HP StorageWorks 6400/8400 Enterprise Virtual Array user guide

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About this guide

This user guide provides the following information:

- Description of the HP StorageWorks 6400/8400 Enterprise Virtual Array and its components
- Operating your storage system
- Regulations and specifications
- EMU-generated error condition reports
- HSV fault management concepts

Intended audience

This book is intended for use by Enterprise Virtual Array customers involved in the operation and management of EVA 6400/8400 storage systems.

Related documentation

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

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

Click **Disk Storage Systems** under Storage, and then select **HP StorageWorks 6400/8400 Enterprise Virtual Arrays under EVA Disk Arrays**.

Document conventions and symbols

Table 1 Document conventions

Convention	Element
Blue text: Table 1	Cross-reference links and e-mail addresses
Blue, underlined text: http://www.hp.com	website addresses
Bold text	• Keys that are pressed • Text typed into a GUI element, such as a box • 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 • System output • Code • Commands, their arguments, and argument values

Convention	Element
Monospace, italic text	• Code variables • Command variables
Monospace, bold text	Emphasized monospace text

⚠ WARNING!

Indicates that failure to follow directions could result in bodily harm or death.

⚠ CAUTION:

Indicates that failure to follow directions could result in damage to equipment or data.

IMPORTANT:

Provides clarifying information or specific instructions.

NOTE:

Provides additional information.

TIP:

Provides helpful hints and shortcuts.

Rack stability

⚠ 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, secure racks together.
- Extend only one rack component at a time. Racks may become unstable if more than one component is extended.

HP technical support

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

Customer self repair

HP customer self repair (CSR) programs allow you to repair your StorageWorks 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. For North America, see the CSR website:

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

Subscription service

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

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

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

HP websites

For additional information, see the following HP websites:

- http://www.hp.com
- http://www.hp.com/go/storage
- http://www.hp.com/support/manuals
- http://h20293.www2.hp.com

Documentation feedback

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

1 EVA 6400/8400 hardware

The EVA6400/8400 contains the following hardware components:

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

M6412-A disk enclosures

The M6412-A 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). Enclosure status indicators are located at the right of each disk. Figure 2 shows the front and Figure 3 shows the rear view of the disk enclosure.

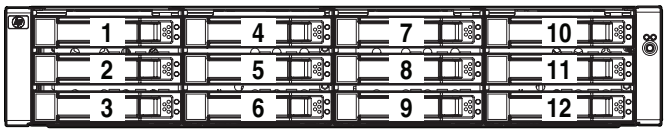
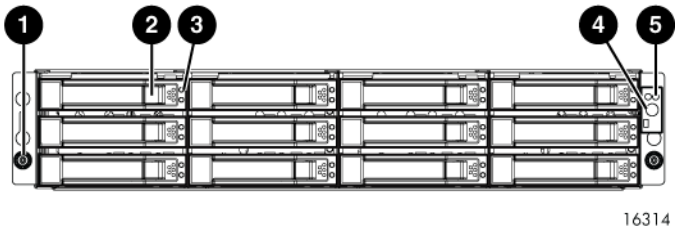
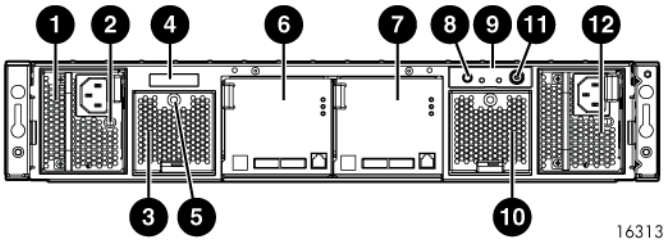


Figure 1 Disk drive bay numbering



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

Figure 2 Disk enclosure front view without bezel ears

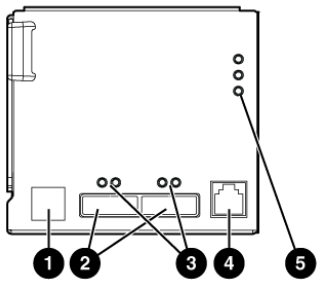


1. Power supply 1
2. Power supply 1 status LED
3. Fan 1
4. Enclosure product number and serial number
5. Fan 1 status LED
6. I/O module A
7. I/O module B
8. Rear UID push button
9. Enclosure status LEDs
10. Fan 2
11. Power push button
12. Power supply 2

Figure 3 Disk enclosure rear view

I/O modules

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



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

Figure 4 I/O module detail

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.

I/O module status indicators

There are five status indicators on the I/O module. See Figure 4. The status indicator states for an operational I/O module are shown in Table 2. Table 3 shows the status indicator states for a non-operational I/O module.

Table 2 Port status LEDs

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

Table 3 I/O module status LEDs

Status LED	Description
UID	• Locate. • Flashing blue — Remotely asserted by application client.
	• Module health indicator: • Flashing green — I/O module powering up. • Solid green — normal operation. • Green off — firmware malfunction.

Status LED	Description
⚠	• Fault indicator: • Flashing amber — Warning condition (not visible when solid amber showing). • Solid amber — Replace FRU. • 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.

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 in)
- 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.

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).

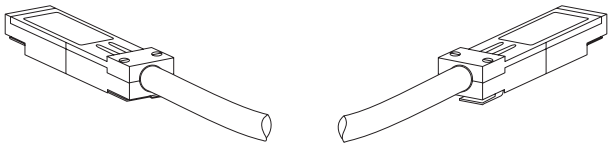


Figure 6 Copper Fibre Channel cable

Fibre Channel disk drives

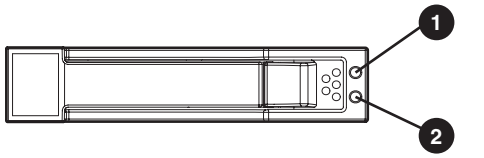
The Fibre Channel disk drives are hot-pluggable and include the following features:

- 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 identifies the disk drive status indicators. Table 4 describes them.



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

Figure 7 Disk status indicators

Table 4 Disk status indicator LED descriptions

Drive LED	Description
Bi-color (top)	• Slow flashing blue (0.5 Hz) — Used to locate drive. • Fast flashing blue (4 Hz) — Used for reserved locate. • Medium flashing blue (1 Hz) — Used for critical locate. • Solid amber — Drive fault.
Green (bottom)	• Flashing — Drive is spinning up or down and is not ready. • Solid — Drive is ready to perform I/O operations. • 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 shows the HSV400 controller rear view and Figure 9 shows the HSV450 controller rear view. The front of the HSV400 and HSV450 is shown in Figure 10.

NOTE:

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

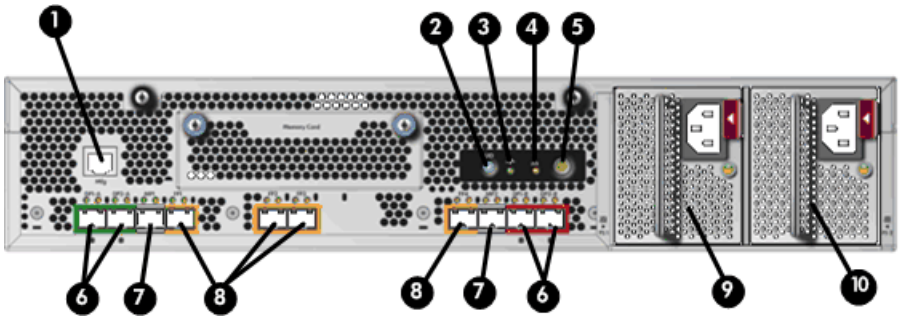


Figure 8 HSV400 controller rear view

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

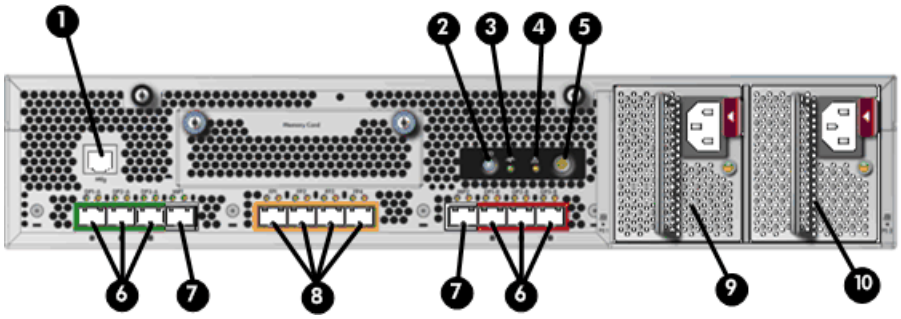


Figure 9 HSV450 controller rear view

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

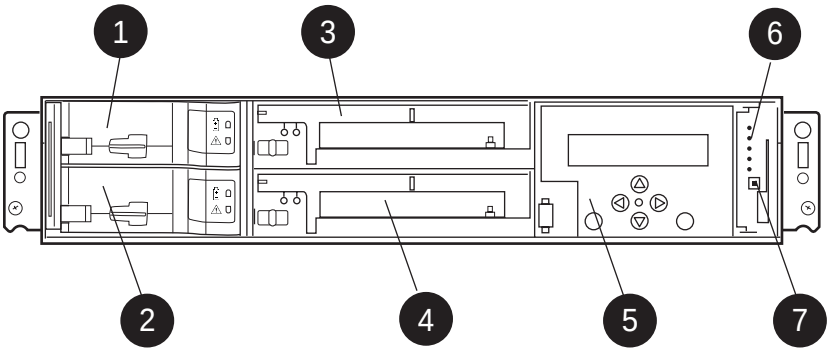


Figure 10 Controller front view

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.

HP Command View EVA 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 Command View EVA is not available, the OCP can be used to perform these tasks.

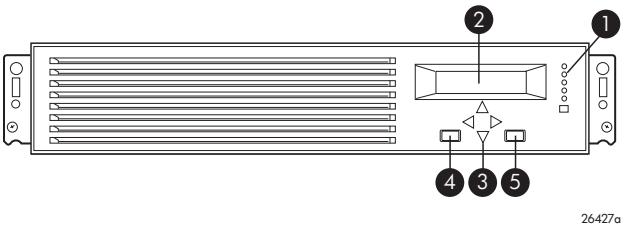


Figure 11 Controller OCP

1. Status indicators (see Table 5) 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 5. 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 5 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 Command View EVA 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 Command View EVA.

Each port on the rear of the controller has an associated status indicator located directly above it. Table 6 lists the port and its status description.

Table 6 Controller port status indicators

Port	Description
Fibre Channel host ports	• Green—Normal operation • Amber—No signal detected • Off—No SFP[1] detected or the Direct Connect OCP setting is incorrect

Port	Description
Fibre Channel device ports	• Green—Normal operation • Amber—No signal detected or the controller has failed the port • Off—No SFP [1] detected
Fibre Channel cache mirror ports	• Green—Normal operation • Amber—No signal detected or the controller has failed the port • 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 7 defines the basic pushbutton 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 7 Navigation button functions

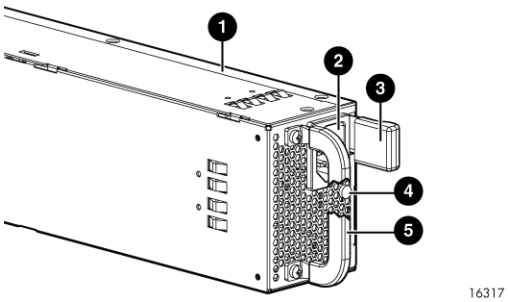
Button	Function
▼	Moves down through the available menus and options
▲	Moves up through the available menus and options
▶	Selects the displayed menu or option.
◀	Returns to the previous menu.
Esc	Used for “No” selections and to return to the default display.
Enter	Used for “Yes” selections and to progress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

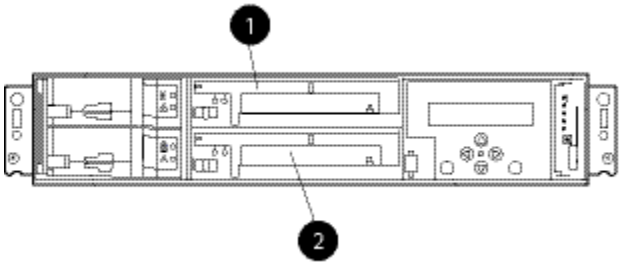


1. Power supply
2. AC input connector
3. Latch
4. Status indicator (solid green on — normal operation; solid amber — failure or no power)
5. Handle

Figure 12 Power supply

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.



1. Blower 1
2. Blower 2

Figure 13 Blower module pulled out

Table 8 Fan status indicators

Status indicator	Fault indicator	Description
On left — green	Solid green	Normal operation.
	Blinking	Maintenance in progress.
	Off	Amber is on or blinking, or the enclosure is powered down.
On right — 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 illustrates the location of the cache batteries and the battery status indicators. See Table 9 for additional information on the status indicators.

