be used to set the password up to match the device so communication can proceed. |

# C Controller fault management

This appendix describes how the controller displays events and termination event information. Termination event information is displayed on the LCD. HP P6000 Command View enables you to view controller events. This appendix also discusses how to identify and correct problems.

Once you create a storage system, an error condition message has priority over other controller displays.

HP P6000 Command View provides detailed descriptions of the storage system error conditions, or faults. The Fault Management displays provide similar information on the LCD, but not in as much detail. Whenever possible, see HP P6000 Command View for fault information.

## Using HP P6000 Command View

HP P6000 Command View provides detailed information about each event affecting system operation in either a Termination Event display or an Event display. These displays are similar, but not identical.

## GUI termination event display

A problem that generates the Termination Event display prevents the system from performing a specific function or process. You can use the information in this display (see "GUI termination event display" (page 107)) to diagnose and correct the problem.

**NOTE:** The major differences between the Termination Event display and the Event display are:

- The Termination Event display includes a Code Flag field; it does not include the EIP Type field.
- The Event display includes an EIP type field; it does not include a Code Flag field.
- The Event display includes a Corrective Action Code field.

**Figure 27 GUI termination event display**

| Date | Time | SWCID | Evt No | Code Flag | Description |
|---|---|---|---|---|---|

The fields in the Termination Event display include:

- Date—The date the event occurred.
- Time—The time the event occurred.
- SWCID—Software Identification Code. A hexadecimal number in the range 0–FF that identifies the controller software component reporting the event.
- Evt No—Event Number. A hexadecimal number in the range 0–FF that is the software component identification number.
- Code Flag—An internal code that includes a combination of other flags.
- Description—The condition that generated the event. This field may contain information about an individual field's content and validity.

## GUI event display

A problem that generates the Event display reduces the system capabilities. You can use the information in this display (see Figure 28 (page 108)) to diagnose and correct problems.

**NOTE:** The major differences between the Event Display and the Termination Event display are:

- The Event display includes an EIP type field; it does not include a Code Flag field.
- The Event display includes a Corrective Action Code (CAC) field.
- The Termination Event display includes a Code Flag field; it does not include the EIP Type field.

**Figure 28 Typical HP P6000 Command View Event display**

| Date | Time | SWCID | Evt No | CAC | EIP Type | Description |
|---|---|---|---|---|---|---|

The Event display provides the following information:

- Date—The date the event occurred.
- Time—The time the even occurred.
- SWCID—Software Identification Code. A number in the range 1–256 that identifies the internal firmware module affected.
- Evt No—Event Number. A hexadecimal number in the range 0–FF that is the software component identification number.
- CAC—Corrective Action Code. A specific action to correct the problem.
- EIP Type—Event Information Packet Type. A hexadecimal character that defines the event information format.
- Description—The problem that generated the event.

## Fault management displays

When you do not have access to the GUI, you can display and analyze termination codes (TCs) on the OCP LCD display. You can then use the event text code document, as described in the section titled "Interpreting Fault Management Information" to determine and implement corrective action. You can also provide this information to the authorized service representative should you require additional support. This lets the service representative identify the tools and components required to correct the condition in the shortest possible time.

When the fault management display is active, you can either display the last fault or display detailed information about the last 32 faults reported.

### Displaying Last Fault Information

Complete the following procedure to display Last Fault information

1. When the Fault Management display is active, press ▶ to select the Last Fault menu.
2. Press ▶ to display the last fault information.

   The first line of the TC display contains the eight-character TC error code and the two-character IDX (index) code. The IDX is a reference to the location in the TC array that contains this error. The second line of the TC display identifies the affected parameter with a two-character parameter number (0–30), the eight-character parameter code affected, and the parameter code number.
3. Press ◀ to return to the Last Fault menu.

### Displaying Detailed Information

The Detail View menu lets you examine detailed fault information stored in the Last Termination Event Array (LTEA). This array stores information for the last 32 termination events.

Complete the following procedure to display the LTEA information about any of the last 32 termination events:

1. When the Fault Management display is active (flashing), press ▼ to select the Detail View menu.

   The LTEA selection menu is active (LTEA 0 is displayed).
2. Press ▼ or ▲ to increment to a specific error.
3. Press ▶ to observe data about the selected error.

## Interpreting fault management information

Each version of HP P6000 Command View includes an ASCII text file that defines all the codes that the authorized service representative can view either on the GUI or on the OCP.

**IMPORTANT:** This information is for the exclusive use of the authorized service representative.

The file name identifies the controller model, file type, XCS baselevel id, and XCS version. For example, the file name *hsv210_event_cr08d3_5020.txt* provides the following information:

- `hsv210_`—The EVA controller model number
- `event_`—The type of information in the file
- `w010605_`—The base level build string (the file creation date).
  - `01`—The creation year
  - `06`—The creation month
  - `05`—The creation date
- `5020`—The XCS version

Table 22 (page 109) describes types of information available in this file.

**Table 23 Controller event text description file**

| Information type | Description |
|---|---|
| Event Code | This hexadecimal code identifies the reported event type. |
| Termination Code (TC) | This hexadecimal code specifies the condition that generated the termination code. It might also define either a system or user initiated corrective action. |
| Coupled Crash Control Codes | This single digit, decimal character defines the requirement for the other controller to initiate a coupled crash control.0. Other controller SHOULD NOT complete a coupled crash.1. Other controller SHOULD complete a coupled crash. |
| Dump/Restart Control Codes | This single decimal character (0, 1, 3) defines the requirement to:0. Perform a crash dump and then restart the controller.1. DO NOT perform a crash dump; just restart the controller.3. DO NOT perform a crash dump; DO NOT restart the controller. |
| Corrective Action Codes (CAC) | These hexadecimal codes supplement the Termination Code information to identify the faulty element and the recommended corrective action. |
| Software Component ID Codes (SWCID) | These decimal codes identify software associated with the event. |
| Event Information Packets (EIP) | These codes specify the packet organization for specific type events. |

# D Non-standard rack specifications

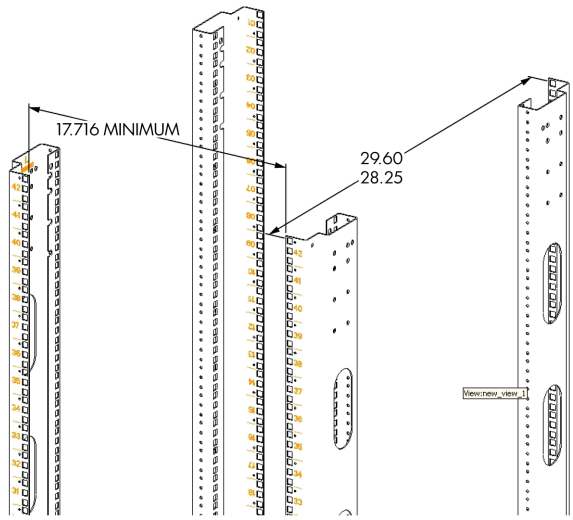
The appendix provides information on the requirements when installing the 6400/8400 in a non-standard rack. All the requirements must be met to ensure proper operation of the storage system.

## Rack specifications

### Internal component envelope

EVA component mounting brackets require space to be mounted behind the vertical mounting rails. Room for the mounting of the brackets includes the width of the mounting rails and needed room for any mounting hardware, such as screws, clip nuts, etc. Figure 29 (page 110) shows the dimensions required for the mounting space for the EVA product line. It does not show required space for additional HP components such as servers.

**Figure 29 Mounting space dimensions**




### EIA310-D standards

The rack must meet the Electronic Industries Association, (EIA), Standard 310-D, Cabinets, Racks and Associated Equipment. The standard defines rack mount spacing and component dimensions specified in U units.

Copies of the standard are available for purchase at http://www.eia.org/.

### EVA cabinet measures and tolerances

EVA component rack mount brackets are designed to fit cabinets with mounting rails set at depths from 28.25 inches to 29.6 inches, inside rails to inside rails.

### Weights, dimensions and component CG measurements

Cabinet CG dimensions are reported as measured from the inside bottom of the cabinet (Z), the leading edge of the vertical mounting rails (Y), and the centerline of the cabinet mounting space (X). Component CG measurements are measured from the bottom of the U space the component is to occupy (Z), the mounting surface of the mounting flanges (Y), and the centerline of the component (X). Table 24 (page 111) lists the CG dimensions for the EVA components.

Determining the CG of a configuration may be necessary for safety considerations. CG considerations for CG calculations do not include cables, PDU's and other peripheral components. Some consideration should be made to allow for some margin of safety when estimating configuration CG.

Estimating the configuration CG requires measuring the CG of the cabinet the product will be installed in. Use the following formula:

$\Sigma d_{component} W = d_{system\ cg} W$

where $d_{component}$= the distance of interest and W = Weight

The distance of a component is its CG's distance from the inside base of the cabinet. For example, if a loaded disk enclosure is to be installed into the cabinet with its bottom at 10U, the distance for the enclosure would be (10*1.75)+2.7 inches.

**Table 24 Component data**

| Component Data | | | | | |
|---|---|---|---|---|---|
| | U height[1] | Weight (Lb) | X (in) | Y (in) | Z (in) |
| HP 10K cabinet CG | | 233 | -0.108 | 25.75 | 14.21 |
| Filler panel, 3U | 3 | 1.4 | 0 | 2.625 | 0 |
| Fully loaded drive enclosure | 3 | 74 | -0.288 | 2.7 | 7.95 |
| Filler panel, 1U | 1 | 0.47 | 0 | 0.875 | 0 |
| Controller pair | 4 | 120 | -0.094 | 2.53 | 10.64 |

[1] 1U = 1.75 inches

## Airflow and Recirculation

### Component Airflow Requirements

Component airflow must be directed from the front of the cabinet to the rear. Components vented to discharge airflow from the sides must discharge to the rear of the cabinet.

### Rack Airflow Requirements

The following requirements must be met to ensure adequate airflow and to prevent damage to the equipment:

- If the rack includes closing front and rear doors, allow 830 square inches (5,350 sq cm) of hole evenly distributed from top to bottom to permit adequate airflow (equivalent to the required 64 percent open area for ventilation).
- For side vented components, the clearance between the installed rack component and the side panels of the rack must be a minimum of 2.75 inches (7 cm).
- Always use blanking panels to fill all empty front panel U-spaces in the rack. This ensures proper airflow. Using a rack without blanking panels results in improper cooling that can lead to thermal damage.

## Configuration Standards

EVA configurations are designed considering cable length, configuration CG, serviceability and accessibility, and to allow for easy expansion of the system. If at all possible, it is best to configure non HP cabinets in a like manner.

# Environmental and operating specifications

This section identifies the product environmental and operating specifications.

**NOTE:** Further testing is required to update the information in Tables 45-47. Once testing is complete, these tables will be updated in a future release.

## UPS Selection

This section provides information that can be used when selecting a UPS for use with the EVA. The four HP UPS products listed in Table 25 (page 112) are available for use with the EVA and are

included in this comparison. Table 26 (page 112) identifies the amount of time each UPS can sustain power under varying loads and with various UPS ERM (Extended Runtime Module) options.

The load imposed on the UPS for different disk enclosure configurations are listed in Table 27 (page 113) and Table 28 (page 113).