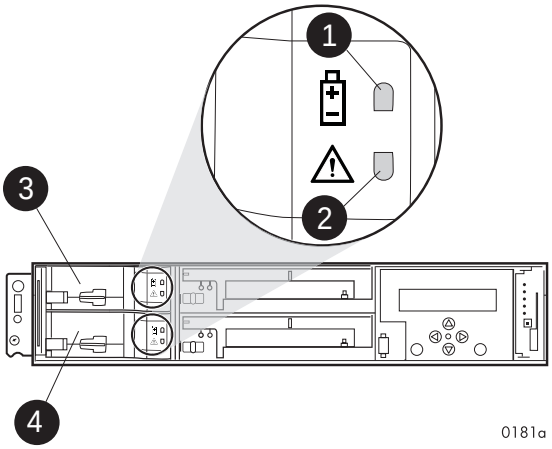


Figure 14 Battery module

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 9 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 6 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 es 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 in) 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 in).

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 enty.
- 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 for a typical EVA6400/8400 rack configuration. The standard rack is the 42U HP 10000 G2 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 onstie 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.

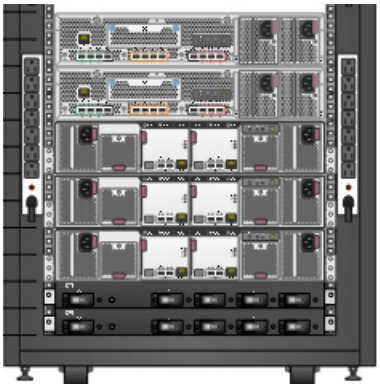


Figure 15 Storage system hardware components – back view

Power distribution

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 (220–240 VAC ±10%, 50 or 60-Hz, ±5%). Figure 16 illustrates the compatible 60-Hz and 50-Hz wall receptacles.

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

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

  Figure 16 60-Hz and 50-Hz wall receptacles

- 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 (see Figure 16).
  - One dual PDU assembly. Each PDU connects to a different wall receptacle.
  - Six Power Distribution Modules (PDM) per rack. Three PDMs mount vertically on each side of the rack. Each set of PDMs connects to a different PDU.
  - The drive enclosure power supplies on the left (PS 1) connect to the PDMs on the left with a gray, 66 cm (26 in) 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 in) power cord.

- The upper controller connects to a PDM on the left with a gray, 152 cm (60 in) power cord.
- The lower controller connects to a PDM on the right with a black, 66 cm (26 in) power cord.

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 Command View EVA 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 228481-002/228481-003 PDU placement is back-to-back, plugs facing down, with switches on top.

- 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.

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 (see Figure 17). The voltages are then routed to PDMs, sometimes referred to as AC power strips, mounted on the two vertical rails in the rear of the rack.

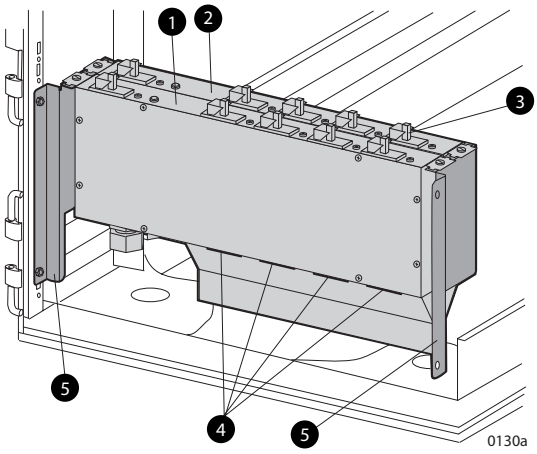


Figure 17 Dual PDU assembly

1. PDU 1
2. PDU 2
3. Circuit breakers
4. AC receptacles
5. Mounting hardware

PDU 1

PDU 1 connects to AC power distribution source 1. A PDU 1 failure:

- Disables the power distribution circuit.
- Removes power from PDMs 1, 2, and 3.
- Disables PS 1 in the drive enclosures.
- Disables the upper controller power supply.

PDU 2

PDU 2 connects to AC power distribution source 2. A PDU 2 failure:

- Disables the power distribution circuit.
- Removes power from PDMs 4, 5, and 6.
- Disables PS 2 in the drive enclosures.
- Disables the lower controller power supply.

PDMs

There are six PDMs mounted in the rear of each rack:

- Three mounted on the left vertical rail connect to PDU 1.
- Three mounted on the right vertical rail connect to PDU 2.

Each PDM has eight AC receptacles and one thermal circuit breaker. The PDMs distribute the AC power from the PDUs to the enclosures. Two power sources exist for each controller pair and drive 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.

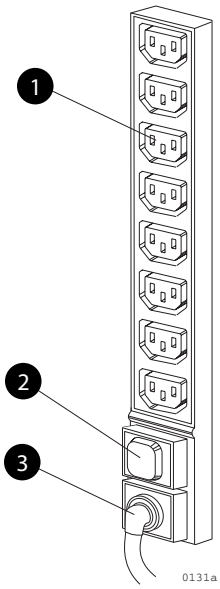


Figure 18 Rack PDM

1. Power receptacles
2. Thermal circuit breakers
3. 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).

- PDMs 1 through 3 connect to receptacles A through D on PDU 1. Power cords connect these PDMs to the number 1 drive enclosure power supplies and to the upper controller enclosure.
- PDMs 4 through 6 connect to receptacles A through D on PDU 2. Power cords connect these PDMs to the number 2 drive enclosure power supplies and to the lower controller enclosure.

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. PDU 1
5. PDM 4	6. PDM 5
7. PDM 6	8. 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 drive enclosure power supplies and to the controller enclosures.
- PDUs 2 and 4 (optional) are mounted on the right side of the cabinet. Power cords connect these PDUs to the number 2 drive enclosure power supplies and to the controller enclosures.

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 (e.g., 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 in) wide for the 60.3 cm (23.7 in) wide, 42U rack. A vertical clearance of 203.2 cm (80 in) should ensure sufficient clearance for the 200 cm (78.7 in) 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 in) wide and 1000 mm (39.37 in) deep (see Figure 20).

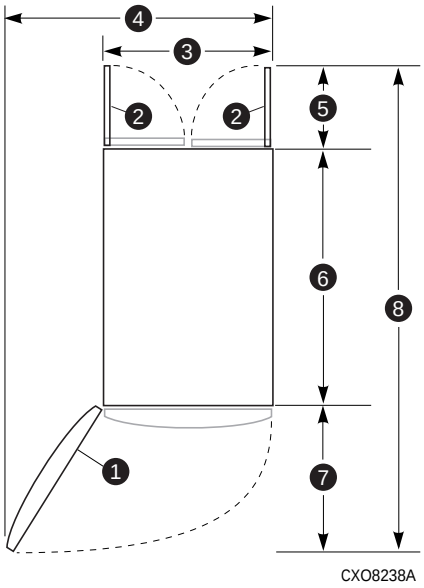


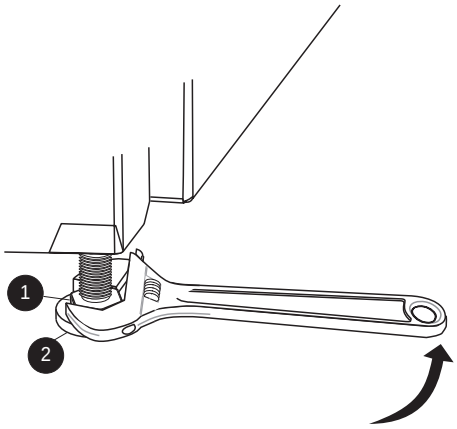
Figure 20 Single rack configuration floor space requirements

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).

2. Repeat Step 1 for the other feet.



CXO7589A

Figure 21 Raising a leveler foot

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).

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.

EVA 8400 storage system connections

Figure 22 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 Command View EVA 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.

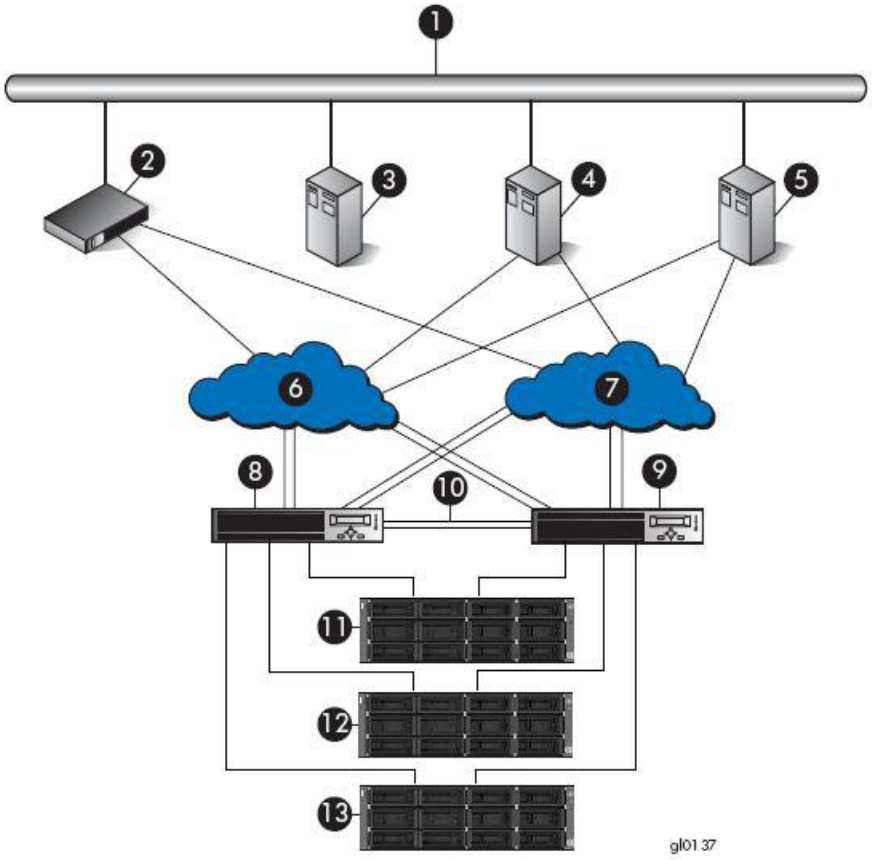


Figure 22 EVA8400 configuration

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

EVA6400 storage system connections

Figure 23 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 Command View EVA 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.

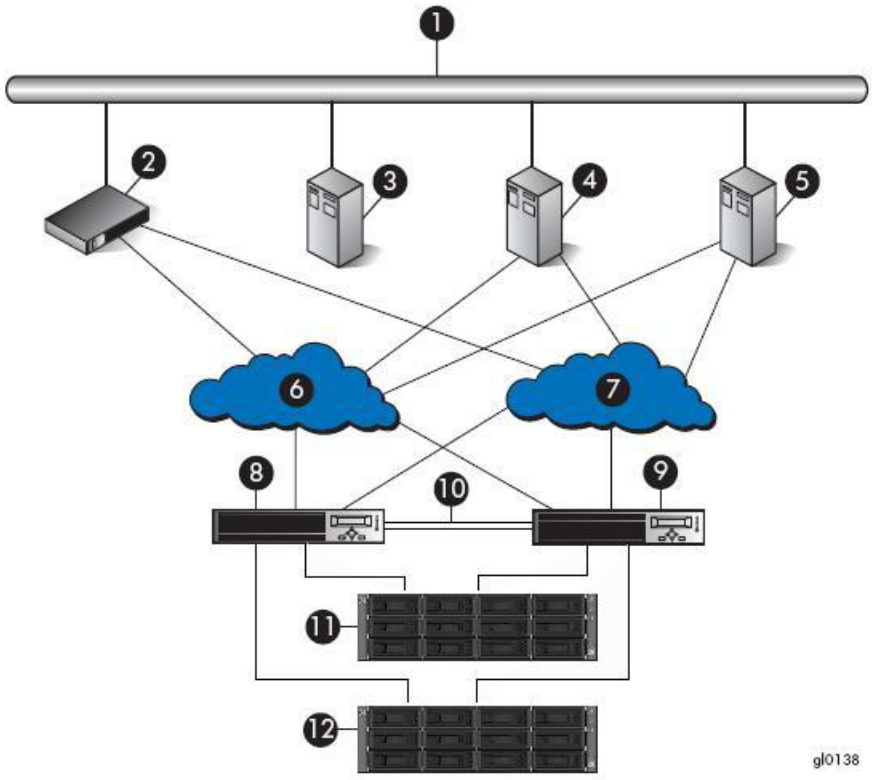


Figure 23 EVA6400 configuration

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

Direct connect

NOTE:

Direct connect is currently 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 host(s), 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 Command View EVA 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 EVA8400, and up to two hosts can be connected to an EVA6400.
- The Host Port Configuration must be set to Direct Connect using the OCP.
- HP Continuous Access EVA 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 Continuous Access EVA.

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 Continuous Access EVA 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 MPX100(s), 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 Continuous Access EVA cannot be used with direct connect configurations.
- EVAs cannot be directly connected to each other to create HP Continuous Access EVA configuration. However, hosts can be direct connected to the EVA in a HP Continuous Access configuration. At least one port from each array in an HP Continuous Access EVA 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 Command View EVA.	HP Service Engineer
5. Prepare the hosts.	Customer
6. Configure the system through HP Command View EVA.	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 StorageWorks 6400/8400 Enterprise Virtual Array World Wide Name label*, (shipped with the storage system).
- *HP StorageWorks 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 Command View EVA 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" on page 25.