**NOTE:** The specified power requirements reflect fully loaded enclosures (14 disks) .

### Table 25 HP UPS models and capacities

| UPS Model | Capacity (in watts) |
|---|---|
| R1500 | 1340 |
| R3000 | 2700 |
| R5500 | 4500 |
| R12000 | 12000 |

### Table 26 UPS operating time limits

| Load (percent) | Minutes of operation | | |
|---|---|---|---|
| | With standby battery | With 1 ERM | With 2 ERMs |
| **R1500** | | | |
| 100 | 5 | 23 | 49 |
| 80 | 6 | 32 | 63 |
| 50 | 13 | 57 | 161 |
| 20 | 34 | 146 | 290 |
| **R3000** | | | |
| 100 | 5 | 20 | |
| 80 | 6.5 | 30 | |
| 50 | 12 | 45 | |
| 20 | 40 | 120 | |
| **R5500** | | | |
| 100 | 7 | 24 | 46 |
| 80 | 9 | 31 | 60 |
| 50 | 19 | 61 | 106 |
| 20 | 59 | 169 | 303 |
| **R12000** | | | |
| 100 | 5 | 11 | 18 |
| 80 | 7 | 15 | 24 |
| 50 | 14 | 28 | 41 |
| 20 | 43 | 69 | 101 |

### Table 27 EVA8400 UPS loading

| Enclosures | Watts | % of UPS capacity | |
|---|---|---|---|
| | | R5500 | R12000 |
| 12 | 4920 | | 41.0 |
| 11 | 4414 | 98.1 | 36.8 |
| 10 | 4037 | 89.7 | 33.6 |
| 9 | 3660 | 81.3 | 30.5 |
| 8 | 3284 | 73.0 | 27.4 |
| 7 | 2907 | 64.6 | 24.2 |
| 6 | 2530 | 56.2 | 21.1 |
| 5 | 2153 | 47.9 | 17.9 |
| 4 | 1777 | 39.5 | 14.8 |
| 3 | 1400 | 31.1 | 11.7 |
| 2 | 1023 | 22.7 | 8.5 |
| 1 | 647 | 14.4 | 5.4 |

### Table 28 EVA6400 UPS loading

| Enclosures | Watts | % of UPS capacity | | |
|---|---|---|---|---|
| | | R3000 | R5500 | R12000 |
| 8 | 3214 | | 71.4 | 26.8 |
| 7 | 2837 | | 63.0 | 23.6 |
| 6 | 2460 | 91.1 | 54.6 | 20.5 |
| 5 | 2083 | 77.2 | 46.2 | 17.3 |
| 4 | 1707 | 63.2 | 37.9 | 14.2 |
| 3 | 1330 | 49.3 | 29.5 | 11.1 |
| 2 | 953 | 35.3 | 21.2 | 7.9 |
| 1 | 577 | 21.4 | 12.8 | 4.8 |

## Shock and vibration specifications

Table 29 (page 113) lists the product operating shock and vibration specifications. This information applies to products weighing 45 Kg (100 lbs) or less.

**NOTE:** HP EVA P6000 products are designed and tested to withstand the operational shock and vibration limits specified in Table 29 (page 113). Transmission of site vibrations through non-HP racks exceeding these limits could cause operational failures of the system components.

### Table 29 Operating Shock/Vibration

| |
|---|
| Shock test with half sine pulses of 10 G magnitude and 10 ms duration applied in all three axes (both positive and negative directions). |
| Sine sweep vibration from 5 Hz to 500 Hz to 5 Hz at 0.1 G peak, with 0.020" displacement limitation below 10 Hz. Sweep rate of 1 octave/minute. Test performed in all three axes. |

**Table 29 Operating Shock/Vibration** *(continued)*

| |
|---|
| Random vibration at 0.25 G rms level with uniform spectrum in the frequency range of 10 to 500 Hz. Test performed for two minutes each in all three axes. |
| Drives and other items exercised and monitored running appropriate exerciser (UIOX, P-Suite, etc.) with appropriate operating system and hardware. |

# E Single Path Implementation

This appendix provides guidance for connecting servers with a single path host bus adapter (HBA) to the Enterprise Virtual Array (EVA) storage system with no multi-path software installed. A single path HBA is defined as an HBA that has a single path to its LUNs. These LUNs are not shared by any other HBA in the server or in the SAN.

The failure scenarios demonstrate behavior when recommended configurations are employed, as well as expected failover behavior if guidelines are not met. To implement single adapter servers into a multi-path EVA environment, configurations should follow these recommendations.

**NOTE:** The purpose of single HBA configurations for non-mission critical storage access is to control costs. This appendix describes the configurations, limitations, and failover characteristics of single HBA servers under different operating systems. Much of the description herein are based upon a single HBA configuration resulting in a single path to the device, but such is not the case with OpenVMS and Tru64 UNIX.

HP OpenVMS and Tru64 UNIX have native multi-path features by default.

With OpenVMS and Tru64 UNIX, a single HBA configuration will result in two paths to the device by virtue of having connections to both EVA controllers. Single HBA configurations are not single path configurations with these operating systems.

In addition, cluster configurations of both OpenVMS and Tru64 UNIX provide enhanced availability and security. To achieve availability within cluster configurations, each member should be configured with its own HBA(s) and connectivity to shared LUNs. Cluster configuration will not be discussed further within this appendix as the enhanced availability requires both additional server hardware and HBAs which is contrary to controlling configuration costs for non-mission critical applications. For further information on cluster configurations and attributes, see the appropriate operating system guides and the SAN design guide.

**NOTE:** HP continually makes additions to its storage solution product line. For more information about the HP Fibre Channel product line, the latest drivers, and technical tips, and to view other documentation, see the HP website at

http://www.hp.com/country/us/eng/prodserv/storage.html

## High-level solution overview

EVA was designed for highly dynamic enterprise environments requiring high data availability, fault tolerance, and high performance; thus, the EVA controller runs only in multi-path failover mode. Multi-path failover mode ensures the proper level of fault tolerance for the enterprise with mission-critical application environments. However, this appendix addresses the need for non-mission-critical applications to gain access to the EVA system running mission-critical production applications.

The non-mission-critical applications gain access to the EVA from a single path HBA server without running a multi-path driver. When a single path HBA server uses the supported configurations, a fault in the single path HBA server does not result in a fault in the other servers.

## Benefits at a glance

The EVA is a high-performance array controller utilizing the benefits of virtualization. Virtualization within the storage system is ideal for environments needing high performance, high data availability, fault tolerance, efficient storage management, data replication, and cluster support. However, enterprise-level data centers incorporate non-mission-critical applications as well as applications that require high availability.

Single-path capability adds flexibility to budget allocation. There is a per-path savings as the additional cost of HBAs and multi-path software is removed from non-mission–critical application requirements. These servers can still gain access to the EVA by using single path HBAs without multi-path software. This reduces the costs at the server and infrastructure level.

## Installation requirements

- The host must be placed in a zone with any EVA worldwide IDs (WWIDs) that access storage devices presented by the hierarchical storage virtualization (HSV) controllers to the single path HBA host. The preferred method is to use HBA and HSV WWIDs in the zone configurations.
- On HP-UX, Solaris, Microsoft Windows Server, Linux, and IBM AIX operating systems, the zones consist of the single path HBA systems and one HSV controller port.
- On OpenVMS and Tru64 UNIX operating systems, the zones consist of the single HBA systems and two HSV controller ports. This will result in a configuration where there are two paths per device, or multiple paths.

## Recommended mitigations

EVA is designed for the mission-critical enterprise environment. When used with multi-path software, high data availability and fault tolerance are achieved. In single path HBA server configurations, neither multi-path software nor redundant I/O paths are present. Server-based operating systems are not designed to inherently recover from unexpected failure events in the I/O path (for example, loss of connectivity between the server and the data storage). It is expected that most operating systems will experience undesirable behavior when configured in non-high-availability configurations.

Because of the risks of using servers with a single path HBA, HP recommends the following actions:

- Use servers with a single path HBA that are not mission-critical or highly available.
- Perform frequent backups of the single path server and its storage.

## Supported configurations

All examples detail a small homogeneous Storage Area Network (SAN) for ease of explanation. Mixing of dual and single path HBA systems in a heterogeneous SAN is supported. In addition to this document, reference and adhere to the SAN Design Reference Guide for heterogeneous SANs, located at:

http://h18006.www1.hp.com/products/storageworks/san/documentation.html

### General configuration components

All configurations require the following components:

- Enterprise XCS software
- HBAs
- Fibre Channel switches

### Connecting a single path HBA server to a switch in a fabric zone

Each host must attach to one switch (fabric) using standard Fibre Channel cables. Each host has its single path HBA connected through switches on a SAN to one port of an EVA.

Because a single path HBA server has no software to manage the connection and ensure that only one controller port is visible to the HBA, the fabric containing the single path HBA server, SAN switch, and EVA controller must be zoned. Configuring the single path by switch zoning and the LUNs by Selective Storage Presentation (SSP) allows for multiple single path HBAs to reside in the same server. A single path HBA server with OpenVMS or Tru64 UNIX operating system should be zoned with two EVA controllers. See the *HP SAN Design Reference Guide* at the following HP website for additional information about zoning:

http://h18006.www1.hp.com/products/storageworks/san/documentation.html

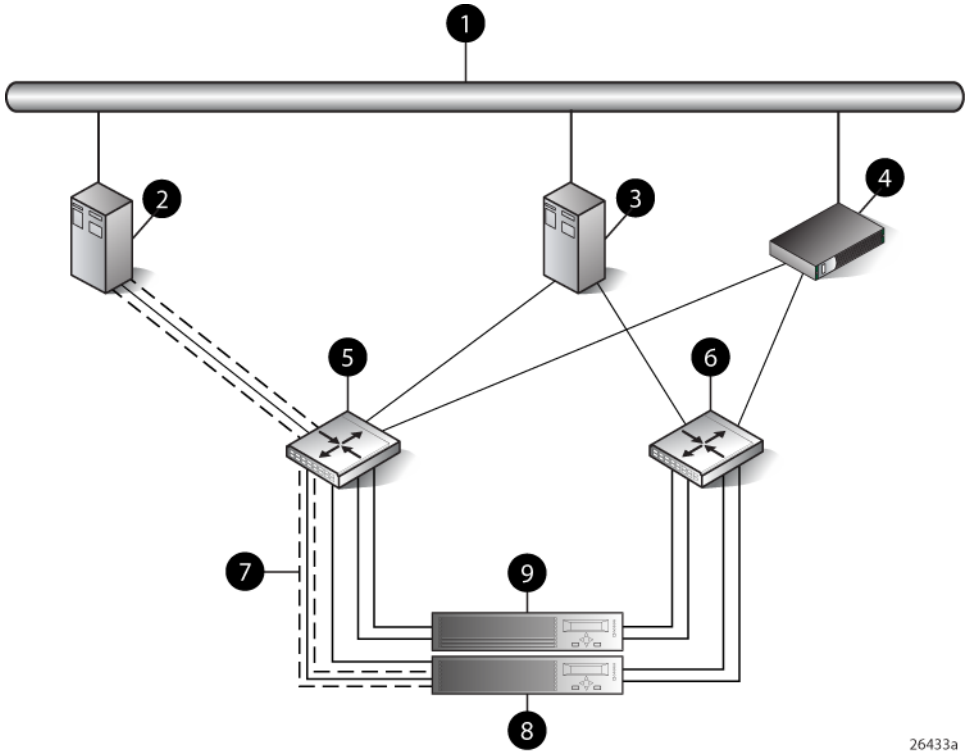
To connect a single path HBA server to a SAN switch:

1. Plug one end of the Fibre Channel cable into the HBA on the server.
2. Plug the other end of the cable into the switch.

Figure 30 (page 117) and Figure 31 (page 118) represent configurations containing both single path HBA server and dual HBA server, as well as a SAN appliance, connected to redundant SAN

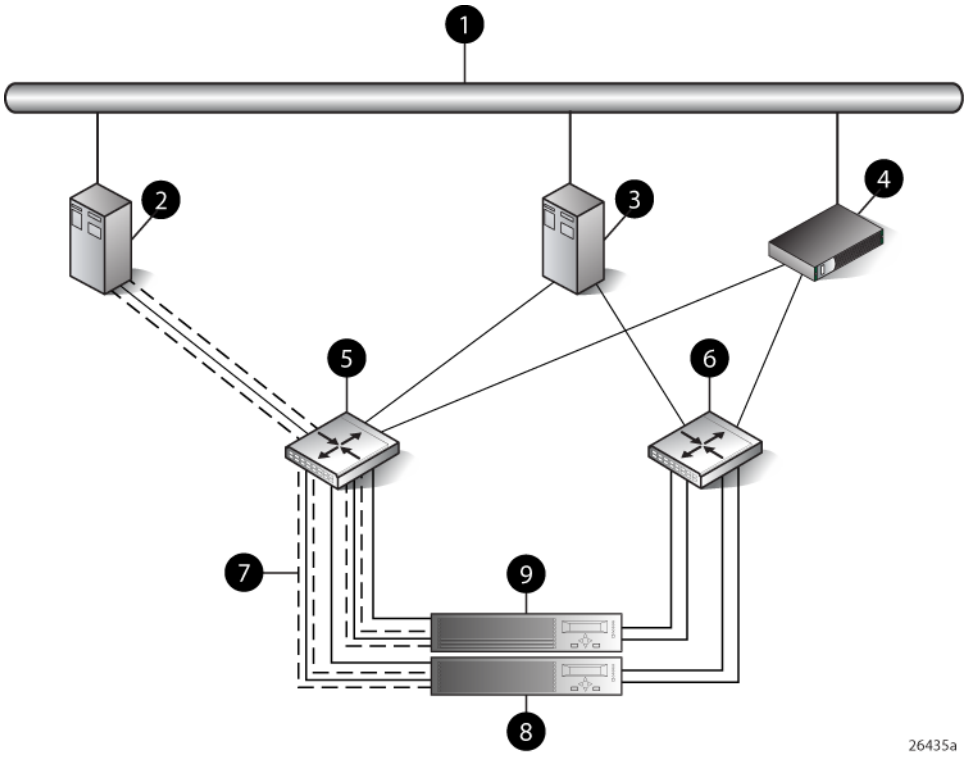
switches and EVA controllers. Whereas the dual HBA server has multi-path software that manages the two HBAs and their connections to the switch (with the exception of OpenVMS and Tru64 UNIX servers), the single path HBA has no software to perform this function. The dashed line in the figure represents the fabric zone that must be established for the single path HBA server. Note that in Figure 31 (page 118), servers with OpenVMS or Tru64 UNIX operating system should be zoned with two controllers.

**Figure 30 Single path HBA server without OpenVMS or Tru64 UNIX**




1 Network interconnection
2 Single HBA server
3 Dual HBA server
4 Management server
5 SAN switch 1
6 SAN switch 2
7 Fabric zone
8 Controller A
9 Controller B

**Figure 31 Single path HBA server with OpenVMS or Tru64 UNIX**




1 Network interconnection
2 Single HBA server
3 Dual HBA server
4 Management server
5 SAN switch 1
6 SAN switch 2
7 Fabric zone
8 Controller A
9 Controller B

# HP-UX configuration

## Requirements

- Proper switch zoning must be used to ensure each single path HBA has an exclusive path to its LUNs.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- Single path HBA server cannot share LUNs with any other HBAs.
- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.

## HBA configuration

- Host 1 is a single path HBA host.
- Host 2 is a multiple HBA host with multi-pathing software.

See Figure 32 (page 119).

### Risks

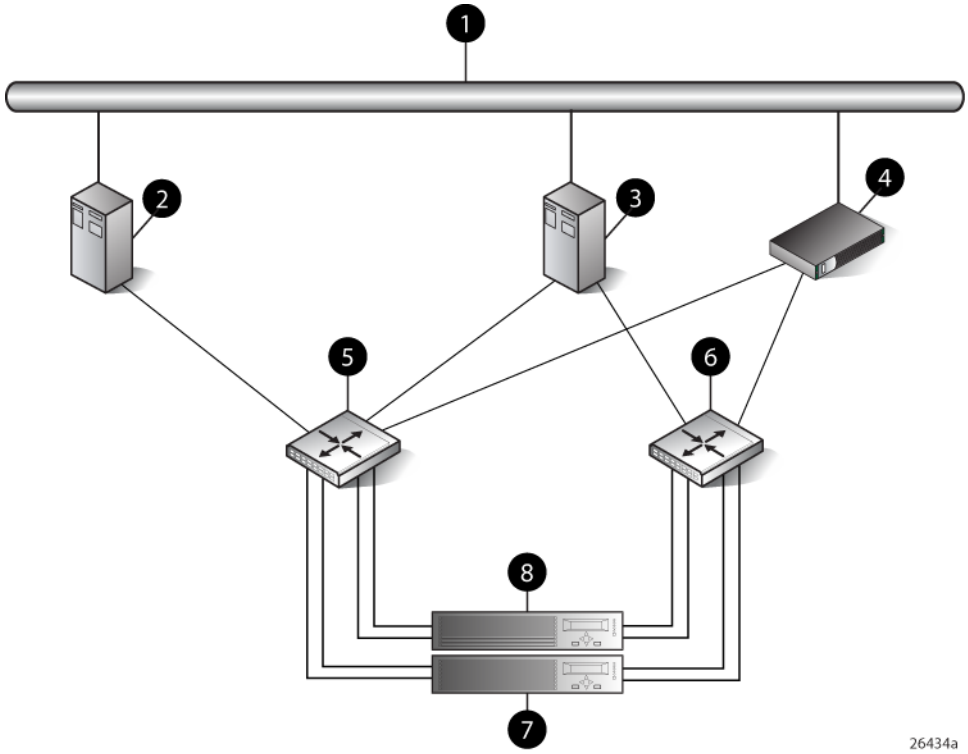
- Disabled jobs hang and cannot umount disks.
- Path or controller failure may results in loss of data accessibility and loss of host data that has not been written to storage.

**NOTE:** For additional risks, see "HP-UX failure scenarios" (page 131).

### Limitations

- HP P6000 Continuous Access is not supported with single-path configurations.
- Single path HBA server is not part of a cluster.
- Booting from the SAN is not supported.

**Figure 32 HP-UX configuration**




1 Network interconnection
2 Host 1
3 Host 2
4 Management server
5 SAN switch 1
6 SAN switch 2
7 Controller A
8 Controller B

## Windows Server (32-bit) configuration

### Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- Single path HBA server cannot share LUNs with any other HBAs.
- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone

becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.

## HBA configuration

- Host 1 is a single path HBA host.
- Host 2 is a multiple HBA host with multi-pathing software.

See Figure 33 (page 120).

## Risks

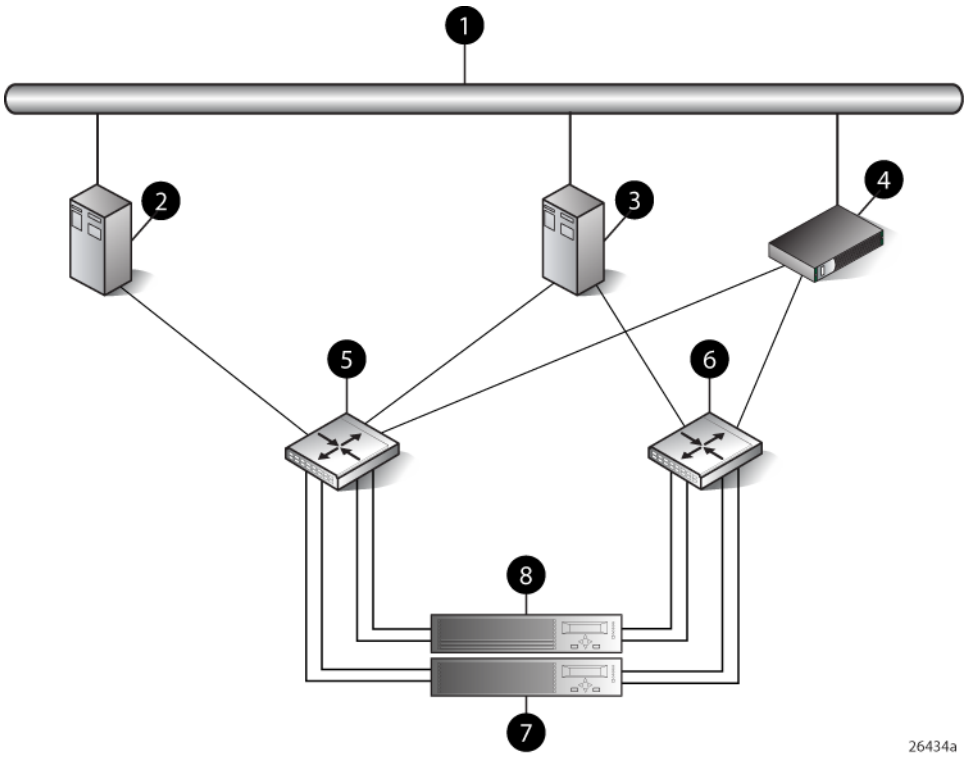
- Single path failure will result in loss of connection with the storage system.
- Single path failure may cause the server to reboot.
- Controller shutdown puts controller in a failed state that results in loss of data accessibility and loss of host data that has not been written to storage.

**NOTE:** For additional risks, see "Windows Server failure scenarios" (page 132).

## Limitations

- HP P6000 Continuous Access is not supported with single path configurations.
- Single path HBA server is not part of a cluster.
- Booting from the SAN is not supported on single path HBA servers.

**Figure 33 Windows Server (32-bit) configuration**




1 Network interconnection
2 Host 1
3 Host 2
4 Management server
5 SAN switch 1
6 SAN switch 2
7 Controller A
8 Controller B

# Windows Server (64-bit) configuration

## Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- Single path HBA server cannot share LUNs with any other HBAs.

## HBA configuration

- Hosts 1 and 2 are single path HBA hosts.
- Host 3 is a multiple HBA host with multi-pathing software.

See Figure 34 (page 122).

**NOTE:** Single path HBA servers running the Windows Server 2003 (x64) operating system will support multiple single path HBAs in the same server. This is accomplished through a combination of switch zoning and controller level SSP. Any single path HBA server will support up to four single path HBAs.

## Risks

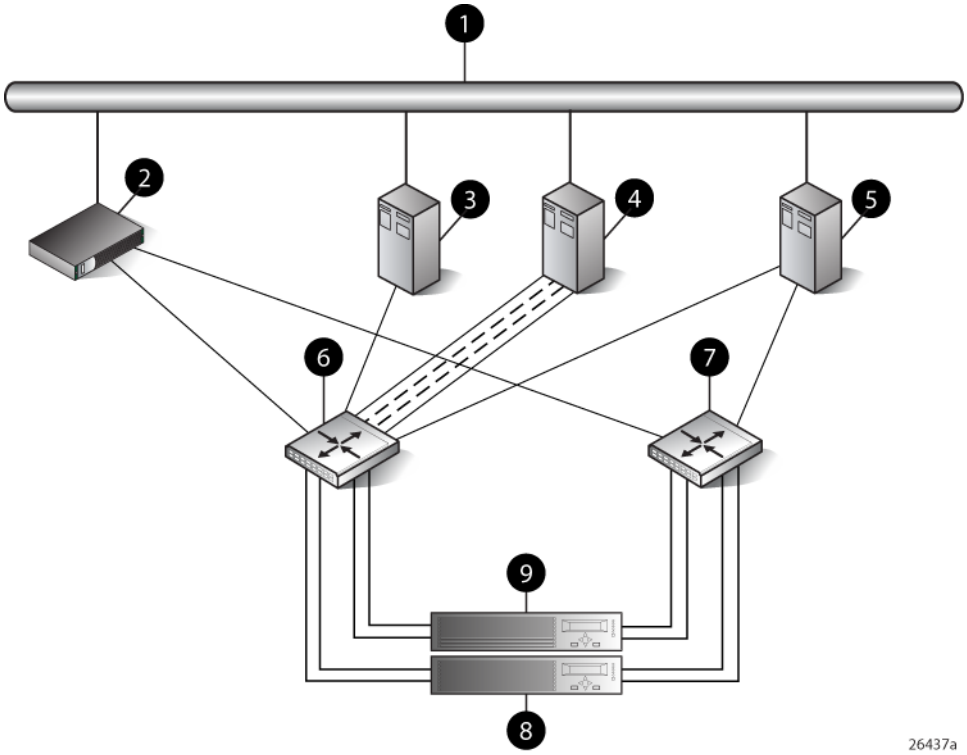
- Single path failure will result in loss of connection with the storage system.
- Single path failure may cause the server to reboot.
- Controller shutdown puts controller in a failed state that results in loss of data accessibility and loss of host data that has not been written to storage.

**NOTE:** For additional risks, see "Windows Server failure scenarios" (page 132).

## Limitations

- HP P6000 Continuous Access is not supported with single path configurations.
- Single path HBA server is not part of a cluster.
- Booting from the SAN is not supported on single path HBA servers.

**Figure 34 Windows Server (64-bit) configuration**




1 Network interconnection
2 Management server
3 Host 1
4 Host 2
5 Host 3
6 SAN switch 1
7 SAN switch 2
8 Controller A
9 Controller B

# Oracle Solaris configuration

## Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- Single path HBA server cannot share LUNs with any other HBAs.
- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.