Table 10 lists the push-button functions when entering the WWN, WWN checksum, and password data.

Table 10 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.

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.

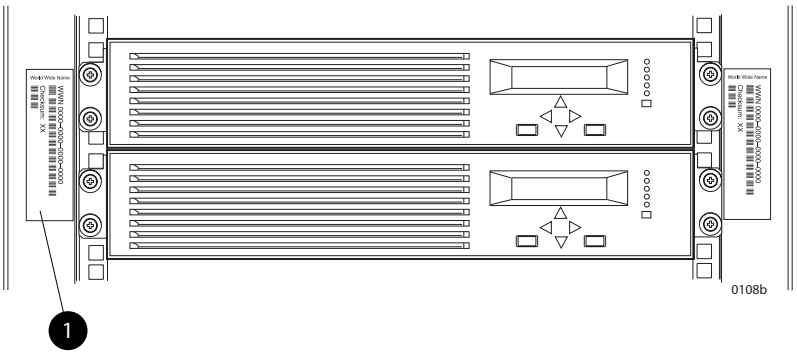


Figure 24 Location of the World Wide Name labels

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 Command View EVA

HP Command View EVA is installed on a management server. Installation may be skipped if the latest version of HP Command View EVA is running. Verify the latest version at the HP website: http://h18006.www1.hp.com/storage/software.html.

See the *HP StorageWorks HP Command View EVA installation guide* for information on installing the software.

Installing optional EVA software licenses

If you purchased optional EVA software, it will be necessary to install the license. Optional software available for the Enterprise Virtual Array includes HP Business Copy EVA and HP Continuous Access EVA. 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 StorageWorks Enterprise Virtual Array configuration best practices* white paper available from 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 StorageWorks Enterprise Virtual Array configuration best practices* white paper. See Best practices.

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. Download the following document for more information on FATA drives, their uses and benefits:

http://h71028.www7.hp.com/ERC/downloads/5982-7353EN.pdf

Failback preference setting for HSV controllers

Table 11 describes the failback preference behavior for the controllers.

Table 11 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.

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 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.
	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 12 describes the failback default behavior and supported settings when Secure Path is running with each operating system or when MPIO 2.x or 3.x is running with Windows.

Table 12 Failback Settings by operating system

Operating system	Default behavior	Settings supported
HP-UX[1]	Auto failback done by the host	No Preference, Path A/B – Failover Only.
True64 UNIX	Host follows the unit	All settings allowed. Recommended setting: Path A/B – Failover/Failback.
OpenVMS (7.3-1 and greater)	Host follows the unit	All settings allowed. Recommended setting: Path A/B – Failover/Failback.
Windows[2]	Auto failback done by the host	No Preference, Path A/B – Failover Only.
Sun Solaris	Auto failback done by the host	No Preference, Path A/B – Failover Only.
IBM AIX	Auto failback done by the host	No Preference, Path A/B – Failover Only.
Linux	Auto failback done by the host	No Preference, Path A/B – Failover Only.

Operating system	Default behavior	Settings supported
Novell NetWare	Auto failback done by the host	No Preference, Path A/B – Failover Only.
VMWare	Auto failback done by the host	No Preference, Path A/B – Failover Only.

[1]Secure Path v3.0F for HP-UX supports hosts connected to the HP StorageWorks Enterprise Virtual Array (EVA5000, EVA3000, EVA4000, EVA6000, EVA8000), HP StorageWorks Modular Array 8000 (MA8000)/Enterprise Modular Array 12000 (EMA12000)/Enterprise Modular Array 16000 (EMA16000), RAID Array 8000 (RA8000)/Enterprise Storage Array 12000 (ESA12000), and Modular Array 6000 (MA6000) storage solutions.

This release also supports hosts connected to the StorageWorks XP48/512, XP256, XP128/1024, XP10000, XP12000, XP24000, VA740012000/7100, and the VA7410/7110.

For HPUX 11.31 native multipathing, the supported settings are No Preference, Path A/B - Failover Only.

[2]These settings also apply to Windows Active/Active MPIO version 3.x.

Changing virtual disk failover/failback setting

Changing the failover/failback setting of a virtual disk may impact which controller presents the disk. Table 13 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 13 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 VCS 4.x and all versions of 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 Continuous Access EVA DR group. Because HP Continuous Access EVA 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 Command View EVA. 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 Command View EVA

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 Command View EVA.
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.
5. If your management server is an SMA and you are not using it to manage other storage arrays, shut down the SMA. From the SMA user interface, click **Settings > Maintenance > Shutdown**.

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. If the management server you shut down is an SMA, power it on and wait for it to completely boot. Verify the SMA is running by logging into it using the web interface.

NOTE:

Before applying power to the rack, ensure that the power switch on each HSV controller is off.

3. Power on the circuit breakers on both EVA rack PDUs. Verify that all drive enclosures are operating properly. The status indicator and the power indicator should be on (green).
4. 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).
5. Power on the upper controller. It takes the role of master controller.
6. Wait 10 seconds and then power on the lower controller. It takes the role of slave controller.
7. Verify that the Operator Control Panel (OCP) display on each controller displays the storage system name and the EVA WWN.
8. Start HP Command View EVA 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.

9. Check the storage system status using HP Command View EVA 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 Storage Management Appliance (SMA) or management server where HP Command View EVA is installed, or any host that can run the Storage System Scripting Utility (SSSU) to communicate with the HP Command View EVA.

NOTE:

For more information on using SSSU, see the *HP StorageWorks Storage System Scripting Utility reference*. See "Related documentation" on page 15.

1. Double-click on the 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`, etc.

   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 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 utility's CAPTURE CONFIGURATION command are not designed to automatically restore this type of configuration. For more information, see the *HP StorageWorks Storage System Scripting Utility reference*.

Example 1. Saving configuration data using SSSU on a Windows Host

To save the storage system configuration:

1. Double-click on the 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 SSSU on a Windows Host

To restore the storage system configuration:

1. Double-click on the SSSU desktop icon to run the application.
2. Enter `FILE pathname\filename`, where *pathname* identifies the location where the configuration files are 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.

Guidelines for adding disk drives

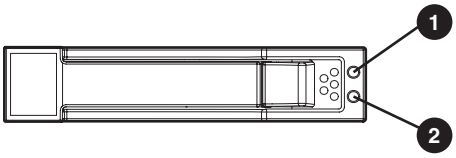
When adding new disk drives to the storage system, you should ensure that the disk drives are installed in the correct positions to maintain availability. The disk drives should be distributed across the disk enclosures to protect against the failure of a single disk enclosure.

Use the following guidelines when adding disk drives to your storage system:

- Install high performance and FATA disk drives in separate groups. These different drive types must be in separate disk groups. You may also want to consider separating different drive capacities and spindle speeds into different groups.
- High performance and FATA disk drives can be installed in the same disk enclosure.
- The disk drives should be distributed evenly across the disk enclosures. The number of disks of a given type in each enclosure should not differ by more than one. For example, no enclosure should have two disks until all the other enclosures have at least one.
- Disk drives should be installed in vertical columns within the disk enclosures. Add drives vertically in multiples of eight, completely filling columns if possible. Disk groups are more robust if filled with the same number of disk drives in each enclosure. See ??? for an example.

NOTE:

When adding multiple disk drives, add a disk and wait for its activity indicator (1) to stop flashing (up to 90 seconds) before installing the next disk (see Figure 25). This procedure must be followed to avoid unexpected EVA system behavior.



gl0113

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

Figure 25 Disk drive activity indicator

Table 14 Disk status indicator LED descriptions

Drive LED	Description
Bi-color (top)	• Slow flashing blue (0.5 Hz) — Used to locate drive. • Fast flashing blue (4 Hz) — Used for reserved locate. • Medium flashing blue (1 Hz) — Used for critical locate. • Solid amber — Drive fault.
Green (bottom)	• Flashing — Drive is spinning up or down and is not ready. • Solid — Drive is ready to perform I/O operations. • Flickering — Indicates drive activity.

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. ??? shows the sequential building of vertical disk groups.

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.
- 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 Command View EVA.

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 15 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 15 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)
IO 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 Command View EVA.

You can use the Shutdown System function to implement the shutdown methods listed below. These shutdown methods are explained in Table 16.

- Shutting down the controller (see Shutting the controller down).

- Restarting the system (see Restarting the System).
- Uninitializing the system (see Uninitializing the System).

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 16 Shutdown methods

LCD prompt	Description
Restart System?	Implementing this procedure establishes communications between the storage system and HP Command View EVA. This procedure is used to restore the controller to an operational state where it can communicate with HP Command View EVA.
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.

Shutting the controller down

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

NOTE:

HP Command View EVA is the preferred method for shutting down the controller. Shut down the controller from the OCP only if HP Command View EVA 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.

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.

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 Command View EVA 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).
- Displaying the current password.
- Changing a password (see Changing a password).
- Removing password protection (see Clearing a password).

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" on page 46 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 Command View EVA 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 Command Vi w EVA 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 Customer replaceable units

Customer self repair (CSR)

Table 13 and Table 18 identifies which hardware components are customer replaceable. Using WEBES, ISEE 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 Command View EVA and/or the WEBES System Event Analyzer 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 System Event Analyzer online help for additional information.

Identifying the spare part

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

8053A-ST

1. Spare component number

Figure 26 Typical product label

Replaceable parts

This product contains the replaceable parts listed in ??? and Table 18. 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 (non RoHS/RoHS)	CSR status
10 pt Ctrl w/4GB total cache (HSV400)	512730–001	•
12 pt CTL w/7GB Total Cashe (HSV450)	512731–001	•
12 pt CTL w/11GB Total Cache (HSV450)	512732–001	•

Description	Spare part number (non RoHS/RoHS)	CSR status
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 18 M6412-A disk enclosure replaceable parts

Description	Spare part number (non RoHS/RoHS)	CSR status
4Gb FC disk shelf midplane	461492–005	•
4Gb 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	•
4Gb FC disk shelf IO module	461494–005	•
FC disk shelf fan module	468715–001	✓
FC disk shelf power supply	405914–001	✓
Disk drive 146GB, 15K, EVA M6412–A Enclosure, Fibre channel	454410–001	✓
Disk drive 300GB, 15K, EVA M6412-A Enclosure, Fibre channel	454411–001	✓
Disk drive 400GB, 15K, EVA M6412-A Enclosure, Fibre channel	466277–001	✓
Disk drive 450GB, 15K, EVA M6412-A Enclosure, Fibre channel	454412–001	✓
Disk drive 1TB, 7.2K, EVA M6412-A Enclosure, FATA	454414–001	✓
Disk drive SSD 72Gb FC	515189–001	✓
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 web site: http://www.hp.com/support/manuals. Under Storage, select **Disk Storage Systems**, then select **HP StorageWorks 6400/8400 Enterprise Virtual Arrays** under 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 StorageWorks controller enclosure replacement instructions
- HP StorageWorks cache battery replacement instructions
- HP StorageWorks controller blower replacement instructions
- HP StorageWorks power supply replacement instructions

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

5 Error messages

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

Table 19 Error Messages

Status Code Value	Meaning	How to Correct
0 Successful Status	The SCMI command completed successfully.	No corrective action required.
1 Object Already Exists	The object or relationship already exists.	Delete the associated object and try the operation again. Several situations can cause this message: Presenting a LUN to a host: • Delete the current association or specify a different LUN number. Storage cell initialize: • Remove or erase disk volumes before the storage cell can be successfully created. Adding a port WWN to a host: • Specify a different port WWN. Adding a disk to a disk group: • Delete the specified disk volume before creating a new disk volume.
2 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 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 Insufficient Available Data Storage	There is insufficient storage available to perform the request.	Reclaim some logical space or add physical hardware.
5 Internal Error	An unexpected condition was encountered while processing a request.	Report the error to product support.
6 Invalid status for logical disk	This error is no longer supported.	Report the error to product support.

Status Code Value	Meaning	How to Correct
7 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 Invalid Function	The function code specified with the class code is of an unknown type.	Report the error to product support.
9 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 Invalid Loop Configuration	The specified request supplied an invalid loop configuration.	Verify the hardware configuration and retry the request.
11 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.
12 Invalid Parameter handle	The supplied handle is invalid. This can indicate a user error, program error, or a storage cell in an uninitialized state. In the following cases, the storage cell is in an uninitialized state, but no action is required: Storage cell discard (informational message): Storage cell look up object count (informational message): 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. Storage cell set device addition policy Storage cell set name Storage cell set time Storage cell set volume replacement delay Storage cell free command lock Storage cell set console lun id
13 Invalid Parameter Id	The supplied identifier is invalid. This can indicate a user or program error.	Report the error to product support.
14 Invalid Quorum Configuration	Quorum disks from multiple storage systems are present.	Report the error to product support.
15 Invalid Target Handle	The supplied target handle is invalid. This can indicate a user or program error (Case 1), or Volume set requested usage (Case 2): 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. Case 2: To add additional capacity to the disk group, use the management software to add disks by count or capacity.

Status Code Value	Meaning	How to Correct
16 Invalid Target Id	The supplied target identifier is invalid. This can indicate a user or program error.	Report the error to product support.
17 Invalid Time	The time value specified is invalid. This can indicate a user or program error.	Report the error to product support.
18 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 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 No Image	There is no firmware image stored for the specified image number.	Report the error to product support.
21 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 Storage system not initialized	The operation requires a storage cell to exist.	Create a storage cell and retry the operation.
23 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 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.

Status Code Value	Meaning	How to Correct
25 Objects in your system are in use, and their state prevents the operation you wish to perform.		Case 1: Either delete the associated object or resolve the in progress state. Case 2: . Report the error to product support. Case 3: Unpresent the LUNs before deleting this virtual disk. Case 4: Resolve the delay before performing the operation. 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. Case 6: Report the error to product support. Case 7: The disk must be in a reserved state before it can be erased. Case 8: Delete the virtual disks or LUN presentations before uninitializing the storage cell. Case 9: Delete the LUN presentations before deleting the EVA host. Case 10: Report the error to product support. Case 11: Resolve the situation before attempting the operation again. Case 12: Resolve the situation before attempting the operation again. Case 13: This may indicate a programming error. Report the error to product support. Case 14: Select another disk or remove the disk from the disk group before making it a member of a different disk group. Case 15: Remove the virtual disks from the group and retry the operation.

Status Code Value	Meaning	How to Correct
	Several states can cause this message: Case 1: The operation cannot be performed because an association exists a related object, or the object is in a progress state. Derived unit create: Case 2: The supplied virtual disk handle is already an attribute of another derived unit. This may indicate a programming error Derived unit discard: Case 3: One or more LUNs are presented to EVA hosts that are based on this virtual disk. Case 4: Logical disk clear data lost: The virtual disk is in the non-mirrored delay window. 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. Case 6: LDAD resolve condition: The disk group contains a disk volume that is in a data-lost state. This condition cannot be resolved. Case 7: Physical Store erase volume: The disk is a part of a disk group and cannot be erased. Case 8: Storage cell discard: The storage cell contains one or more virtual disks or LUN presentations. Case 9: Storage cell client discard: = The EVA host contains one or more LUN presentations. Case 10: SCVD discard: The virtual disk contains one or more derived units and cannot be discarded. This may indicate a programming error. Case 11: SCVD set capacity: The capacity cannot be modified because the virtual disk has a dependency on either a snapshot or snapclone. Case 12: SCVD set disk cache policy: The virtual disk cache policy cannot be modified while the virtual disk is presented and enabled. 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. 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.	

Status Code Value	Meaning	How to Correct
	Case 15: GROUP discard: The Continuous Access group cannot be discarded as one or more virtual disk members exist.	
26 Parameter Object Does Not Exist	The operation cannot be performed because the object does not exist. This can indicate a user or program error. 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 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. 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. 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. 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. Case 2: Retry the request at a later time. Case 3: Report the error to product support. Case 4: Report the error to product support.
28 Timeout	A timeout has occurred in processing the request.	Verify the hardware connections and that communication to the device is successful.
29 Unknown Id	The supplied storage cell identifier is invalid. This can indicate a user or program error.	Report the error to product support.
30 Unknown Parameter Handle	The supplied parameter handle is unknown. This can indicate a user or program error.	Report the error to product support.
31 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 Invalid State	This error is no longer supported.	Report the error to product support.
33 Transport Error	A SCMI transport error has occurred.	Verify the hardware connections, communication to the device, and that the management software is operating successfully.

Status Code Value	Meaning	How to Correct
34 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 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 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 No More Events	There are no more events to retrieve. (This message is informational only.)	No action required.
38 Lock Busy	The command lock is busy and being held by another process.	Retry the request at a later time.
39 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 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 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 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 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 Not licensed for data replication	This error is no longer supported.	Report the error to product support.
45 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 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 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.

Status Code Value	Meaning	How to Correct
48 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 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 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 Storage system connection down	The Continuous Access group is not functioning. .	Verify that devices are powered on and that device hardware connections are functioning correctly.
52 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 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 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.
55 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 Cache batteries failed or missing.	The battery system is missing or discharged.	Report the error to product support.
57 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 Other controller failed	Invalid status for logical disk. This error is no longer supported.	Report the error to product support.

Status Code Value	Meaning	How to Correct
59 Maximum Number of Objects Exceeded.	Case 1: The maximum number of items allowed has been reached. Case 2: The maximum number of EVA hosts has been reached. 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. Case 2: If this operation is still desired, delete one or more of the EVA hosts and retry the operation. Case 3: If this operation is still desired, delete one or more of the port WWNs and retry the operation.
60 Max size exceeded	Case 1: The maximum number of items already exist on the destination storage cell. Case 2: The size specified exceeds the maximum size allowed. Case 3: The presented user space exceeds the maximum size allowed. Case 4: The presented user space exceeds the maximum size allowed. Case 5: The size specified exceeds the maximum size allowed. Case 6: The maximum number of EVA hosts already exist on the destination storage cell. Case 7: The maximum number of EVA hosts already exist on the destination storage cell. 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. Case 2: Use a smaller size and retry the operation. Case 3: No action required. Case 4: No action required. Case 5: Use a smaller size and try this operation again. Case 6: If this operation is still desired, delete one or more of the EVA hosts and retry the operation. 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. Case 8: If this operation is still desired, delete one or more of the groups and retry the operation.
61 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 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 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.
64 Connection is suspended	The operation cannot be performed because the Continuous Access connection is currently suspended	Resolve the suspended mode and retry the request.

Status Code Value	Meaning	How to Correct
65 Bad image header	The firmware image file has a header checksum error.	Retrieve a valid firmware image file and retry the request.
66 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. 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 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 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 Image already loaded	The firmware version already exists on the device.	No action required.
73 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 Logical Disk Sharing	Case 1: The operation cannot be performed because the virtual disk or snapshot is part of a snapshot group. 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. 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. Case 4: A capacity change is not allowed on a virtual disk or snapshot that is a part of a snapshot group. 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. Case 2: No action required. 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. Case 4: No action required. Case 5: No action required.
75 Bad Image Size	The firmware image file is not the correct size.	Retrieve a valid firmware image file and retry the request.

Status Code Value	Meaning	How to Correct
76 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 Volume Failure Predicted	The disk volume specified is in a predictive failed state.	Report the error to product support.
78 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 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 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 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 Shutdown In Progress	The controller is currently shutting down.	No action required.
83 Controller API Not Ready, Try Again Later	The device is not ready to process the request.	Retry the request at a later time.
84 Is Snapshot	This is a snapshot virtual disk and cannot be a member of a Continuous Access group.	No action required.
85 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.

Status Code Value	Meaning	How to Correct
86 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 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 Storage system inoperative	The storage system is inoperative and cannot process the request.	Report the error to product support.
89 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 Data Flush Incomplete	The disk cache data need to be flushed before the condition can be resolved.	Retry the request later.
91 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 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 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 Unknown remote Vdisk	The remote storage system specified does not exist.	Correctly select the remote storage system and retry the request.
95 Unknown remote DR group	The remote Continuous Access group specified does not exist.	Correctly select the remote Continuous Access group retry the request.
96 PLDMC failed	The disk metadata was unable to be updated.	Resolve the condition and retry the request. Report the error to product support.

Status Code Value	Meaning	How to Correct
97 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 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 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 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 re-moved. The management software must be used to set the password up to match the device so commu-nication can proceed.

A Regulatory notices and specifications

This appendix includes regulatory notices and product specifications for the HP StorageWorks Enterprise Virtual Array family.

Regulatory notices

Federal Communications Commission (FCC) 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.

The rating label on the device shows the classification (A or B) of the equipment. Class B devices have an FCC logo or FCC ID on the label. Class A devices do not have an FCC logo or FCC ID on the label. After the class of the device is determined, see the corresponding statement in the following sections.

FCC Class A certification

This equipment generates, uses, and may emit radio frequency energy. The equipment has been type tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC rules, which are designed to provide reasonable protection against such radio frequency interference.

Operation of this equipment in a residential area may cause interference, in which case the user at the user's own expense will be required to take whatever measures may be required to correct the interference.

Any modifications to this device—unless approved by the manufacturer—can void the user's authority to operate this equipment under Part 15 of the FCC rules.

NOTE:

Additional information on the need to interconnect the device with shielded (data) cables or the need for special devices, such as ferrite beads on cables, is required if such means of interference suppression was used in the qualification test for the device. This information will vary from device to device and needs to be obtained from the HP EMC group.

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 your product, see http://thenew.hp.com.

For questions regarding this FCC declaration, contact:

- Hewlett-Packard Company Product Regulations Manager, 3000 Hanover St., Palo Alto, CA 94304
- Or call 1-650-857-1501

To identify this product, see the part, series, or model number found on the product.

Modifications

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

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.

Laser device

All Hewlett-Packard systems equipped with a laser device comply with safety standards, including International Electrotechnical Commission (IEC) 825. With specific regard to the laser, the equipment complies with laser product performance standards set by government agencies as a Class 1 laser product. The product does not emit hazardous light; the beam is totally enclosed during all modes of customer operation and maintenance.

Laser safety warnings

Heed the following warning:

⚠ WARNING!

WARNING: To reduce the risk of exposure to hazardous radiation:

- Do not try to open the laser device 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 laser device.

Compliance with CDRH regulations

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.

Certification and classification information

This product contains a laser internal to the Optical Link Module (OLM) for connection to the Fibre communications port.

In the USA, the OLM is certified as a Class 1 laser product conforming to the requirements contained in the Department of Health and Human Services (DHHS) regulation 21 CFR, Subchapter J. The certification is indicated by a label on the plastic OLM housing.

Outside the USA, the OLM is certified as a Class 1 laser product conforming to the requirements contained in IEC 825-1:1993 and EN 60825-1:1994, including Amendment 11:1996.

The OLM includes the following certifications:

- UL Recognized Component (USA)
- CSA Certified Component (Canada)
- TUV Certified Component (European Union)
- CB Certificate (Worldwide)

Canadien 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 classe 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 classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

European union notice

Products with the CE Marking comply with both the EMC Directive (2004/108/EC) and the Low Voltage Directive (2006/95/EC) issued by the Commission of the European Community.

Compliance with these directives implies conformity to the following European Norms (the equivalent international standards are in parenthesis):

- EN55022 (CISPR 22) - Electromagnetic Interference
- EN55024 (IEC61000-4-2, 3, 4, 5, 6, 8, 11) - Electromagnetic Immunity
- EN61000-3-2 (IEC61000-3-2) - Power Line Harmonics
- EN61000-3-3 (IEC61000-3-3) - Power Line Flicker
- EN60950 (IEC950) - Product Safety

Notice for France

DECLARATION D'INSTALLATION ET DE MISE EN EXPLOITATION d'un matériel de traitement de l'information (ATI), classé A en fonction des niveaux de perturbations radioélectriques émis, définis dans la norme européenne EN 55022 concernant la Compatibilité Electromagnétique.

WEEE Recycling Notices

English notice

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

This symbol on the product or on its packaging indicates that this product must not be disposed of with your other household waste. Instead, it is your responsibility to dispose of your waste equipment by handing it over to a designated collection point for recycling of waste electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help to conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste equipment

for recycling, please contact your local city office, your household waste disposal service, or the shop where you purchased the product.

Dutch notice

Verwijdering van afgedankte apparatuur door privé-gebruikers in de Europese Unie

Dit symbool op het product of de verpakking geeft aan dat dit product niet mag worden gedeponeerd bij het normale huishoudelijke afval. U bent zelf verantwoordelijk voor het inleveren van uw afgedankte apparatuur bij een inzamelingspunt voor het recyclen van oude elektrische en elektronische apparatuur. Door uw oude apparatuur apart aan te bieden en te recyclen, kunnen natuurlijke bronnen worden behouden en kan het materiaal worden hergebruikt op een manier waarmee de volksgezondheid en het milieu worden beschermd. Neem contact op met uw gemeente, het afvalinzamelingsbedrijf of de winkel waar u het product hebt gekocht voor meer informatie over inzamelingspunten waar u oude apparatuur kunt aanbieden voor recycling.

Czechoslovakian notice

Likvidace za ízení soukromými domácími uživateli v Evropské unii

Tento symbol na produktu nebo balení ozna uje výrobek, který nesmí být vyhozen spolu s ostatním domácím odpadem. Povinností uživatele je p edat takto ozna ený odpad na p edem ur ené sb rné místo pro recyklaci elektrických a elektronických za ízení. Okamžité t íd ní a recyklace odpadu pom že uchovat p írodní prost edí a zajistí takový zp sob recyklace, který ochrání zdraví a životní prost edí lov ka. Další informace o možnostech odevzdání odpadu k recyklaci získáte na p íslušném obecním nebo m stském ú ad , od firmy zabývající se sb rem a svozem odpadu nebo v obchod , kde jste produkt zakoupili.

Estonian notice

Seadmete jäätmete kõrvaldamine eramajapidamistes Euroopa Liidus

See tootel või selle pakendil olev sümbol näitab, et kõnealust toodet ei tohi koos teiste majapidamisjäätmetega kõrvaldada. Teie kohus on oma seadmete jäätmed kõrvaldada, viies need elektri- ja elektroonikaseadmete jäätmete ringlussevõtmiseks selleks ettenähtud kogumispunkti. Seadmete jäätmete eraldi kogumine ja ringlussevõtmine kõrvaldamise ajal aitab kaitsta loodusvarasid ning tagada, et ringlussevõtmine toimub viisil, mis kaitseb inimeste tervist ning keskkonda. Lisateabe saamiseks selle kohta, kuhu oma seadmete jäätmed ringlussevõtmiseks viia, võtke palun ühendust oma kohaliku linnakantselei, majapidamisjäätmete kõrvaldamise teenistuse või kauplusega, kust Te toote ostsite.