## HBA configuration

- Host 1 is a single path HBA host.
- Host 2 is a multiple HBA host with multi-pathing software.

See Figure 35 (page 123).

### Risks

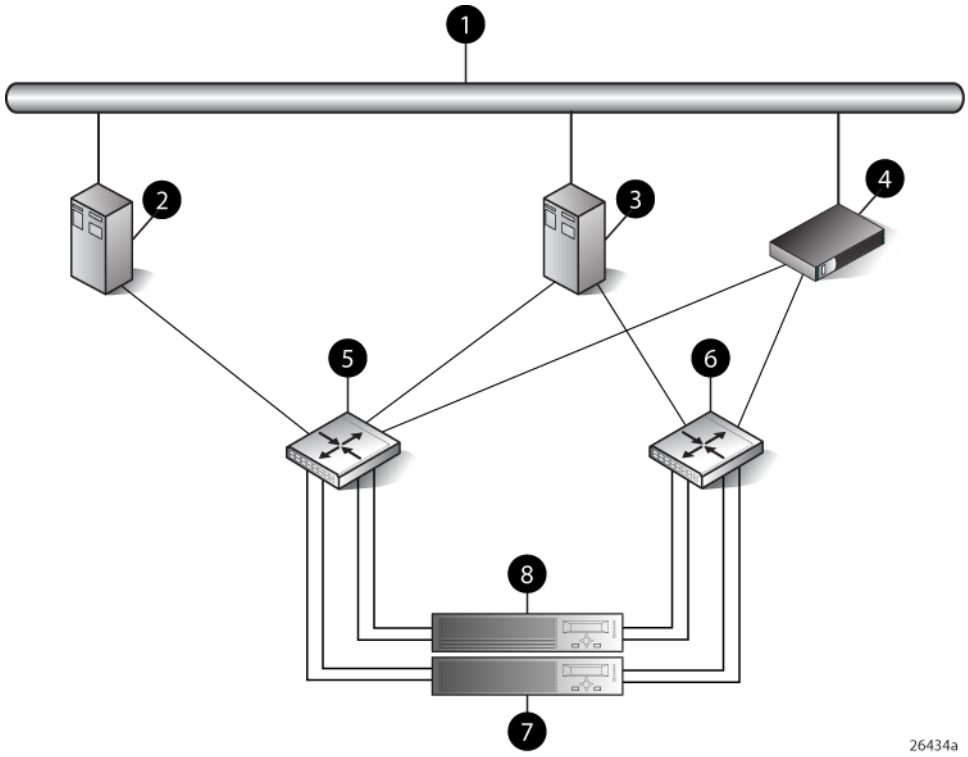
- Single path failure may result in loss of data accessibility and loss of host data that has not been written to storage.
- Controller shutdown results in loss of data accessibility and loss of host data that has not been written to storage.

**NOTE:** For additional risks, see "Oracle Solaris failure scenarios" (page 132).

### Limitations

- HP P6000 Continuous Access is not supported with single path configurations.
- Single path HBA server is not part of a cluster.
- Booting from the SAN is not supported.

**Figure 35 Oracle Solaris configuration**




| | |
|---|---|
| 1 Network interconnection | 5 SAN switch 1 |
| 2 Host 1 | 6 SAN switch 2 |
| 3 Host 2 | 7 Controller A |
| 4 Management server | 8 Controller B |

## Tru64 UNIX configuration

### Requirements

- Switch zoning or controller level SSP must be used to ensure each HBA has exclusive access to its LUNs.
- All nodes with direct connection to a disk must have the same access paths available to them.
- Single HBA server can be in the same fabric as servers with multiple HBAs.
- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single host that are zoned with the same controller.

In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.

## HBA configuration

- Host 1 is single HBA host with Tru64.
- Host 2 is a dual HBA host.

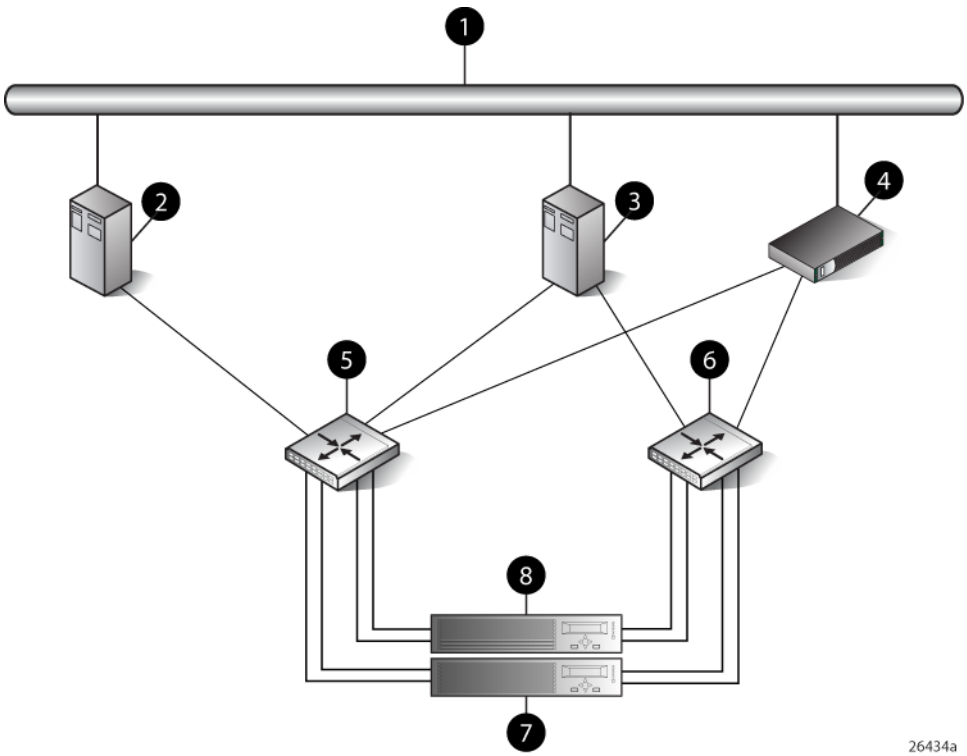
See Figure 36 (page 124).

## Risks

- For nonclustered nodes with a single HBA, a path failure from the HBA to the SAN switch will result in a loss of connection with storage devices.
- If a host crashes or experiences a power failure, or if the path is interrupted, data will be lost. Upon re-establishment of the path, a retransmit can be performed to recover whatever data may have been lost during the outage. The option to retransmit data after interruption is application-dependent.

**NOTE:** For additional risks, see "OpenVMS and Tru64 UNIX failure scenarios" (page 133).

**Figure 36 Tru64 UNIX configuration**




1 Network interconnection
2 Host 1
3 Host 2
4 Management server
5 SAN switch 1
6 SAN switch 2
7 Controller A
8 Controller B

# OpenVMS configuration

## Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- All nodes with direct connection to a disk must have the same access paths available to them.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.

## HBA configuration

- Host 1 is a single path HBA host.
- Host 2 is a dual HBA host.

See Figure 37 (page 126).

## Risks

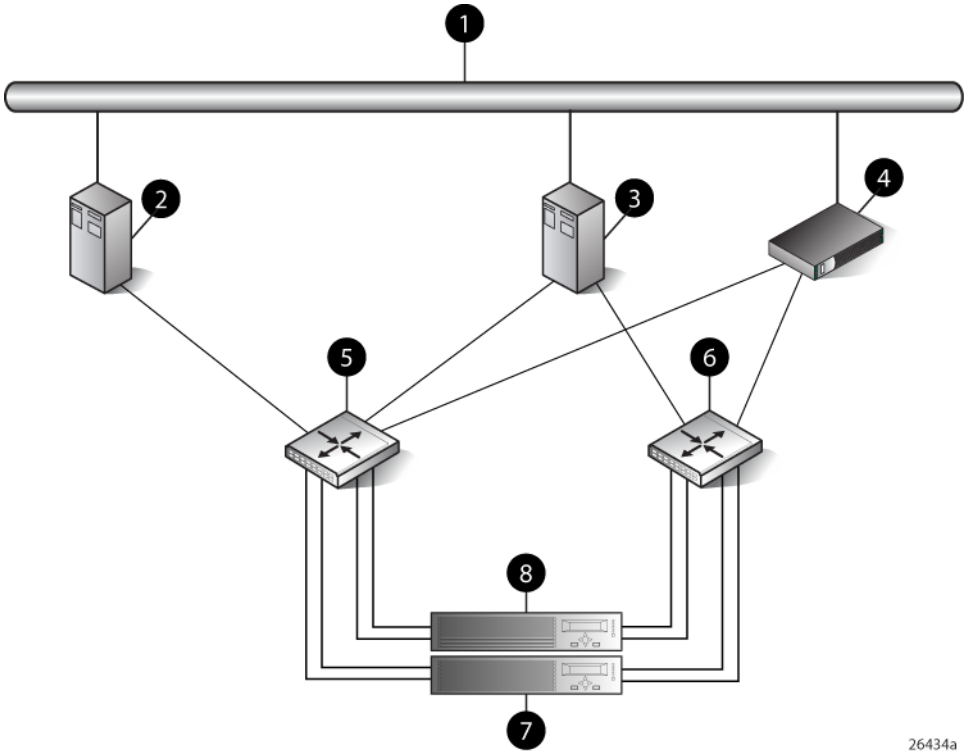
- For nonclustered nodes with a single path HBA, a path failure from the HBA to the SAN switch will result in a loss of connection with storage devices.

**NOTE:** For additional risks, see "OpenVMS and Tru64 UNIX failure scenarios" (page 133).

### Limitations

- HP P6000 Continuous Access is not supported with single path configurations.

**Figure 37 OpenVMS configuration**




| | |
|---|---|
| 1 Network interconnection | 5 SAN switch 1 |
| 2 Host 1 | 6 SAN switch 2 |
| 3 Host 2 | 7 Controller A |
| 4 Management server | 8 Controller B |

## Linux (32-bit) configuration

### Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- All nodes with direct connection to a disk must have the same access paths available to them.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.

### HBA configuration

- Host 1 is a single path HBA.
- Host 2 is a dual HBA host with multi-pathing software.

See Figure 38 (page 127).

### Risks

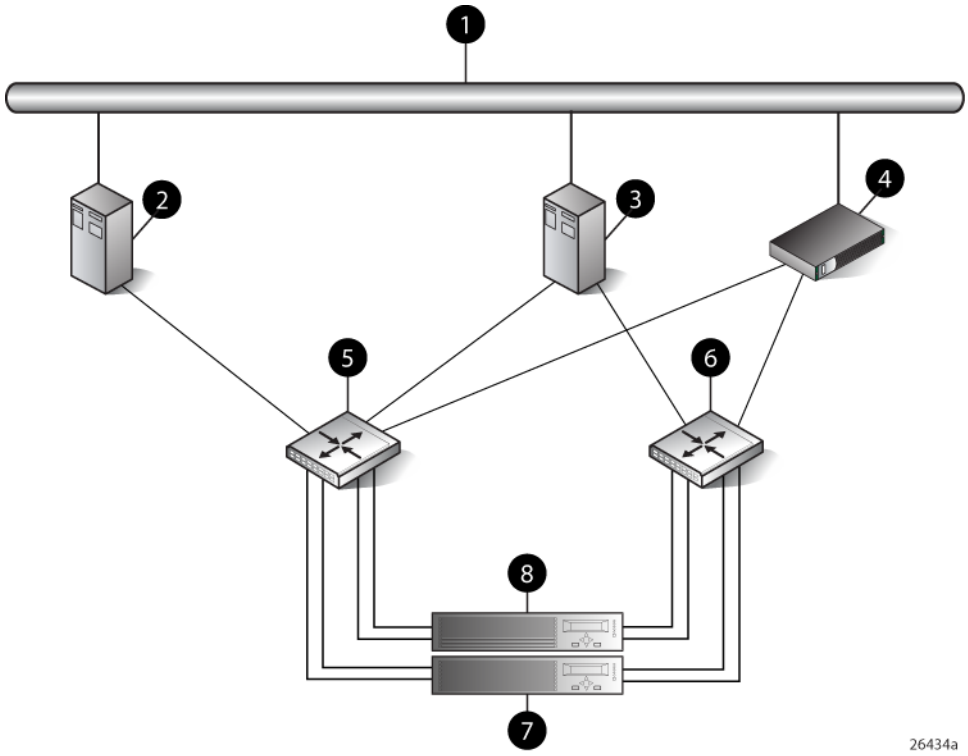
- Single path failure may result in data loss or disk corruption.