Finnish notice

Laitteiden hävittäminen kotitalouksissa Euroopan unionin alueella

Jos tuotteessa tai sen pakkauksessa on tämä merkki, tuotetta ei saa hävittää kotitalousjätteiden mukana. Tällöin hävitettävä laite on toimitettava sähkölaitteiden ja elektronisten laitteiden kierrätyspisteeseen. Hävitettävien laitteiden erillinen käsittely ja kierrätys auttavat säästämään

luonnonvaroja ja varmistamaan, että laite kierrätetään tavalla, joka estää terveyshaitat ja suojelee luontoa. Lisätietoja paikoista, joihin hävitettävät laitteet voi toimittaa kierrätettäväksi, saa ottamalla yhteyttä jätehuoltoon tai liikkeeseen, josta tuote on ostettu.

French notice

Élimination des appareils mis au rebut par les ménages dans l'Union européenne

Le symbole apposé sur ce produit ou sur son emballage indique que ce produit ne doit pas être jeté avec les déchets ménagers ordinaires. Il est de votre responsabilité de mettre au rebut vos appareils en les déposant dans les centres de collecte publique désignés pour le recyclage des équipements électriques et électroniques. La collecte et le recyclage de vos appareils mis au rebut indépendamment du reste des déchets contribue à la préservation des ressources naturelles et garantit que ces appareils seront recyclés dans le respect de la santé humaine et de l'environnement. Pour obtenir plus d'informations sur les centres de collecte et de recyclage des appareils mis au rebut, veuillez contacter les autorités locales de votre région, les services de collecte des ordures ménagères ou le magasin dans lequel vous avez acheté ce produit.

German notice

Entsorgung von Altgeräten aus privaten Haushalten in der EU

Das Symbol auf dem Produkt oder seiner Verpackung weist darauf hin, dass das Produkt nicht über den normalen Hausmüll entsorgt werden darf. Benutzer sind verpflichtet, die Altgeräte an einer Rücknahmestelle für Elektro- und Elektronik-Altgeräte abzugeben. Die getrennte Sammlung und ordnungsgemäße Entsorgung Ihrer Altgeräte trägt zur Erhaltung der natürlichen Ressourcen bei und garantiert eine Wiederverwertung, die die Gesundheit des Menschen und die Umwelt schützt. Informationen dazu, wo Sie Rücknahmestellen für Ihre Altgeräte finden, erhalten Sie bei Ihrer Stadtverwaltung, den örtlichen Müllentsorgungsbetrieben oder im Geschäft, in dem Sie das Gerät erworben haben.

Greek notice

Απόρριψη άχρηστου εξοπλισμού από χρήστες σε ιδιωτικά νοικοκυριά στην Ευρωπαϊκή Ένωση

Το σύμβολο αυτό στο προϊόν ή τη συσκευασία του υποδεικνύει ότι το συγκεκριμένο προϊόν δεν πρέπει να διατίθεται μαζί με τα άλλα οικιακά σας απορρίμματα. Αντίθετα, είναι δική σας ευθύνη να απορρίψετε τον άχρηστο εξοπλισμό σας παραδίδοντάς τον σε καθορισμένο σημείο συλλογής για την ανακύκλωση άχρηστου ηλεκτρικού και ηλεκτρονικού εξοπλισμού. Η ξεχωριστή συλλογή και ανακύκλωση του άχρηστου εξοπλισμού σας κατά την απόρριψη θα συμβάλει στη διατήρηση των φυσικών πόρων και θα διασφαλίσει ότι η ανακύκλωση γίνεται με τρόπο που προστατεύει την ανθρώπινη υγεία και το περιβάλλον. Για περισσότερες πληροφορίες σχετικά με το πού μπορείτε να παραδώσετε τον άχρηστο εξοπλισμό σας για ανακύκλωση, επικοινωνήστε με το αρμόδιο τοπικό γραφείο, την τοπική υπηρεσία διάθεσης οικιακών απορριμμάτων ή το κατάστημα όπου αγοράσατε το προϊόν.

Hungarian notice

Készülékek magánháztartásban történ selejtezése az Európai Unió területén

A készüléken, illetve a készülék csomagolásán látható azonos szimbólum annak jelzésére szolgál, hogy a készülék a selejtezés során az egyéb háztartási hulladéktól eltér módon kezelend . A vásárló a hulladékká vált készüléket köteles a kijelölt gy jt helyre szállítani az elektromos és elektronikai készülékek újrahasznosítása céljából. A hulladékká vált készülékek selejtezéskori begy jtése és újrahasznosítása hozzájárul a természeti er források meg rzéséhez, valamint biztosítja a selejtezett termékek környezetre és emberi egészségre nézve biztonságos feldolgozását. A begy jtés pontos helyér l b vebb tájékoztatást a lakhelye szerint illetékes önkormányzattól, az illetékes szemételtakarító vállalattól, illetve a terméket elárusító helyen kaphat.

Italian notice

Smaltimento delle apparecchiature da parte di privati nel territorio dell'Unione Europea

Questo simbolo presente sul prodotto o sulla sua confezione indica che il prodotto non può essere smaltito insieme ai rifiuti domestici. È responsabilità dell'utente smaltire le apparecchiature consegnandole presso un punto di raccolta designato al riciclo e allo smaltimento di apparecchiature elettriche ed elettroniche. La raccolta differenziata e il corretto riciclo delle apparecchiature da smaltire permette di proteggere la salute degli individui e l'ecosistema. Per ulteriori informazioni relative ai punti di raccolta delle apparecchiature, contattare l'ente locale per lo smaltimento dei rifiuti, oppure il negozio presso il quale è stato acquistato il prodotto.

Korean Communication Committee notice

A급 기기 (업무용 방송통신기기)	이 기기는 업무용(A급)으로 전자파적합등록을 한 기기이오니 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정 외의 지역에서 사용하는 것을 목적으로 합니다.

Latvian notice

Nolietotu iek rtu izn cin šanas noteikumi lietot jiem Eiropas Savien bas priv taj s m jsaimniec b s

Š ds simbols uz izstr d juma vai uz t iesai ojuma nor da, ka šo izstr d jumu nedr kst izmest kop ar citiem sadz ves atkritumiem. J s atbildat par to, lai nolietot s iek rtas tiktu nodotas speci li iek rtotos punktos, kas paredz ti izmantoto elektrisko un elektronisko iek rtu sav kšanai otrreiz jai p rstr dei. Atseviš a nolietoto iek rtu sav kšana un otrreiz j p rstr de pal dz s saglab dabas resursus un garant s, ka š s iek rtas tiks otrreiz ji p rstr d tas t d veid , lai pasarg tu vidi un cilv ku vesel bu. Lai uzzin tu, kur nolietot s iek rtas var izmest otrreiz jai p rstr dei, j vršas savas dz ves vietas pašvald b , sadz ves atkritumu sav kšanas dienest vai veikal , kur izstr d jums tika nopirkts.

Lithuanian notice

Vartotoj iš priva i nam ki rangos atliek šalinimas Europos S jungoje

Šis simbolis ant gaminio arba jo pakuot s rodo, kad šio gaminio šalinti kartu su kitomis nam kio atliekomis negalima. Šalintinas rangos atliekas privalote pristatyti speciali surinkimo viet elektros ir elektronin s rangos atliekoms perdirbti. Atskirai surenkamos ir perdirbamos šalintinos rangos atliekos pad s saugoti gamtinius išteklius ir užtikrinti, kad jos bus perdirbtos tokiu b du, kuris nekenkia žmoni sveikatai ir aplinkai. Jeigu norite sužinoti daugiau apie tai, kur galima pristatyti perdirbtinas rangos atliekas, kreipkit s savo seni nij , nam kio atliek šalinimo tarnyb arba parduotuv , kurioje sigijote gamin .

Polish notice

Pozbywanie si zu ytego sprz tu przez u ytkowników w prywatnych gospodarstwach domowych w Unii Europejskiej

Ten symbol na produkcie lub jego opakowaniu oznacza, e produktu nie wolno wyrzuca do zwykłych pojemników na mieci. Obowi zkiem u ytkownika jest przekazanie zu ytego sprz tu do wyznaczonego punktu zbiórki w celu recyklingu odpadów powstałych ze sprz tu elektrycznego i elektronicznego. Osobna zbiórka oraz recykling zu ytego sprz tu pomog w ochronie zasobów naturalnych i zapewni ponowne wprowadzenie go do obiegu w sposób chroni cy zdrowie człowieka i rodowisko. Aby uzyska wi cej informacji o tym, gdzie mo na przekaza zu yty sprz t do recyklingu, nale y si skontaktowa z urz dem miasta, zakładem gospodarki odpadami lub sklepem, w którym zakupiono produkt.

Portuguese notice

Descarte de Lixo Elétrico na Comunidade Européia

Este símbolo encontrado no produto ou na embalagem indica que o produto não deve ser descartado no lixo doméstico comum. É responsabilidade do cliente descartar o material usado (lixo elétrico), encaminhando-o para um ponto de coleta para reciclagem. A coleta e a reciclagem seletivas desse tipo de lixo ajudarão a conservar as reservas naturais; sendo assim, a reciclagem será feita de uma forma segura, protegendo o ambiente e a saúde das pessoas. Para obter mais informações sobre locais que reciclam esse tipo de material, entre em contato com o escritório da HP em sua cidade, com o serviço de coleta de lixo ou com a loja em que o produto foi adquirido.

Slovakian notice

Likvidácia vyradených zariadení v domácnostiach v Európskej únii

Symbol na výrobku alebo jeho balení ozna uje, že daný výrobok sa nesmie likvidova s domovým odpadom. Povinnos ou spotrebite a je odovzda vyradené zariadenie v zbernom mieste, ktoré je ur ené na recykláciu vyradených elektrických a elektronických zariadení. Separovaný zber a recyklácia vyradených zariadení prispieva k ochrane prírodných zdrojov a zabezpe uje, že recyklácia sa vykonáva spôsobom chrániacim udské zdravie a životné prostredie. Informácie o zberných miestach na recykláciu vyradených zariadení vám poskytne miestne zastupite stvo, spolo nos zabezpe ujúca odvoz domového odpadu alebo obchod, v ktorom ste si výrobok zakúpili.

Slovenian notice

Odstranjevanje odslužene opreme uporabnikov v zasebnih gospodinjstvih v Evropski uniji

Ta znak na izdelku ali njegovi embalaži pomeni, da izdelka ne smete odvre i med gospodinjske odpadke. Nasprotno, odsluženo opremo morate predati na zbirališ e, pooblaš eno za recikliranje odslužene elektri ne in elektronske opreme. Lo eno zbiranje in recikliranje odslužene opreme prispeva k ohranjanju naravnih virov in zagotavlja recikliranje te opreme na zdravju in okolju neškodljiv na in. Za podrobnejše informacije o tem, kam lahko odpeljete odsluženo opremo na recikliranje, se obrnite na pristojni organ, komunalno službo ali trgovino, kjer ste izdelek kupili.

Spanish notice

Eliminación de residuos de equipos eléctricos y electrónicos por parte de usuarios particulares en la Unión Europea

Este símbolo en el producto o en su envase indica que no debe eliminarse junto con los desperdicios generales de la casa. Es responsabilidad del usuario eliminar los residuos de este tipo depositándolos en un "punto limpio" para el reciclado de residuos eléctricos y electrónicos. La recogida y el reciclado selectivos de los residuos de aparatos eléctricos en el momento de su eliminación contribuirá a conservar los recursos naturales y a garantizar el reciclado de estos residuos de forma que se proteja el medio ambiente y la salud. Para obtener más información sobre los puntos de recogida de residuos eléctricos y electrónicos para reciclado, póngase en contacto con su ayuntamiento, con el servicio de eliminación de residuos domésticos o con el establecimiento en el que adquirió el producto.

Swedish notice

Bortskaffande av avfallsprodukter från användare i privathushåll inom Europeiska Unionen

Om den här symbolen visas på produkten eller förpackningen betyder det att produkten inte får slängas på samma ställe som hushållssopor. I stället är det ditt ansvar att bortskaffa avfallet genom att överlämna det till ett uppsamlingsställe avsett för återvinning av avfall från elektriska och elektroniska produkter. Separat insamling och återvinning av avfallet hjälper till att spara på våra naturresurser och gör att avfallet återvinns på ett sätt som skyddar människors hälsa och miljön. Kontakta ditt lokala kommunkontor, din närmsta återvinningsstation för hushållsavfall eller affären där du köpte produkten för att få mer information om var du kan lämna ditt avfall för återvinning.