**NOTE:** For additional risks, see "Linux failure scenarios" (page 133).

### Limitations

- HP P6000 Continuous Access is not supported with single path configurations.
- Single path HBA server is not part of a cluster.
- Booting from the SAN is supported on single path HBA servers.

**Figure 38 Linux (32-bit) configuration**




1 Network interconnection
2 Host 1
3 Host 2
4 Management server
5 SAN switch 1
6 SAN switch 2
7 Controller A
8 Controller

## Linux (64-bit) configuration

### Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- All nodes with direct connection to a disk must have the same access paths available to them.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone

becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.

- Linux 64-bit servers can support up to14 single or dual path HBAs per server. Switch zoning and SSP are required to isolate the LUNs presented to each HBA from each other.

## HBA configuration

- Host 1 and 2 are single path HBA hosts.
- Host 3 is a dual HBA host with multi-pathing software.

See Figure 39 (page 128).

## Risks

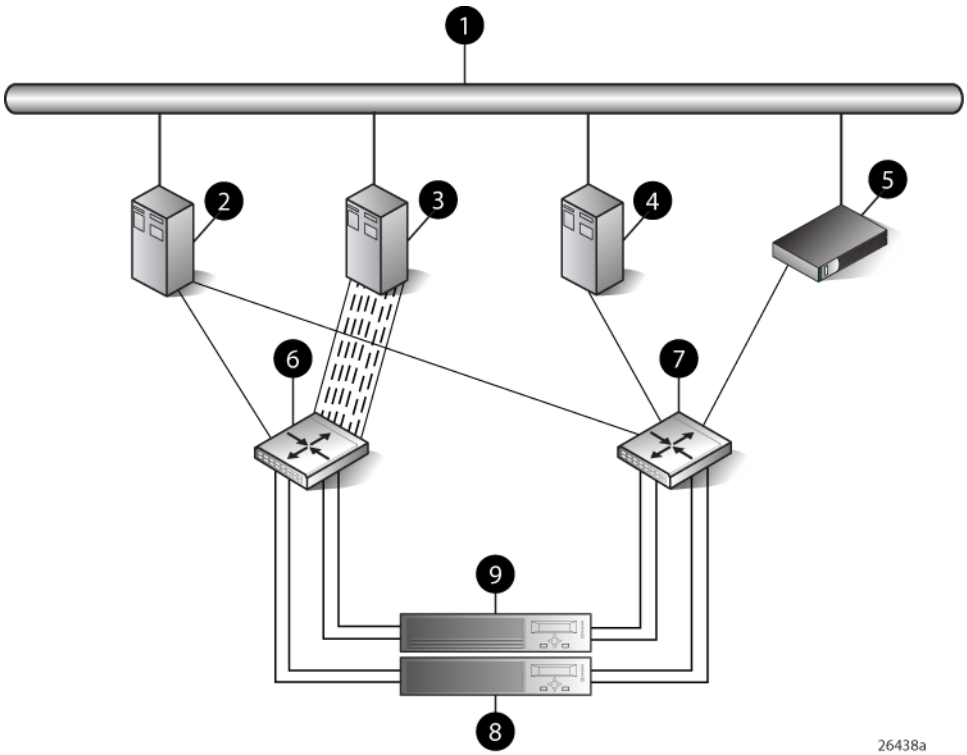
- Single path failure may result in data loss or disk corruption.

**NOTE:** For additional risks, see "Linux failure scenarios" (page 133).

## Limitations

- HP P6000 Continuous Access is not supported with single path configurations.
- Single path HBA server is not part of a cluster.
- Booting from the SAN is supported on single path HBA servers.

**Figure 39 Linux (64-bit) configuration**




1 Network interconnection
2 Host 3
3 Host 2
4 Host 1
5 Management server
6 SAN switch 1
7 SAN switch 2
8 Controller A
9 Controller B

# IBM AIX configuration

## Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- Single path HBA server cannot share LUNs with any other HBAs.
- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.

## HBA configuration

- Host 1 is a single path HBA host.
- Host 2 is a dual HBA host with multi-pathing software.

See Figure 40 (page 130).

## Risks

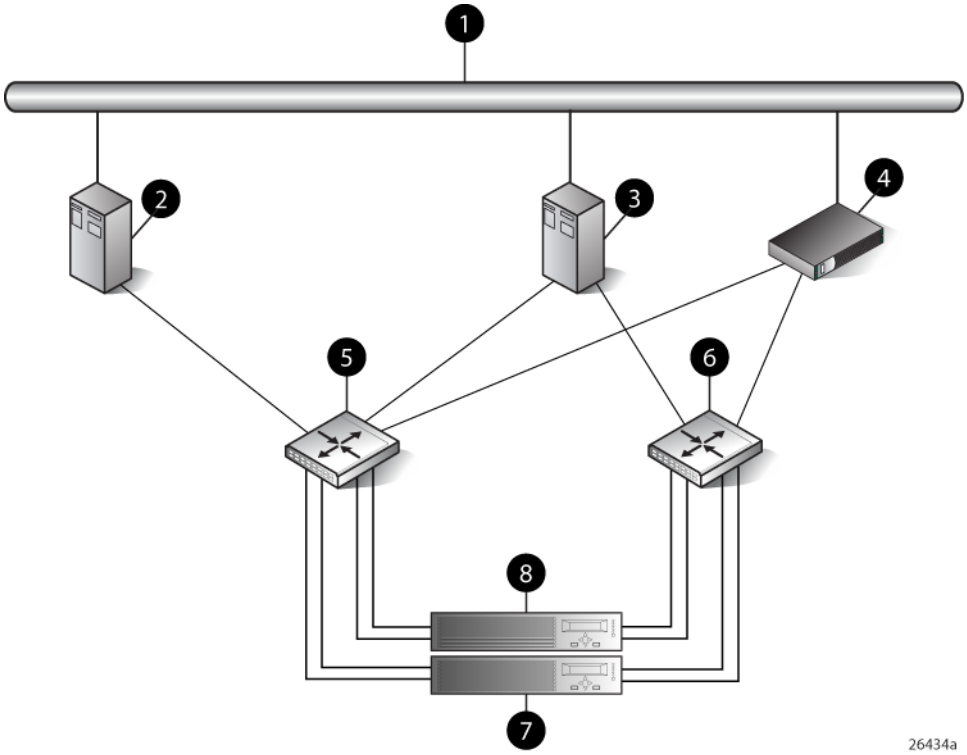
- Single path failure may result in loss of data accessibility and loss of host data that has not been written to storage.
- Controller shutdown results in loss of data accessibility and loss of host data that has not been written to storage.

**NOTE:** For additional risks, see "IBM AIX failure scenarios" (page 134).

## Limitations

- HP P6000 Continuous Access is not supported with single path configurations.
- Single path HBA server is not part of a cluster.
- Booting from the SAN is not supported.

**Figure 40 IBM AIX Configuration**




| | |
|---|---|
| 1 Network interconnection | 5 SAN switch 1 |
| 2 Single HBA server | 6 SAN switch 2 |
| 3 Dual HBA server | 7 Controller A |
| 4 Management server | 8 Controller B |

## VMware configuration

### Requirements

- Switch zoning or controller level SSP must be used to ensure each single path HBA has an exclusive path to its LUNs.
- All nodes with direct connection to a disk must have the same access paths available to them.
- Single path HBA server can be in the same fabric as servers with multiple HBAs.
- In the use of snapshots and snapclones, the source virtual disk and all associated snapshots and snapclones must be presented to the single path hosts that are zoned with the same controller. In the case of snapclones, after the cloning process has completed and the clone becomes an ordinary virtual disk, you may present that virtual disk as you would any other ordinary virtual disk.

### HBA configuration

- Host 1 is a single path HBA.
- Host 2 is a dual HBA host with multi-pathing software.

See Figure 41 (page 131).

### Risks

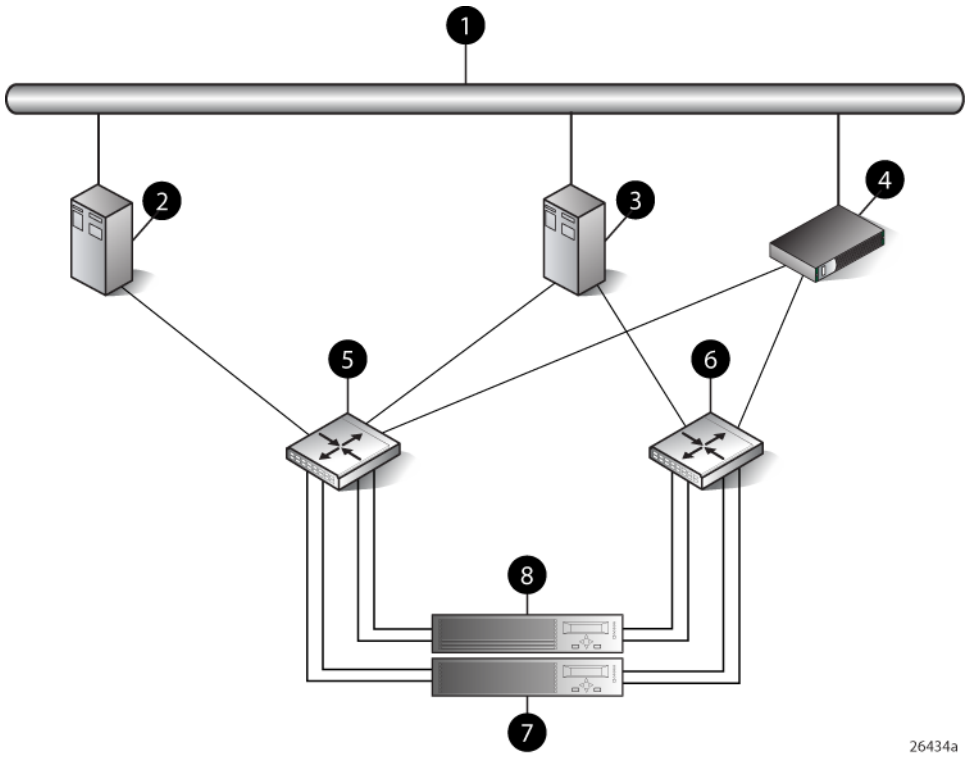
- Single path failure may result in data loss or disk corruption.

**NOTE:** For additional risks, see "VMware failure scenarios" (page 134).

### Limitations

- HP P6000 Continuous Access is not supported with single path configurations.
- Single path HBA server is not part of a cluster.
- Booting from the SAN is supported on single path HBA servers.