Germany noise declaration

Schalldruckpegel Lp = 70 dB(A)

Am Arbeitsplatz (operator position)

Normaler Betrieb (normal operation)

Nach ISO 7779:1999 (Typprüfung)

Japanese notice

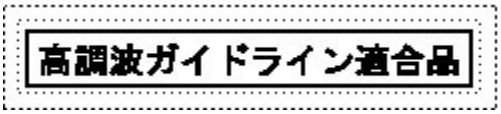
ご使用になっている装置にVCCIマークが付いていましたら、次の説明文をお読み下さい。

この装置は、情報処理装置等電波障害自主規制協議会（VCCI）の基準に基づくクラス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マークが付いていない場合には、次の点にご注意下さい。

この装置は、情報処理装置等電波障害自主規制協議会（VCCI）の基準に基づくクラス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。

Harmonics conformance (Japan)



Taiwanese 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。

Japanese power cord notice

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。

Country-specific certifications

HP tests electronic products for compliance with country-specific regulatory requirements, as an individual item or as part of an assembly. The product label (see Figure 27) specifies the regulations with which the product complies.

NOTE:

Components without an individual product certification label are qualified as part of the next higher assembly (for example, enclosure, rack, or tower).

CXO8157A

Figure 27 Typical enclosure certification label

NOTE:

The certification symbols on the label depend upon the certification level. For example, the FCC Class A certification symbol is not the same as the FCC Class B certification symbol.

B EMU-generated condition reports

This section provides a description of the EMU generated condition reports that contain the following information:

- Element type (*et*), a hexadecimal number in the range *01* through *FF*.
- Element number (*en*), a decimal number in the range *00* through *99* that identifies the specific element with a problem.
- Error code (*ec*), a decimal number in the range *00* through *99* that defines a specific problem.
- The recommended corrective action.

NOTE:

The conventions used to differentiate between the elements of the condition report are:

- Element type—period after each character
- Element number—period after the second character
- Error code—no periods

The EMU can send error messages to the controller for transmission to HP Command View EVA. The messages displayed are specific to HP Command View EVA and are not within the scope of this publication.

The I/O modules have the built-in intelligence to:

- Observe fibre channel events
- Bypass drive ports based on events
- Perform drive port testing and monitoring to prevent poor-performing drives from participating in the loop
- Communicate fibre channel events to the controllers

This appendix explains the condition report format, correcting problems, and how to identify element types. The error codes are arranged in element type sequence (that is, *0.1., 0.2., 0.3., etc.*).

Condition report format

When the EMU alphanumeric display is Er, three additional displays identify the possible cause of the problem: the element type, the specific element, and the error code, which defines the possible cause of the problem.

- The first-level display identifies the type of element affected with two alphanumeric characters separated by periods such as *0.1., 0.2., 1.3., F.F.*, and so forth. A disk drive problem would display an element type number of *0.1*.
- The second-level display identifies the element affected with a two-digit, decimal number followed by a period. For example, when a bay 6 drive error occurs, the element number display is *06.*; a display of *14.* indicates a bay 14 problem.

- The third-level display identifies a specific problem, the error code with a two-digit, decimal number. For example, should the problem be either the installation of an incorrectly configured drive or one that cannot operate at the loop link rate, the display is *01*.

Correcting errors

Correcting an error may require you to perform a specific set of actions. In some cases, the only available corrective action is to replace the element.

Table 20 lists the element type codes assigned to the drive enclosure elements.

Table 20 Assigned element type codes

Code	Element
0.1.	Disk Drives
0.2.	Power Supplies
0.3.	Blowers
0.4.	Temperature Sensors
0.7.	EMU
0.C.	Controller OCP LCD
0.F.	Transceivers
1.0.	Language
1.1.	Communication Port
1.2.	Voltage Sensors
1.	Current Sensors
8.0	Drive Enclosure
8.2.	Drive Enclosure Backplane
8.7.	I/O Modules

Drive conditions

The format of a disk drive condition report is *0.1.en.ec*, where:

- *0.1.* is the disk drive element type number
- *en.* is the two-character disk drive element
- *ec* is the error code

A direct correlation exists between the disk drive element number and the bay number. However, no direct correlation exists between the disk drive bay number and the device Fibre Channel drive enclosure physical address. The Fibre Channel drive enclosure physical address is assigned by negotiation during system initialization.

The following sections define the disk drive error codes.

0.1.en.01 CRITICAL condition—Drive configuration or drive link rate

As each drive spins up and comes on-line, the EMU determines if the drive is Fibre Channel compatible and can operate at the link rate (1 Gbps or 2 Gbps) established by the I/O module. If either of these conditions are not met, the EMU issues the condition report *0.1.en.01*.

The corrective actions for these conditions are:

- When the drive is not Fibre Channel-compatible you must install a Fibre Channel compatible drive or a drive blank.
- When the drive is Fibre Channel-compatible, the EMU compares the drive link rate with the I/O module link rate, the loop link rate.

If the EMU cannot determine the drive link rate, the EMU activates the drive bypass function for one minute. During this time the EMU continually checks the drive to determine the link rate.

- If the EMU determines the drive cannot operate at the Fibre Channel link rate set by the I/O module, the drive bypass function ends and the drive is placed on the loop. This does not generate a condition report.
- The EMU issues the condition report *0.1.en.01* when the drive link rate is incompatible with Fibre Channel link rate.
- When the EMU cannot determine the drive link rate during the one-minute drive bypass time, the EMU places the drive on the loop. This process allows the drive to negotiate for an address.
  - If negotiation indicates the link rates are compatible, the EMU rechecks the drive link rate to verify compatibility.
  - If negotiation indicates the link rates are incompatible, an error condition exists and drive loop data transfers stop.

This condition report remains active until the problem is corrected. The problem affects disk drive en. Therefore, correction to prevent the possible failure of other elements is not required.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Replace the defective drive with:
   - A Fibre Channel-compatible drive.
   - A Fibre Channel drive capable of operating at a link rate supported by I/O modules and transceivers.
3. Observe the EMU to ensure the error is corrected.
4. If unable to correct the problem, contact your authorized service representative.

0.1.en.02 INFORMATION condition—Drive missing

The drive is improperly installed or missing. Either option could affect the enclosure air flow and cause an over temperature condition for another element.

- This error remains active for one minute, or until the problem is corrected, whichever occurs first.
- Immediate correction is not required. However, correction cannot be delayed indefinitely.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Remove and install the drive to ensure that it is properly installed.
3. Observe the EMU to ensure the error is corrected.

4. If removing and installing the drive did not correct the problem, install a replacement drive or a drive blank.
5. Observe the EMU to ensure the error is corrected.
6. If unable to correct the problem, contact your authorized service representative.

0.1.en.03 INFORMATION condition—Drive software lock active

Some enclosures have a software-activated lock that prevents physically removing a drive while this feature is active. This feature can be activated even when an enclosure does not have a physical lock. Removing a drive when this feature is active generates a condition report. This error remains active for 15 seconds.

No action is required to correct this condition.

0.1.en.04 CRITICAL condition—Loop a drive link rate incorrect

The drive is capable of operating at the loop link rate but is running at a different rate. For example, the drive is operating at 1 Gbps, and the loop is operating at 2 Gbps. Only when the drive is operating at the Fibre Channel link rate established by the I/O module can this drive transfer data.

This error remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Remove and replace the drive in the enclosure.
3. Observe the drive status indicators to ensure the drive is operational.
4. Observe the EMU to ensure the error is corrected.
5. If removing and replacing the drive did not correct the problem, replace the drive.
6. Observe the drive status indicators to ensure the drive is operational.
7. Observe the EMU to ensure the error is corrected.
8. If unable to correct the problem, contact your authorized service representative.

0.1.en.05 CRITICAL condition—Loop b drive link rate incorrect

The drive is capable of operating at the loop link rate but is running at a different rate. For example, the drive is operating at 1 Gbps, and the loop is operating at 2 Gbps. Only when the drive is operating at the Fibre Channel link rate established by the I/O module can this drive transfer data.

This error remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Remove and replace the drive in the enclosure.
3. Observe the drive status indicators to ensure the drive is operational.
4. Observe the EMU to ensure the error is corrected.
5. If removing and replacing the drive did not correct the problem, replace the drive.
6. Observe the drive status indicators to ensure the drive is operational.
7. Observe the EMU to ensure the error is corrected.

8. If unable to correct the problem, contact your authorized service representative.

Power supply conditions

The format of a power supply condition report is *0.2.en.ec*, where:

- *0.2.* is the power supply element type number
- *en.* is the two-character power supply element number
- *ec* is the error code

Figure 28 shows the location of power supply 1 and power supply 2.

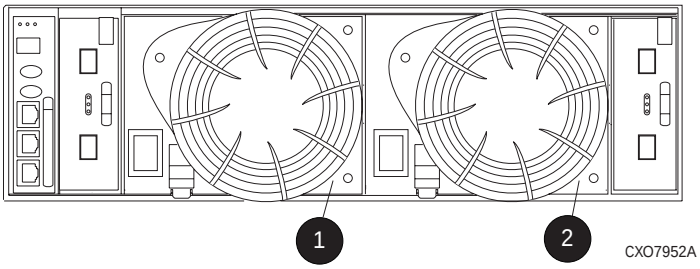


Figure 28 Power supply element numbering

The following sections define the power supply condition reports.

0.2.en.01 NONCRITICAL Condition—Power supply AC input missing

The loss of the AC input to a power supply makes the remaining power supply a single point of failure.

This condition report remains active until AC power is applied to the power supply.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Ensure that there is AC power to the rack PDU, and from the PDU to the PDMs, and that the PDU and PDM circuit breakers are not reset.

   If there is no AC power to the PDU, contact building facilities management.

   Verify that the power supply AC power cord is properly connected.
3. If AC is present, and the rack power distribution circuitry is functioning properly, the power supply indicator should be on.
4. Observe the EMU to ensure the error is corrected.
5. Contact your authorized service representative.

0.2.en.02 UNRECOVERABLE condition—Power supply missing

This condition report indicates a power supply is not installed or installed incorrectly. Both of these conditions affect air flow within the enclosure and can cause an over-temperature condition. Enclosure shutdown is imminent.

The operational power supply will automatically shut down after seven minutes, thereby disabling the enclosure. This condition report remains active until either the problem is corrected, or the operational power supply shuts down, whichever occurs first.

To correct this problem, record all six characters of the condition report, then contact your authorized service representative.

△ CAUTION:

Removing power from an enclosure may cause the loss or corruption of data. To avoid this condition, shut down the system using HP Command View EVA. An automatic shutdown and possible data corruption may result if the power supply is removed before a replacement is available.

0.2.en.03 CRITICAL condition—Power supply load unbalanced

This condition report indicates that a component within a power supply may have failed. This can make the remaining power supply a single point of failure.

This condition report remains active until corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Ensure that the blower on the power supply is functioning properly. If not, correct the blower condition and wait one minute.
3. Contact your authorized service representative.

Blower conditions

The format of a blower condition report is *0.3.en.ec*, where:

- *0.3.* is the blower element type number
- *en.* is the two-character blower element number
- *ec* is the error code

As shown in Figure 29, blower 1 is in location 1 and blower 2 is in location 2.

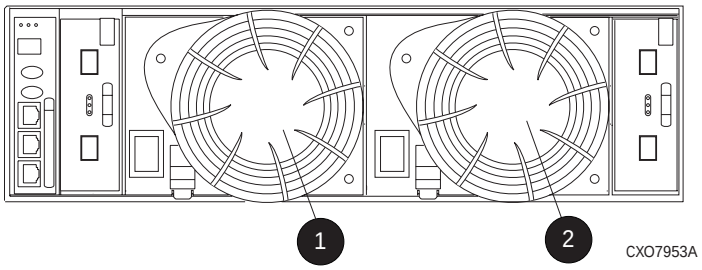


Figure 29 Blower element numbering

△ CAUTION:

A single blower operating at high speed can provide sufficient air flow to cool an enclosure and the elements for up to 100 hours. However, operating an enclosure at temperatures approaching an overheating threshold can damage elements and may reduce the MTBF of a specific element. Immediate replacement of the defective blower is required.

The following sections define the power supply condition reports.

0.3.en.01 NONCRITICAL condition—Blower speed

A blower is operating at a speed outside of the EMU specified range, possibly because of a bearing problem. This can affect enclosure cooling and cause an element to fail. This condition report remains active until the problem is corrected.

This error does not normally require immediate correction. However, an error of this type could contribute to an element overheating.

HP recommends replacing the blower as soon as possible.

To correct this problem, record all six characters of the condition report, then contact your HP authorized service representative.

0.3.en.02 CRITICAL condition—Blower speed

A blower is operating at a speed that is significantly outside the EMU specified range, possibly because of a bearing problem. This can cause the loss of cooling and cause an element to fail. The error remains active until the problem is corrected.

HP recommends replacing the blower as soon as possible.

To correct this problem, record all six characters of the condition report, then contact your authorized service representative.

0.3.en.03 UNRECOVERABLE condition—Blower failure

A blower has stopped. The operational blower now operates at high speed and is a single point of failure. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your authorized service representative.

0.3.en.04 UNRECOVERABLE condition—Blower internal

A power supply reported an internal blower error that could affect enclosure cooling and cause an element to fail. HP recommends correcting the problem before the blower fails. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your HP authorized service representative.