**Figure 41 VMware configuration**




1 Network interconnection
2 Single HBA server
3 Dual HBA server
4 Management server
5 SAN switch 1
6 SAN switch 2
7 Controller A
8 Controller B

# Failure scenarios

## HP-UX

**Table 30 HP-UX failure scenarios**

| Fault stimulus | Failure effect |
|---|---|
| Server failure (host power-cycled) | Extremely critical event on UNIX. Can cause loss of system disk. |
| Switch failure (SAN switch disabled) | Short term: Data transfer stops. Possible I/O errors.<br>Long term: Job hangs, cannot umount disk, fsck failed, disk corrupted, need mkfs disk. |
| Controller failure | Short term: Data transfer stops. Possible I/O errors.<br>Long term: Job hangs, cannot umount disk, fsck failed, disk corrupted, need mkfs disk. |
| Controller restart | Short term: Data transfer stops. Possible I/O errors.<br>Long term: Job hangs, cannot umount disk, fsck failed, disk corrupted, need mkfs disk. |

### Table 30 HP-UX failure scenarios *(continued)*

| Fault stimulus | Failure effect |
|---|---|
| Server path failure | Short term: Data transfer stops. Possible I/O errors.<br>Long term: Job hangs, cannot umount disk, fsck failed, disk corrupted, need mkfs disk. |
| Storage path failure | Short term: Data transfer stops. Possible I/O errors.<br>Long term: Job hangs, replace cable, I/O continues. Without cable replacement job must be aborted; disk seems error free. |

## Windows Server

### Table 31 Windows Server failure scenarios

| Fault stimulus | Failure effect |
|---|---|
| Server failure (host power-cycled) | OS runs a command called chkdsk when rebooting. Data lost, data that finished copying survived. |
| Switch failure (SAN switch disabled) | Write delay, server hangs until I/O is cancelled or cold reboot. |
| Controller failure | Write delay, server hangs or reboots. One controller failed, other controller and shelves critical, shelves offline. Volume not accessible. Server cold reboot, data lost. Check disk when rebooting. |
| Controller restart | Controller momentarily in failed state, server keeps copying. All data copied, no interruption. Event error warning error detected during paging operation. |
| Server path failure | Write delay, volume inaccessible. Host hangs and restarts. |
| Storage path failure | Write delay, volume disappears, server still running. When cables plugged back in, controller recovers, server finds volume, data loss. |

## Oracle Solaris

### Table 32 Oracle Solaris failure scenarios

| Fault stimulus | Failure effect |
|---|---|
| Server failure (host power-cycled) | Check disk when rebooting. Data loss, data that finished copying survived. |
| Switch failure (SAN switch disabled) | Short term: Data transfer stops. Possible I/O errors.<br>Long term: Repeated error messages on console, no access to CDE. System reboot causes loss of data on disk. Must newfs disk. |
| Controller failure | Short term: Data transfer stops. Possible I/O errors.<br>Long term: Repeated error messages on console, no access to CDE. System reboot causes loss of data on disk. Must newfs disk. |
| Controller restart | Short term: Data transfer stops. Possible I/O errors.<br>Long term: Repeated error messages on console, no access to CDE. System reboot causes loss of data on disk. Must newfs disk. |
| Server path failure | Short term: Data transfer stops. Possible I/O errors.<br>Long term: Repeated error messages on console, no access to CDE. System reboot causes loss of data on disk. Must newfs disk. |
| Storage path failure | Short term: Job hung, data lost.<br>Long term: Repeated error messages on console, no access to CDE. System reboot causes loss of data on disk. Must newfs disk. |

## OpenVMS and Tru64 UNIX

### Table 33 OpenVMS and Tru64 UNIX failure scenarios

| Fault stimulus | Failure effect |
|---|---|
| Server failure (host power-cycled) | All I/O operations halted. Possible data loss from unfinished or unflushed writes. File system check may be needed upon reboot. |
| Switch failure (SAN switch disabled) | OpenVMS—OS will report the volume in a Mount Verify state until the MVTIMEOUT limit is exceeded, when it then marks the volume as Mount Verify Timeout. No data is lost or corrupted.<br>Tru64 UNIX—All I/O operations halted. I/O errors are returned back to the applications. An I/O failure to the system disk can cause the system to panic. Possible data loss from unfinished or unflushed writes. File system check may be needed upon reboot. |
| Controller failure | I/O fails over to the surviving path. No data is lost or corrupted. |
| Controller restart | OpenVMS—OS will report the volume in a Mount Verify state until the MVTIMEOUT limit is exceeded, when it then marks the volume as Mount Verify Timeout. No data is lost of corrupted.<br>Tru64 UNIX—I/O retried until controller back online. If maximum retries exceeded, I/O fails over to the surviving path. No data is lost or corrupted. |
| Server path failure | OpenVMS—OS will report the volume in a Mount Verify state until the MVTIMEOUT limit is exceeded, when it then marks the volume as Mount Verify Timeout. No data is lost or corrupted.<br>Tru64 UNIX—All I/O operations halted. I/O errors are returned back to the applications. An I/O failure to the system disk can cause the system to panic. Possible data loss from unfinished or unflushed writes. File system check may be needed upon reboot. |
| Storage path failure | OpenVMS—OS will report the volume in a Mount Verify state until the MVTIMEOUT limit is exceeded, when it then marks the volume as Mount Verify Timeout. No data is lost or corrupted.<br>Tru64 UNIX—I/O fails over to the surviving path. No data is lost or corrupted. |

## Linux

### Table 34 Linux failure scenarios

| Fault stimulus | Failure effect |
|---|---|
| Server failure (host power-cycled) | OS reboots, automatically checks disks. HSV disks must be manually checked unless auto mounted by the system. |
| Switch failure (SAN switch disabled) | Short: I/O suspended, possible data loss.<br>Long: I/O halts with I/O errors, data loss. HBA driver must be reloaded before failed drives can be recovered, fsck should be run on any failed drives before remounting. |
| Controller failure | Short term: I/O suspended, possible data loss.<br>Long term: I/O halts with I/O errors, data loss. Cannot reload driver, need to reboot system, fsck should be run on any failed disks before remounting. |
| Controller restart | Short term: I/O suspended, possible data loss.<br>Long term: I/O halts with I/O errors, data loss. Cannot reload driver, need to reboot system, fsck should be run on any failed disks before remounting. |

### Table 34 Linux failure scenarios *(continued)*

| Fault stimulus | Failure effect |
|---|---|
| Server path failure | Short: I/O suspended, possible data loss.<br>Long: I/O halts with I/O errors, data loss. HBA driver must be reloaded before failed drives can be recovered, fsck should be run on any failed drives before remounting. |
| Storage path failure | Short: I/O suspended, possible data loss.<br>Long: I/O halts with I/O errors, data loss. HBA driver must be reloaded before failed drives can be recovered, fsck should be run on any failed drives before remounting. |

## IBM AIX

### Table 35 IBM AIX failure scenarios

| Fault stimulus | Failure effect |
|---|---|
| Server failure (host power-cycled) | Check disk when rebooting. Data loss, data that finished copying survived |
| Switch failure (SAN switch disabled) | Short term: Data transfer stops. Possible I/O errors.<br>Long term: Repeated error messages in errpt output. System reboot causes loss of data on disk. Must crfs disk. |
| Controller failure | Short term: Data transfer stops. Possible I/O errors.<br>Long term: Repeated error messages in errpt output. System reboot causes loss of data on disk. Must crfs disk. |
| Controller restart | Short term: Data transfer stops. Possible I/O errors.<br>Long term: Repeated error messages in errpt output. System reboot causes loss of data on disk. Must crfs disk. |
| Server path failure | Short term: Data transfer stops. Possible I/O errors.<br>Long term: Repeated error messages in errpt output. System reboot causes loss of data on disk. Must crfs disk. |
| Storage path failure | Short term: Data transfer stops. Possible I/O errors.<br>Long term: Repeated error messages in errpt output. System reboot causes loss of data on disk. Must crfs disk. |

## VMware

### Table 36 VMware failure scenarios

| Fault stimulus | Failure effect |
|---|---|
| Server failure (host power-cycled) | OS reboots, automatically checks disks. HSV disks must be manually checked unless auto mounted by the system. |
| Switch failure (SAN switch disabled) | Short: I/O suspended, possible data loss.<br>Long: I/O halts with I/O errors, data loss. HBA driver must be reloaded before failed drives can be recovered, fsck should be run on any failed drives before remounting. |
| Controller failure | Short term: I/O suspended, possible data loss.<br>Long term: I/O halts with I/O errors, data loss. Cannot reload driver, need to reboot system, fsck should be run on any failed disks before remounting. |
| Controller restart | Short term: I/O suspended, possible data loss.<br>Long term: I/O halts with I/O errors, data loss. Cannot reload driver, need to reboot system, fsck should be run on any failed disks before remounting. |

**Table 36 VMware failure scenarios** *(continued)*

| Fault stimulus | Failure effect |
|---|---|
| Server path failure | Short: I/O suspended, possible data loss.<br>Long: I/O halts with I/O errors, data loss. HBA driver must be reloaded before failed drives can be recovered, fsck should be run on any failed drives before remounting. |
| Storage path failure | Short: I/O suspended, possible data loss.<br>Long: I/O halts with I/O errors, data loss. HBA driver must be reloaded before failed drives can be recovered, fsck should be run on any failed drives before remounting. |

# Glossary

This glossary defines terms used in this guide or related to this product and is not a comprehensive glossary of computer terms.

## Symbols and numbers

**3U** A unit of measurement representing three "U" spaces. "U" spacing is used to designate panel or enclosure heights. Three "U" spaces is equivalent to 133 mm (5.25 inches).
*See also* rack-mounting unit.

**µm** A symbol for micrometer; one millionth of a meter. For example, 50 µm is equivalent to 0.000050 m.

## A

**active member of a virtual disk family** A simulated disk drive created by the controllers as storage for one or more hosts. An active member of a virtual disk family is accessible by one or more hosts for normal storage. An active virtual disk member and its snapshot, if one exists, constitute a virtual disk family. An active member of a virtual disk family is the only necessary member of a virtual disk family.
*See also* virtual disk,virtual disk copy,virtual disk family, and snapshot .

**adapter** *See* controller.

**AL_PA** Arbitrated loop physical address. A 1-byte value the arbitrated loop topology uses to identify the loop ports. This value becomes the last byte of the address identifier for each public port on the loop.

**allocation policy** The storage system rules that govern how virtual disks are created. There are two rules:

- Allocate Completely—The space a virtual disk requires on the physical disks is reserved, even if the virtual disk is not currently using the space.
- Allocate on Demand—The space a virtual disk requires on the physical disks is not reserved until needed.

**ALUA** Asymmetric logical unit access. Operating systems that support asymmetric logical unit access work with the array's active/active functionality to enable any virtual disk to be accessed through either of the array's two controllers.

**ambient temperature** The air temperature in the area where a system is installed. Also called intake temperature or room temperature.

**ANSI** American National Standards Institute. A non-governmental organization that develops standards (such as SCSI I/O interface standards and Fibre Channel interface standards) used voluntarily by many manufacturers within the United States.

**arbitrated loop** A Fibre Channel topology that links multiple ports (up to 126) together on a single shared simplex medium. Transmissions can only occur between a single pair of nodes at any given time. Arbitration is the scheme that determines which node has control of the loop at any given moment

**arbitrated loop physical address** *See* AL_PA.

**arbitrated loop topology** *See* arbitrated loop.

**array** synonym of storage array, storage system, and virtual array. A group of disks in one or more disk enclosures combined with controller software that presents disk storage capacity as one or more virtual disks.

**array controller** *See* controller.

**array controller failover** The process that takes place when one controller assumes the workload of a failed companion controller.

**asynchronous** Events scheduled as the result of a signal requesting the event or that which is without any specified time relation.

## B

**backplane** An electronic printed circuit board that distributes data, control, power, and other signals among components in an enclosure.

**bad block** A data block that contains a physical defect.

**bad block replacement** A replacement routine that substitutes defect-free disk blocks for those found to have defects. This process takes place in the controller and is transparent to the host.

**bail lock** The part of the power supply AC receptacle that engages the AC power cord connector to ensure that the cord cannot be accidentally disconnected.

**battery** A rechargeable unit mounted within a controller enclosure that supplies backup power to the cache module in case of primary power shortage.

**baud** The maximum rate of signal state changes per second on a communication circuit. If each signal state change corresponds to a code bit, then the baud rate and the bit rate are the same. It is also possible for signal state changes to correspond to more than one code bit so the baud rate may be lower than the code bit rate.

**bay** The physical location of an element, such as a drive, I/O module, EMU or power supply in a drive enclosure. Each bay is numbered to define its location.

**bidirectional** *Also* called Bi-Di. The movement of optical signals in opposite directions through a common fiber cable such as the data flow path typically on a parallel printer port. A parallel port can provide two-way data flow for disk drives, scanning devices, FAX operations and even parallel modems.

**block** Also called a sector. The smallest collection of consecutive bytes addressable on a disk drive. In integrated storage elements, a block contains 512 bytes of data, error codes, flags, and the block address header.

**blower** *See* fan.

## C

**cabinet** An alternate term used for a rack.

**cable assembly** A fiber optic cable that has connectors installed on one or both ends. General use of these cable assemblies includes the interconnection of multimode fiber optic cable assemblies with either LC or SC type connectors.

- When there is a connector on only one end of the cable, the cable assembly is referred to as a pigtail.
- When there is a connector on each end of the cable, the cable assembly is referred to as a jumper.

**CAC** Corrective Action Code. An HP P6000 Command View graphical user interface (GUI) display component that defines the action required to correct a problem.

**cache** High-speed memory that sets aside data as an intermediate data buffer between a host and the storage media. The purpose of cache is to improve performance.

**cache battery** *See* battery.

**carrier** A drive enclosure-compatible assembly containing a disk drive or other storage devices.

**client** An intelligent device that requests services from other intelligent devices. In the context of HP P6000 Command View, a client is a computer that is used to access the software remotely using a supported browser.

**clone** A full copy of a volume usable by an application.

**communication LUN** *See* console LUN.

**condition report** A three-element code generated by the EMU in the form where e.t. is the element type (a hexadecimal number), en. is the element number (a decimal number), and ec is the condition code (a decimal number).

**console LUN** A SCSI-3 virtual object that makes a controller pair accessible by the host before any virtual disks are created. *Also* called a communication LUN.

**console LUN ID** The ID that can be assigned when a host operating system requires a unique ID. The console LUN ID is assigned by the user, usually when the storage system is initialized.

**controller** A hardware/firmware device that manages communications between host systems and other devices. Controllers typically differ by the type of interface to the host and provide functions beyond those the devices support.

**controller enclosure** A unit that holds one or more controllers, power supplies, blowers or fans, cache batteries, transceivers, and connectors.

**controller event** A significant occurrence involving any storage system hardware or software component reported by the controller to HP P6000 Command View.

**controller pair** Two connected controller modules that control a disk array.

**corrective action code** *See* CAC.

**CRITICAL Condition** A drive enclosure EMU condition that occurs when one or more drive enclosure elements have failed or are operating outside of their specifications. The failure of the element makes continued normal operation of at least some elements in the enclosure impossible. Some enclosure elements may be able to continue normal operations. Only an UNRECOVERABLE condition has precedence. This condition has precedence over NONCRITICAL errors and INFORMATION condition.

**CRU** Customer replaceable unit. A storage system element that a user can replace without using special tools or techniques, or special training.

**customer replaceable unit** *See* CRU.

## D

**data entry mode** The state in which controller information can be displayed or controller configuration data can be entered. On the Enterprise Storage System, the controller mode is active when the LCD on the HSV Controller OCP is Flashing.

**default disk group** The disk group that is created when the array is initialized. The minimum number of disks the group can contain is eight. The maximum is the number of installed disks.

**Detailed Fault View** An HSV Controller OCP display that permits a user to view detailed information about a controller fault.

**device channel** A channel used to connect storage devices to a host I/O bus adapter or intelligent controller.

**device ports** The controller pair device ports connected to the storage system's physical disk drive array through the Fibre Channel drive enclosure. *Also* called a device-side port.

**device-side ports** *See* device ports.

**DIMM** Dual inline memory module. A small circuit board holding memory chips.

**dirty data** The write-back cached data that has not been written to storage media even though the host operation processing the data has completed.

**disk drive** A carrier-mounted storage device supporting random access to fixed size blocks of data.

**disk drive blank** A carrier that replaces a disk drive to control airflow within a drive enclosure whenever there is less than a full complement of storage devices.

**disk drive enclosure** A unit that holds storage system devices such as disk drives, power supplies, fans, I/O modules, and transceivers.

**disk failure protection** A method by which a controller pair reserves drive capacity to take over the functionality of a failed or failing physical disk. For each disk group, the controllers reserve space in the physical disk pool equivalent to the selected number of physical disk drives.

**disk group** A named group of disks selected from all the available disks in a disk array. One or more virtual disks can be created from a disk group. Also refers to the physical disk locations associated with a parity group.

**disk migration state**
A physical disk drive operating state. A physical disk drive can be in a stable or migration state:
- Stable—The state in which the physical disk drive has no failure nor is a failure predicted.
- Migration—The state in which the disk drive is failing, or failure is predicted to be imminent. Data is then moved off the disk onto other disk drives in the same disk group.

**disk replacement delay**
The time that elapses between a drive failure and when the controller starts searching for spare disk space. Drive replacement seldom starts immediately in case the "failure" was a glitch or temporary condition.

**DR group failover**
An operation that reverses data replication direction so that the destination becomes the source and the source becomes the destination. Failovers can be planned or unplanned and can occur between DR groups or managed sets (which are sets of DR groups).

**drive enclosure event**
A significant operational occurrence involving a hardware or software component in the drive enclosure. The drive enclosure EMU reports these events to the controller for processing.

**dual fabric**
Two independent fabrics providing multipath connections between Fibre Channel end devices.

**dual power supply configuration**
*See* redundant power configuration.

**dual-loop**
A configuration where each drive is connected to a pair of controllers through two loops. These two Fibre Channel loops constitute a loop pair.

**dynamic capacity expansion**
A storage system feature that provides the ability to increase the size of an existing virtual disk. Before using this feature, you must ensure that your operating system supports capacity expansion of a virtual disk (or LUN).

## E

**EIA**
Electronic Industries Alliance. A standards organization specializing in the electrical and functional characteristics of interface equipment.

**EIP**
Event Information Packet. The event information packet is an HSV element hexadecimal character display that defines how an event was detected. Also called the EIP type.

**electromagnetic interference**
*See* EMI.

**electrostatic discharge**
*See* ESD.

**element**
In a disk enclosure, a device such as a, power supply, disk, fan/blower, or I/O module. The object can be controllled, interrogated, or described by the enclosure services process.

**EMI**
Electromagnetic Interference. The impairment of a signal by an electromagnetic disturbance.

**EMU**
Environmental Monitoring Unit. An element which monitors the status of an enclosure, including the power, air temperature, and blower status. The EMU detects problems and displays and reports these conditions to a user and the controller. In some cases, the EMU implements corrective action.

**enclosure**
A unit used to hold various storage system devices such as disk drives, controllers, power supplies, I/O modules, or fans/blowers.

**enclosure address bus**
An Enterprise storage system bus that interconnects and identifies controller enclosures and disk drive enclosures by their physical location. Enclosures within a reporting group can exchange environmental data. This bus uses enclosure ID expansion cables to assign enclosure numbers to each enclosure. Communications over this bus do not involve the Fibre Channel drive enclosure bus and are, therefore, classified as out-of-band communications.

**enclosure number (En)**
One of the vertical rack-mounting positions where the enclosure is located. The positions are numbered sequentially in decimal numbers starting from the bottom of the cabinet. Each disk enclosure has its own enclosure number. A controller pair shares an enclosure number. If the system has an expansion rack, the enclosures in the expansion rack are numbered from 15 to 24, starting at the bottom.

**enclosure services**
Those services that establish the mechanical environmental, electrical environmental, and external indicators and controls for the proper operation and maintenance of devices with an enclosure

as described in the *SES SCSI-3 Enclosure Services Command Set (SES), Rev 8b, American National Standard for Information Services*.

**Enclosure Services Interface** *See* ESI.

**Enclosure Services Processor** *See* ESP.

**environmental monitoring unit** *See* EMU.

**error code** The portion of an EMU condition report that defines a problem.

**ESD** Electrostatic Discharge. The emission of a potentially harmful static electric voltage as a result of improper grounding.

**ESI** Enclosure Services Interface. The SCSI-3 engineering services interface implementation developed for storage products. A bus that connects the EMU to the disk drives.

**ESP** Enclosure Services Processor. An EMU that implements an enclosure's services process.

**event** Any significant change in the state of the Enterprise storage system hardware or software component reported by the controller to HP P6000 Command View.
*See also* controller event, drive enclosure event, management agent event, and termination event.

**Event Information Packet** *See* EIP.

**Event Number** A sequential number assigned to each Software Code Identification (SWCID) event. It is a decimal number in the range 0-255.

**Evt No.** *See* Event Number.

**exabyte** A unit of storage capacity that is the equivalent of $2^{60}$ bytes or 1,152,921,504,606,846,976 bytes. One exabyte is equivalent to 1,024 petabytes.

## F

**fabric** A network of Fibre Channel switches or hubs and other devices.

**fabric port** A port which is capable of supporting an attached arbitrated loop. This port on a loop will have the AL_PA hexadecimal address 00 (loop ID 7E), giving the fabric the highest priority access to the loop. A loop port is the gateway to the fabric for the node ports on a loop.

**failover** *See* array controller failover or DR group failover.

**failsafe** A safe state that devices automatically enter after a malfunction. Failsafe DR groups stop accepting host input and stop logging write history if a group member becomes unavailable.

**fan** The variable speed airflow device that cools an enclosure or component by forcing ambient air into an enclosure or component and forcing heated air out the other side.

**FATA** Fibre Attached Technology Adapted disk drive.

**Fault Management Code** *See* FMC.

**FC HBA** Fibre Channel Host Bus Adapter.
*See also* FCA.

**FCA** Fibre Channel Adapter.
*See also* FC HBA.

**FCC** Federal Communications Commission. The federal agency responsible for establishing standards and approving electronic devices within the United States.

**FCP** Fibre Channel Protocol.

**fiber** The optical media used to implement Fibre Channel.

**fiber optic cable** A transmission medium designed to transmit digital signals in the form of pulses of light. Fiber optic cable is noted for its properties of electrical isolation and resistance to electrostatic contamination.

**fiber optics** The technology where light is transmitted through glass or plastic (optical) threads (fibers) for data communication or signaling purposes.

**Fibre Channel** A data transfer architecture designed for mass storage devices and other peripheral devices that require high bandwidth.

**Fibre Channel adapter** *See* FCA.

**Fibre Channel drive enclosure** An enclosure that provides 12-port central interconnect for Fibre Channel arbitrated loops following the ANSI Fibre Channel disk enclosure standard.

**Fibre Channel Loop** Fibre Channel Arbitrated Loop. The American National Standards Institute's (ANSI) document that specifies arbitrated loop topology operation.

**field replaceable unit** *See* FRU.

**flush** The act of writing dirty data from cache to a storage media.

**FMC** Fault Management Code. The HP P6000 Command View display of the Enterprise Storage System error condition information.

**form factor** A storage industry dimensional standard for 89 mm (3.5 inch) and 133 mm (5.25 inch) high storage devices. Device heights are specified as low-profile (25.4 mm), half-height (41 mm), and full-height (133 mm).

**FPGA** Field Programmable Gate Array. A programmable device with an internal array of logic blocks surrounded by a ring of programmable I/O blocks connected together through a programmable interconnect.

**frequency** The number of cycles that occur in one second expressed in Hertz (Hz). Thus, 1 Hz is equivalent to one cycle per second.

**FRU** Field replaceable unit. An assembly component that is designed to be replaced on site, without the system having to be returned to the manufacturer for repair.

## G

**Giga (G)** The notation to represent $10^9$ or 1 billion (1,000,000,000).

**gigabaud** An encoded bit transmission rate of one billion ($10^9$) bits per second.

## H

**HBA** Host Bus Adapter.

**host** A computer that runs user applications and uses the information stored on an array.

**Host Bus Adapter** Host bus adapter.

**host computer** *See* host.

**host link indicator** The HSV Controller display that indicates the status of the storage system Fibre Channel links.

**host ports** A connection point to one or more hosts through a Fibre Channel fabric.

**host-side ports** *See* host ports.

**hot-pluggable** The ability to add and remove elements or devices to a system or appliance while the appliance is running and have the operating system automatically recognize the change.

**hub** A communications infrastructure device to which nodes on a multi-point bus or loop are physically connected. It is used to improve the manageability of physical cables.

## I

**I/O module** Input/Output module. The enclosure element that is the Fibre Channel drive enclosure interface to the host or controller.

**IDX** A 2-digit decimal number portion of the HSV controller termination code display that defines one of 32 locations in the Termination Code array that contains information about a specific event.

**in-band communication** The communication that uses the same communications channel as the operational data.

**INFORMATION condition** A drive enclosure EMU condition that may require action. This condition is for information purposes only and does not indicate the failure of an element.

**initialization** A configuration step that binds the controllers together and establishes preliminary data structures on the array. Initialization also sets up the first disk group, called the default disk group, and makes the array ready for use.

**input/output module** *See* I/O module.

**intake temperature** *See* ambient temperature.

**interface** A set of protocols used between components such as cables, connectors, and signal levels.

## J

**JBOD** Just a Bunch of Disks.

## L

**laser** A device that amplifies light waves and concentrates them in a narrow, very intense beam.

**Last Fault View** An HSV Controller display defining the last reported fault condition.

**Last Termination Error Array** *See* LTEA.

**license key** A WWN-encoded sequence that is obtained from the license key fulfillment website.

**link**
1. A connection of ports on Fibre Channel devices.
2. A full duplex connection to a fabric or a simplex connection of loop devices.