0.3.en.05 NONCRITICAL condition—Blower missing

A blower has been removed or is improperly installed. Even though the blower flaps close to maintain the proper air flow, the reduced cooling capability can cause overheating, causing an element to fail. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your HP authorized service representative.

0.3.en.06 UNRECOVERABLE condition—No blowers installed

NOTE:

IMPORTANT

When this condition exists there will be two error messages.

The first message will be *0.3.en.05* and will identify the first blower.

The second message will be *0.3.en.06* and will identify the second blower.

The EMU cannot detect any installed blowers. *Shutdown is imminent!* The EMU will shut down the enclosure in *seven minutes* unless you correct the problem. This condition report remains active until you correct the problem or the EMU shuts down the power supplies, whichever occurs first.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Use the controller shutdown procedure to shut down the controllers.
3. Contact your authorized service representative.

CAUTION:

An automatic shutdown and possible data corruption may result if the blower is removed before a replacement is available.

Temperature conditions

The format of a temperature condition report is *0.4.en.ec*, where:

- *0.4.* is the temperature sensor element type
- *en.* is the two-character temperature sensor element
- *ec* is the error code

See Table 21 to determine the location of each temperature sensor.

Table 21 Temperature sensor element numbering

Sensor	Sensor location	Sensor	Sensor location
01.	Power Supply 1 Exhaust	10.	Drive Bay 7
02.	Power Supply 2 Exhaust	11.	Drive Bay 8
03.	EMU	12.	Drive Bay 9
04.	Drive Bay 1	13.	Drive Bay 10
05.	Drive Bay 2	14.	Drive Bay 11
06.	Drive Bay 3	15.	Drive Bay 12
07.	Drive Bay 4	16.	Drive Bay 13

Sensor	Sensor location	Sensor	Sensor location
08.	Drive Bay 5	17.	Drive Bay 14
09.	Drive Bay 6		

The following sections list the temperature condition reports and the default temperature thresholds. Use HP Command View EVA to view the temperature sensor ranges for the disk drives, EMU, and power supplies.

0.4.en.01 NONCRITICAL condition—High temperature

This condition report indicates that an element temperature is approaching, but has not reached, the high temperature CRITICAL threshold. Continued operation under these conditions may result in a CRITICAL condition. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Ensure that all elements are properly installed to maintain proper air flow.
3. Ensure that nothing is obstructing the air flow at either the front of the enclosure or the rear of the blower.
4. Ensure that both blowers are operating properly (the indicators are on) and neither blower is operating at high speed.
5. Verify that the ambient temperature range is +10° C to +35° C (+50° F to +95° F). Correct the ambient conditions.
6. Observe the EMU to ensure the error is corrected.
7. If unable to correct the problem, contact your authorized service representative.

0.4.en.02 CRITICAL condition—High temperature

This condition report indicates that an element temperature is above the high temperature CRITICAL threshold. Continued operation under these conditions may result in element failure and may reduce an element MTBF. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Ensure that all elements are properly installed to maintain proper air flow.
3. Ensure that nothing is obstructing the air flow at either the front of the enclosure or the rear of the blower.
4. Ensure that both blowers are operating properly (the indicators are on) and neither blower is operating at high speed.
5. Verify that the ambient temperature range is +10° C to +35° C (+50° F to +95° F). Adjust as necessary.
6. Observe the EMU to ensure the error is corrected.
7. If unable to correct the problem, contact your authorized service representative.

0.4.en.03 NONCRITICAL condition—Low temperature

This condition report indicates that an element temperature is approaching, but has not reached, the low temperature CRITICAL threshold. Continued operation under these conditions may result in a CRITICAL condition. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Verify that the ambient temperature range is +10° C to +35° C (+50° F to +95° F). Adjust as necessary.
3. Observe the EMU to ensure the error is corrected.
4. If the ambient temperature is correct and the problem persists, contact your Authorized Service Representative.

0.4.en.04 CRITICAL condition—Low temperature

This condition report indicates that an element temperature has reached the low temperature CRITICAL threshold. HP recommends correcting this error to prevent affecting other elements. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Verify that the ambient temperature range is +10° C to +35° C (+50° F to +95° F). Adjust as necessary.
3. Observe the EMU to ensure the error is corrected.
4. If the ambient temperature is correct and the problem persists, contact your authorized service representative.

0.4.en.05 UNRECOVERABLE condition—High temperature

This condition report indicates that the EMU has evaluated the temperature of the three temperature groups (EMU, disk drives, and power supplies), and determined that the average temperature of two of the three groups exceeds the critical level (use HP Command View EVA to view the temperature thresholds). Under these conditions the EMU starts a timer that will automatically shut down the enclosure in seven minutes unless you correct the problem. *Enclosure shutdown is imminent!*

△ CAUTION:

An automatic shutdown and possible data corruption may result if the procedure below is not performed *immediately*.

Complete the following procedure to correct this problem.

1. Ensure that all disk drives, I/O modules, and power supply elements are fully seated.
2. Ensure that all blowers are operating properly.
3. Verify that the ambient temperature range is +10° C to +35° C (+50° F to +95° F). Adjust as necessary.

4. If steps 1, 2 or 3 did not reveal a problem, use HP Command View EVA to request the HSV controller to shut down the drive enclosure. Completing this action will halt the drive enclosure data transfers.
5. Contact your authorized service representative and request assistance.

EMU conditions

The format of an EMU condition report is *0.7.01.ec*, where:

- *0.7.* is the EMU element type number
- *01.* is the two-character EMU element number
- *ec* is the error code

NOTE:

There is only one EMU in a drive enclosure. Therefore, the element number is always 01.

Resetting the EMU

In some cases, the only corrective action for an EMU error is to replace the EMU. Call your authorized service representative if this action is required. Another option is to reset the EMU using the following procedure.

1. Firmly grasp the EMU mounting handle and pull the EMU partially out of the enclosure.

NOTE:

You do not need to remove the EMU from the enclosure or disconnect the cables. You must avoid putting any strain on the cables or connectors.

2. Wait 30 seconds, and then push the EMU in and fully seat the element in the backplane. The EMU should display any enclosure condition report within two minutes.

07.01.01 CRITICAL condition—EMU internal clock

There is an internal EMU clock error that will remain active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Reset the EMU.
3. If resetting the EMU did not correct the problem, replace the EMU.
4. Observe the EMU to ensure the error is corrected.
5. If unable to correct the problem, contact your HP authorized service representative.

07.01.02 UNRECOVERABLE condition—EMU interrupted

The Inter-IC (I2C) bus is not processing data and the EMU is unable to monitor or report the status of the elements or enclosures. *IMMEDIATE* corrective action is required to ensure proper enclosure operation. This condition report remains active until the problem is corrected.

Complete the following procedure *NOW* to correct this problem.

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error is corrected.
4. If resetting the EMU did not correct the problem, replace the EMU.
5. If unable to correct the problem, contact your HP authorized service representative.

0.7.01.03 UNRECOVERABLE Condition—Power supply shutdown

This message only appears in HP Command View EVA to report a power supply has already shut down. This message can be the result of the controller shutdown command or an EMU or power supply initiated power shutdown.

This message cannot be displayed until after restoration of power. Therefore, there is no corrective action required.

0.7.01.04 INFORMATION condition—EMU internal data

The EMU is unable to collect data for the SCSI-3 Engineering Services (SES) page. This condition report remains active for 15 seconds. The condition report affects only internal EMU operations. There is no degradation of enclosure operations.

The EMU initiates automatic recovery procedures.

If the problem is not automatically corrected after one minute, contact your HP authorized service representative.

0.7.01.05 UNRECOVERABLE condition—Backplane NVRAM

NOTE:

IMPORTANT

Backplane NVRAM errors usually occur during manufacture. At this time they are identified and corrected. They rarely occur during normal operation.

When a backplane NVRAM is not programmed or cannot be read by the EMU, there is no communication with the disk drives. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error is corrected.
4. If resetting the EMU did not correct the problem, contact your HP authorized service representative.

0.7.01.10 NONCRITICAL condition—NVRAM invalid read data

The data read from the EMU NVRAM is invalid. This error initiates an automatic recovery process. This condition report remains active until the problem is corrected.

If the automatic recovery process does not correct the problem, complete the following procedure.

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error is corrected.
4. If resetting the enclosure did not correct the problem, contact your HP authorized service representative.

0.7.01.11 NONCRITICAL condition—EMU NVRAM write failure

The EMU cannot write data to the NVRAM. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error is corrected.
4. If resetting the enclosure did not correct the problem, contact your HP authorized service representative.

0.7.01.12 NONCRITICAL condition—EMU cannot read NVRAM data

The EMU is unable to read data from the NVRAM. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error is corrected.
4. If resetting the enclosure did not correct the problem, contact your HP authorized service representative.

0.7.01.13 UNRECOVERABLE condition—EMU load failure

The EMU Field Programmable Gate Array (FPGA) that controls the ESI bus failed to load information required for EMU operation. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error is corrected.
4. If resetting the enclosure did not correct the problem, contact your HP authorized service representative.

0.7.01.14 NONCRITICAL condition—EMU enclosure address

Either the enclosure address is incorrect or the enclosure has no address. Possible causes include a defective enclosure address bus cable, an incorrectly connected cable, or a defective enclosure

address bus enclosure ID expansion cable. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Remove and reconnect the cable between the address bus enclosure ID expansion cable and the EMU.

NOTE:

The EMU display may not display a change in condition for up to 30 seconds.

3. Observe the EMU to ensure the error is corrected.
4. If the problem is not corrected, remove and reinstall the lower and upper terminators, and all the enclosure ID expansion cable-to-enclosure ID expansion cables.
5. Observe the EMU to ensure the error is corrected.
6. Reset the EMU, then observe the EMU to ensure the error is corrected.
7. If resetting the EMU did not correct the problem, contact your HP authorized service representative.

0.7.01.15 UNRECOVERABLE condition—EMU hardware failure

The EMU has detected an internal hardware problem. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error does not recur within the first minute.
4. If the error does recur, contact your HP authorized service representative. The EMU is inoperative and must be replaced as soon as possible.

0.7.01.16 INFORMATION condition—EMU internal ESI data corrupted

The EMU ESI data is corrupted. This condition does not affect any other element and no action is required.

0.7.01.17 UNRECOVERABLE condition—Power shutdown failure

The power supply did not respond to a controller, EMU, or power supply shut down command. Shutting down the supply is required to prevent overheating.

Complete the following procedure to correct the problem:

1. Record all six characters of the condition report.
2. Move the power cord bail lock 1, Figure 30, to the left.

3. Disconnect the AC power cord 2 from the supply.

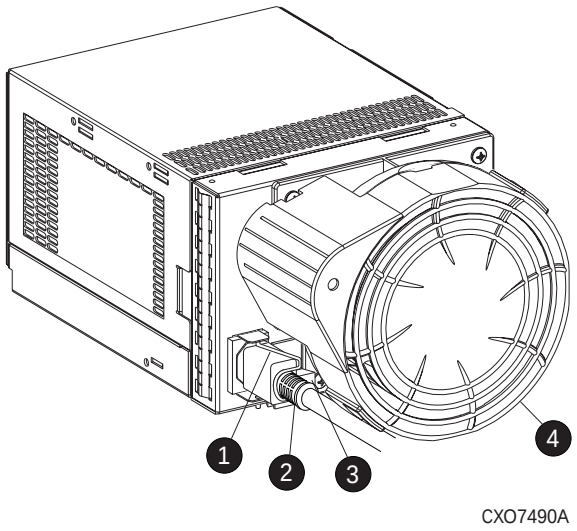


Figure 30 Disconnecting AC power

0.7.01.18 UNRECOVERABLE condition—EMU hardware failure

The EMU has detected an internal hardware problem. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error does not recur within the first minute.
4. If the error does recur, contact your HP authorized service representative. The EMU is inoperative and must be replaced as soon as possible.

0.7.01.19 UNRECOVERABLE condition—EMU ESI driver failure

The EMU has detected an internal hardware problem. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error does not recur within the first minute.
4. If the error does recur, contact your HP authorized service representative. The EMU is inoperative and must be replaced as soon as possible.

Transceiver conditions

The format of a transceiver condition report is *0.F.en.ec*, where:

- *0.F.* is the transceiver element type number
- *en.* is the two-character transceiver element number (see Figure 31)

- *ec* is the error code

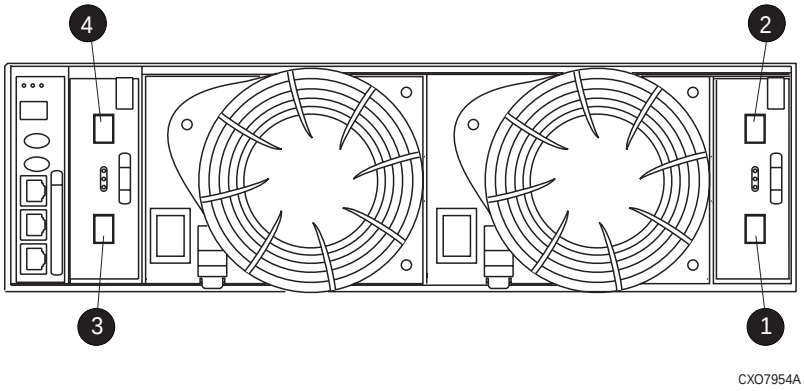


Figure 31 Transceiver element numbering

1. Transceiver 01
2. Transceiver 02
3. Transceiver 03
4. Transceiver 04

0.F.en.01 CRITICAL condition—Transceiver incompatibility

The transceivers on this link are not the same type or they are incompatible with the I/O module. This error prevents the controller from establishing a link with the enclosure disk drives and eliminates the enclosure dual-loop capability. This error remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your HP authorized service representative.