**logon** A procedure whereby a user or network connection is identified as being an authorized network user or participant.

**loop** *See* arbitrated loop.

**loop ID** Seven-bit values numbered contiguous from 0 to 126 decimal that represent the 127 valid AL-PA values on a loop. (With Fibre Channel, not all 256 hexadecimal values are allowed as AL-PA values.)

**loop pair** A Fibre Channel attachment between a controller and physical disk drives. Physical disk drives connect to controllers through paired Fibre Channel arbitrated loops. There are two loop pairs, designated loop pair 1 and loop pair 2. Each loop pair consists of two loops (called loop A and loop B) that operate independently during normal operation, but provide mutual backup in case one loop fails.

**LTEA** Last termination event array. A two-digit HSV Controller number that identifies a specific event that terminated an operation. Valid numbers range from 00 to 31.

**LUN** Logical unit number. A LUN results from mapping a SCSI logical unit number, port ID, and LDEV ID to a RAID group. The size of the LUN is determined by the emulation mode of the LDEV and the number of LDEVs associated with the LUN. For example, a LUN associated with two OPEN-3 LDEVs has a size of 4,693 MB.

## M

**management agent** The HP P6000 Command View software that controls and monitors the HP Enterprise storage system. The software can exist on more than one management server in a fabric. Each installation is a management agent.

**management agent event** A significant occurrence to or within the management agent software, or an initialized storage cell controlled or monitored by the management agent.

**mean time between failures** *See* MTBF.

**Mega** A notation denoting a multiplier of 1 million (1,000,000).

**metadata** The data in the first sectors of a disk drive that the system uses to identify virtual disk members.

**micro meter** *See* µm.

**mirrored caching** A process in which half of each controller's write cache mirrors the companion controller's write cache. The total memory available for cached write data is reduced by half, but the level of protection is greater.

**mirroring** The act of creating an exact copy or image of data.

**MTBF** Mean time between failures. The average time from start of use to first failure in a large population of identical systems, components, or devices.

**multi-mode fiber** A fiber optic cable with a diameter large enough (50 microns or more) to allow multiple streams of light to travel different paths from the transmitter to the receiver. This transmission mode enables bidirectional transmissions.

## N

**near-online storage** On-site storage of data on media that takes slightly longer to access than online storage kept on high-speed disk drives.

**Network Storage Controller** *See* NSC.

**node port** A device port that can operate on the arbitrated loop topology.

**non-OFC (Open Fibre Control)** A laser transceiver whose lower-intensity output does not require special open Fibre Channel mechanisms for eye protection. The HP Enterprise Storage System transceivers are non-OFC compatible.

**NONCRITICAL Condition** An EMU condition that occurs when one or more elements in the drive enclosure fail or are operating outside specifications. The failure does not affect operation of the enclosure; all devices in the enclosure continue to operate according to specifications. If there are additional failures, however, the devices may not operate properly. UNRECOVERABLE and CRITICAL errors take precedence over this condition. This condition takes precedence over the INFORMATION condition. Early correction can prevent the loss of data.

**NSC** Network storage controller. The HSV controllers used by the HP Enterprise Storage System.

**NVRAM** Nonvolatile Random Access Memory. Memory whose contents are not lost when a system is turned Off or if there is a power failure. This is achieved through the use of UPS batteries or implementation technology such as flash memory. NVRAM is commonly used to store important configuration parameters.

## O

**occupancy alarm level** A percentage of the total disk group capacity in blocks. When the number of blocks in the disk group that contain user data reaches this level, an event code is generated. The alarm level is specified by the user.

**OCP** Operator Control Panel. The element that displays the controller's status using indicators and an LCD. Information selection and data entry is controlled by the OCP pushbutton.

**online storage** An allotment of storage space that is available for immediate use, such as a peripheral device that is turned on and connected to a server.

**operator control panel** *See* OCP.

## P

**param** That portion of the HP HSV controller termination code display that defines:

- The two-character parameter identifier that is a decimal number in the 0 through 31 range.
- The eight-character parameter code that is a hexadecimal number.

**password** A security interlock where the purpose is to allow:

- A management agent to control only certain storage systems
- Only certain management agents to control a storage system

**PDM** Power distribution module. A thermal circuit breaker-equipped power strip that distributes power from a PDU to HP Enterprise Storage System elements.

**PDU** Power distribution unit. The rack device that distributes conditioned AC or DC power within a rack.

**petabyte** A unit of storage capacity that is the equivalent of $2^{50}$, 1,125,899,906,842,624 bytes or 1,024 terabytes.

**physical disk** A disk drive mounted in a drive enclosure that communicates with a controller pair through the device-side Fibre Channel loops. A physical disk is hardware with embedded software, as opposed to a virtual disk, which is constructed by the controllers. Only the controllers can communicate directly with the physical disks.

The physical disks, in aggregate, are called the array and constitute the storage pool from which the controllers create virtual disks.

**physical disk array** *See* array.

**port** A physical connection that allows data to pass between a host and a disk array.

**port-colored** Pertaining to the application of the color of port or red wine to a CRU tab, lever, or handle to identify the unit as hot-pluggable.

**port_name** A 64-bit unique identifier assigned to each Fibre Channel port. The port_name is communicated during the login and port discovery processes.

**power distribution module** *See* PDM.

**power distribution unit** *See* PDU.

**power supply** An element that develops DC voltages for operating the storage system elements from either an AC or DC source.

**preferred address** An AL_PA which a node port attempts to acquire during loop initialization.

**preferred path** A preference for which controller of the controller pair manages the virtual disk. This preference is set by the user when creating the virtual disk. A host can change the preferred path of a virtual disk at any time. The primary purpose of preferring a path is load balancing.

**protocol** The conventions or rules for the format and timing of messages sent and received.

## Q

**quiesce** The act of rendering bus activity inactive or dormant. For example, “quiesce the SCSI bus operations during a device warm-swap.”

## R

**rack** A floorstanding structure primarily designed for, and capable of, holding and supporting storage system equipment. All racks provide for the mounting of panels per Electronic Industries Alliance (EIA) *Standard RS310C*.

**rack-mounting unit** A measurement for rack heights based upon a repeating hole pattern. It is expressed as “U” spacing or panel heights. Repeating hole patterns are spaced every 44.45 mm (1.75 inches) and based on EIA’s *Standard RS310C*. For example, a 3U unit is 133.35 mm (5.25 inches) high, and a 4U unit is 177.79 mm (7.0 inches) high.

**read ahead caching** A cache management method used to decrease the subsystem response time to a read request by allowing the controller to satisfy the request from the cache memory rather than from the disk drives.

**read caching** A cache method used to decrease subsystem response times to a read request by allowing the controller to satisfy the request from the cache memory rather than from the disk drives. Reading data from cache memory is faster than reading data from a disk. The read cache is specified as either On or Off for each virtual disk. The default state is on.

**reconstruction** The process of regenerating the contents of a failed member data. The reconstruction process writes the data to a spare set disk and incorporates the spare set disk into the mirrorset, striped mirrorset or RAID set from which the failed member came.

**redundancy**

1. Element Redundancy—The degree to which logical or physical elements are protected by having another element that can take over in case of failure. For example, each loop of a device-side loop pair normally works independently but can take over for the other in case of failure.
2. Data Redundancy—The level to which user data is protected. Redundancy is directly proportional to cost in terms of storage usage; the greater the level of data protection, the more storage space is required.

**redundant power configuration**
A capability of the HP Enterprise Storage System racks and enclosures to allow continuous system operation by preventing single points of power failure.

**reporting group**
An Enterprise Storage System controller pair and the associated disk drive enclosures. The Enterprise Storage System controller assigns a unique decimal reporting group number to each EMU on its loops. Each EMU collects disk drive environmental information from its own sub-enclosure and broadcasts the data over the enclosure address bus to all members of the reporting group. Information from enclosures in other reporting groups is ignored.

**RoHS**
Reduction of Hazardous Substances.

**room temperature**
*See* ambient temperature.

**RPO**
Recovery point objective. The maximum age of the data you want the ability to restore in the event of a disaster. For example, if your RPO is six hours, you want to be able to restore systems back to the state they were in as of no longer than six hours ago. To achieve this objective, you need to make backups or other data copies at least every six hours.

## S

**SCSI-3**
The ANSI standard that defines the operation and function of Fibre Channel systems.

**SCSI-3 Enclosure Services**
*See* SES.

**selective presentation**
The process whereby a controller presents a virtual disk only to the host computer which is authorized access.

**serial transmission**
A method of transmission where each bit of information is sent sequentially on a single channel, not simultaneously on all channels as occurs in parallel transmission.

**SES**
SCSI-3 Enclosures Services. Those services that establish the mechanical environment, electrical environment, and external indicators and controls for the proper operation and maintenance of devices within an enclosure.

**SFP**
Small form-factor pluggable transceiver.

**solid state disk (SSD)**
A high-performance storage device that contains no moving parts. SSD components include either DRAM or EEPROM memory boards, a memory bus board, a CPU, and a battery card.

**SSN**
Storage system name. A unique 20-character name, assigned by HP P6000 Command View, that identifies a storage system.

**storage carrier**
*See* carrier.

**storage pool**
The aggregated blocks of available storage in the total physical disk array.

**storage system**
*See* array.

**Storage System Name**
*See* SSN.

**switch**
An electro-mechanical device that initiates an action or completes a circuit.

## T

**TC**
Termination Code. An eight-character hexadecimal display that identifies why controller operations have halted.

**Termination Code**
*See* TC.

**termination event**
The occurrences that cause the storage system to cease operation.

**terminator**
Interconnected elements that form the ends of the transmission lines in the enclosure address bus.

**topology** An interconnection scheme that allows multiple Fibre Channel ports to communicate. Point-to-point, arbitrated loop, and ed fabric are all Fibre Channel topologies.

**transceiver** The device that converts electrical signals to optical signals at the point where the fiber cables connect to the Fibre Channel elements such as hubs, controllers, or adapters.

## U

**UID** Unit identification.

**uninitialized system** A state in which the storage system is not ready for use.

**UNRECOVERABLE Condition** An EMU condition that occurs when one or more elements in the drive enclosure have failed and have disabled the enclosure. The enclosure may not be able to recover or bypass the failure; this will require repairs to correct the condition. This is the highest-level condition. It takes precedence over all other errors and requires immediate corrective action.

**unwritten cached data** *Also* known as unflushed data.
*See also* dirty data.

**UPS** Uninterruptible power supply. A battery-operated power supply guaranteed to provide power to an electrical device in the event of an unexpected interruption to the primary power supply. Uninterruptible power supplies are usually rated by the amount of voltage supplied and the length of time the voltage is supplied.

**UUID** Unique universal identifier. A unique 128-bit identifier for each component of an array. UUIDs are internal system values that users cannot modify.

## V

**virtual disk** Variable disk capacity that is defined and managed by the array controller and presentable to hosts as a disk.

**virtual disk family** A virtual disk and its snapshot, if a snapshot exists, constitute a family. The original virtual disk is called the active disk. When you first create a virtual disk family, the only member is the active disk.

**Vraid0** Optimized for I/O speed and efficient use of physical disk space, but provides no data redundancy.

**Vraid1** Optimized for data redundancy and I/O speed, but uses the most physical disk space.

**Vraid5** Provides a balance of data redundancy, I/O speed, and efficient use of physical disk space.

**Vraid6** Offers the features of Vraid5 while providing more protection for an additional drive failure, but uses additional physical disk space.

## W

**World Wide Name** *See* WWN.

**write back caching** A controller process that notifies the host that the write operation is complete when the data is written to the cache. This occurs before transferring the data to the disk. Write back caching improves response time since the write operation completes as soon as the data reaches the cache. As soon as possible after caching the data, the controller then writes the data to the disk drives.

**write caching** A process when the host sends a write request to the controller, and the controller places the data in the controller cache module. As soon as possible, the controller transfers the data to the physical disk drives.

**WWN** World Wide Name. A unique identifier assigned to a Fibre Channel device.

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## W



## X



## Z