0.F.en.02 CRITICAL condition—Transceiver data signal lost

This symptom can occur when a controller has been powered off or a cable has been removed from the transceiver. The transceiver can no longer detect a data signal. This error prevents the controller from transferring data on a loop and eliminates the enclosure dual-loop capability. This error remains active until the problem is fixed.

To correct this problem, record all six characters of the condition report, then contact your HP authorized service representative.

0.F.en.03 CRITICAL condition—Transceiver fibre channel drive enclosure bus fault

The system has detected a Fibre Channel drive enclosure bus fault involving a transceiver. This error prevents the controller from transferring data on a loop and eliminates the enclosure dual-loop capability.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Check all the transceivers and cables to ensure they are properly connected.
3. Check all the transceivers on the loop to ensure they are compatible with the I/O module.
4. If the problem persists, contact your HP authorized service representative.

0.F.en.04 CRITICAL condition—Transceiver removed

The EMU detects that a transceiver has been removed. This error remains active until the problem is fixed.

The error can be cleared by doing one of the following:

1. Install a new transceiver,

   or

   Reconfigure the system by moving from a loop topology to one with Vixel switches. This change makes the transceiver is unnecessary.
2. Clear the error by resetting the EMU or by removing and then re-installing the I/O module.

0.F.en.05 CRITICAL condition—Invalid fibre channel character

This symptom can occur under the following conditions:

- The incoming data stream is corrupted.
- A cable is not completely connected.
- The signal is degraded.

This error prevents the controller from transferring data on a loop and eliminates the enclosure dual-loop capability. This error remains active until the problem is fixed.

To correct this problem, record all six characters of the condition report, then contact your HP authorized service representative.

CAN bus communication port conditions

The format of a CAN bus communication port report is *1.1.03.ec* , where:

- *1.1.* is the communication port element type
- *03.* is the two-character CAN bus element number
- *ec* is the error code

NOTE:

The only communication port for which conditions are reported is the CAN bus. Therefore, the element number is always 03.

Resetting the EMU

In some cases, the only corrective action for an EMU error is to replace the EMU. Call your authorized service representative if this action is required. Another option is to reset the EMU using the following procedure:

1. Firmly grasp the EMU mounting handle and pull the EMU partially out of the enclosure.

NOTE:

You do not need to remove the EMU from the enclosure or disconnect the cables. You must avoid putting any strain on the cables or connectors.

2. Wait 30 seconds, and then push the EMU in and fully seat the element in the backplane. The EMU should display any enclosure condition report within two minutes.

1.1.03.01 NONCRITICAL condition—Communication error

This condition report indicates that the EMU is unable to communicate over the CAN bus. Continued operation under these conditions may result in the failure to restore loop functionality when there is a disk drive disrupting the loop. This error initiates an automatic recovery process. This condition report remains active until the automatic recovery process is complete or until the EMU is reset.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error does not recur within the first minute.
4. If the error does recur, contact your HP authorized service representative. The EMU is inoperative and must be replaced as soon as possible.

1.1.03.02 INFORMATION condition—Recovery completed

This condition report notes completion of the automatic recovery initiated by the occurrence of the 1.1.03.01 condition. This condition report remains active until one of the following occurs:

- 90 seconds elapses
- The CURRENT ALARM QUEUE is read via SES
- The RECENT ALARM LOG is read via SES

No action is required.

1.1.03.03 INFORMATION condition—Overrun recovery

This condition report notes automatic recovery initiated by the occurrence of too many data overruns with respect to received messages on the CAN bus. This condition report remains active until one of the following occurs:

- 90 seconds elapses
- The CURRENT ALARM QUEUE is read via SES
- The RECENT ALARM LOG is read via SES

No action is required.

Voltage sensor and current sensor conditions

The format of these sensor condition reports is *1.2.en.ec* for a voltage sensor, and *1.3.en.ec* for a current sensor, where:

- *1.2.* is the voltage sensor element type
- *1.3.* is the current sensor element type number
- *en.* is the sensor element number
- *ec* is the error code

Table 22 lists the location of the power supply voltage and current sensors.

Table 22 Voltage and current sensor locations

Sensor	Sensor Element Location
01.	Power Supply 1 +5 VDC
02.	Power Supply 1 +12 VDC
03.	Power Supply 2 +5 VDC
04.	Power Supply 2 +12 VDC

Use HP Command View EVA to view the voltage and current error thresholds for both +5 VDC and +12 VDC power supplies.

1.2.en.01 NONCRITICAL condition—High voltage

This condition report indicates that an element voltage is approaching, but has not reached, the high voltage CRITICAL threshold. Continued operation under these conditions may result in a CRITICAL condition. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your HP-authorized service representative.

1.2.en.02 CRITICAL condition—High voltage

This condition report indicates that an element voltage has reached the high voltage CRITICAL threshold. This report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your HP-authorized service representative.

1.2.en.03 NONCRITICAL condition—Low voltage

This condition report indicates that an element voltage is approaching, but has not reached, the low voltage CRITICAL threshold. Continued operation under these conditions may result in a CRITICAL condition. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your HP-authorized service representative.

1.2.en.04 CRITICAL condition—Low voltage

This condition report indicates that an element voltage has reached the low voltage CRITICAL threshold. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your HP-authorized service representative.

1.3.en.01 NONCRITICAL condition—High current

This condition report indicates that an element current is approaching, but has not reached, the high current CRITICAL threshold. Continued operation under these conditions may result in a CRITICAL condition. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your HP-authorized service representative.

1.3.en.02 CRITICAL condition—High current

This condition report indicates that an element current has reached the high current CRITICAL threshold. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your HP-authorized service representative.

Backplane conditions

IMPORTANT:

Backplane NVRAM errors usually occur during manufacture. At this time they are identified and corrected. They rarely occur during normal operation.

The format of a backplane condition report is *8.2.01.ec*, where:

- *8.2.* is the backplane element type number
- *01.* is the two-character backplane element number
- *ec* is the error code

The only corrective action available for this error is to replace the drive enclosure.

8.2.01.10 NONCRITICAL condition—Backplane NVRAM read

An invalid NVRAM read occurred and an automatic recovery process has begun. This condition report is active for 15 seconds.

If the automatic recovery process does not correct the problem, record all six characters of the condition report, then contact your HP-authorized service representative.

8.2.01.11 NONCRITICAL condition—Backplane NVRAM write failure

The system is unable to write data to the NVRAM. This problem prevents communication between elements in the enclosure. This condition report is active for 15 seconds.

To correct this problem, record all six characters of the condition report, then contact your HP-authorized service representative.

8.2.01.12 NONCRITICAL condition—Backplane NVRAM read failure

The system is unable to read data from the NVRAM. This problem prevents communication between elements in the enclosure. This condition report is active for 15 seconds.

To correct this problem, record all six characters of the condition report, then contact your HP-authorized service representative.

8.2.01.13 NONCRITICAL condition—Backplane WWN is blank

The system is unable to read valid data from the NVRAM. This report is active until corrected. This condition can result in incorrect device location data being displayed.

To correct this problem, record all six characters of the condition report, then contact your HP-authorized service representative.

I/O Module conditions

The format of an I/O module condition report is *8.7.en.ec*, where:

- *8.7.* is the I/O module element type number
- *en.* is the two-character I/O module element number (see Figure 32)
- *ec* is the error code

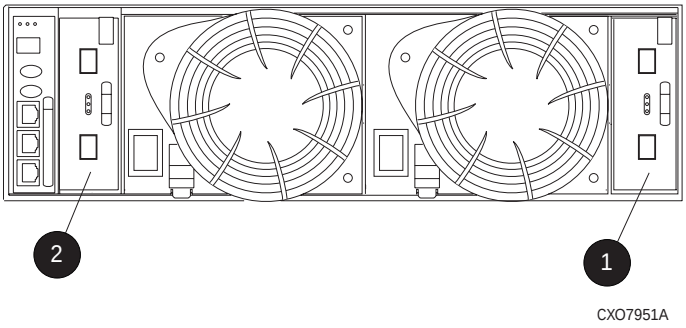


Figure 32 I/O module element numbering

1. I/O Module A (01)
2. I/O Module B (02)

Correction of an I/O module problem normally requires replacing the module. The following sections define the I/O module problem by I/O module location.

8.7.en.01 CRITICAL condition—I/O module unsupported

The I/O module Fibre Channel link speed is not supported by the backplane. This error prevents the controller from establishing a link with enclosure drives and eliminates the enclosure dual-loop capability. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your HP-authorized service representative.

8.7.en.02 CRITICAL condition—I/O module communication

The I/O module is unable to communicate with the EMU.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.

2. Contact your HP-authorized service representative.

IMPORTANT:

Multiple erroneous error messages indicating I2C bus errors, such as NVRAM errors, blowers missing, and so forth, could indicate an EMU problem.

8.7.en.10 NONCRITICAL condition—I/O module NVRAM read

An invalid NVRAM read occurred and automatic recovery was initiated.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Observe the I/O module status indicators for an operational display.
3. Contact your HP-authorized service representative.

8.7.en.11 NONCRITICAL condition—I/O module NVRAM write

The system is unable to write data to the I/O module NVRAM.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Observe the I/O module status indicators for an operational display.
3. Contact your HP-authorized service representative.

8.7.en.12 NONCRITICAL condition—I/O Module NVRAM read failure

The system is unable to read data from the I/O module NVRAM.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.
2. Contact your HP-authorized service representative.

8.7.en.13 NONCRITICAL condition—I/O module removed

The system detects that an I/O module has been removed.

To correct the problem, install an I/O module.

Host conditions

The EMU has the capability of displaying host controller defined condition reports on the EMU alphanumeric display.

The format of a host condition report is *F.F.en.ec*, where:

- *F.F.* is the host element type number
- *en.* is the two-character host element number
- *ec* is the error code

The host controller can display host controller defined error codes on the EMU alphanumeric display

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 Command View EVA 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 Command View EVA 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 Command View EVA for fault information.

Using HP Command View EVA

HP Command View EVA 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) 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.

Date	Time	SWCID	Evt No	Code Flag	Description

Figure 33 GUI termination event display

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 34) 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 34 Typical HP Command View EVA Event display

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 Command View EVA 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 19 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.

Information type	Description
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 35 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.

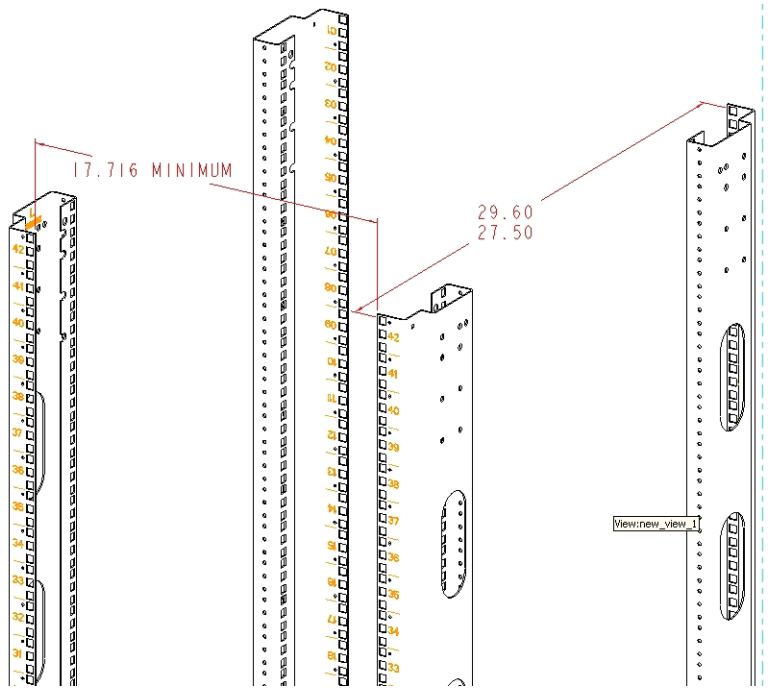


Figure 35 Mounting space dimensions

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 27.5 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 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:

$$d_{component}W = d_{system\ cg}W$$

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
XL 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 are available for use with the EVA and are included in this comparison. Table 26 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 and Table 28.

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

UPS Model	Capacity (in watts)
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

Enclosures	Watts	% of UPS capacity	
		R5500	R12000
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 lists the product operating shock and vibration specifications. This information applies to products weighing 45 Kg (100 lbs) or less.

NOTE:

HP StorageWorks EVA products are designed and tested to withstand the operational shock and vibration limits specified in Table 29. 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.
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 2003 (32-bit), Novell NetWare, 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 VCS 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 StorageWorks 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 36 and Figure 37 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 37, servers with OpenVMS or Tru64 UNIX operating system should be zoned with two controllers.

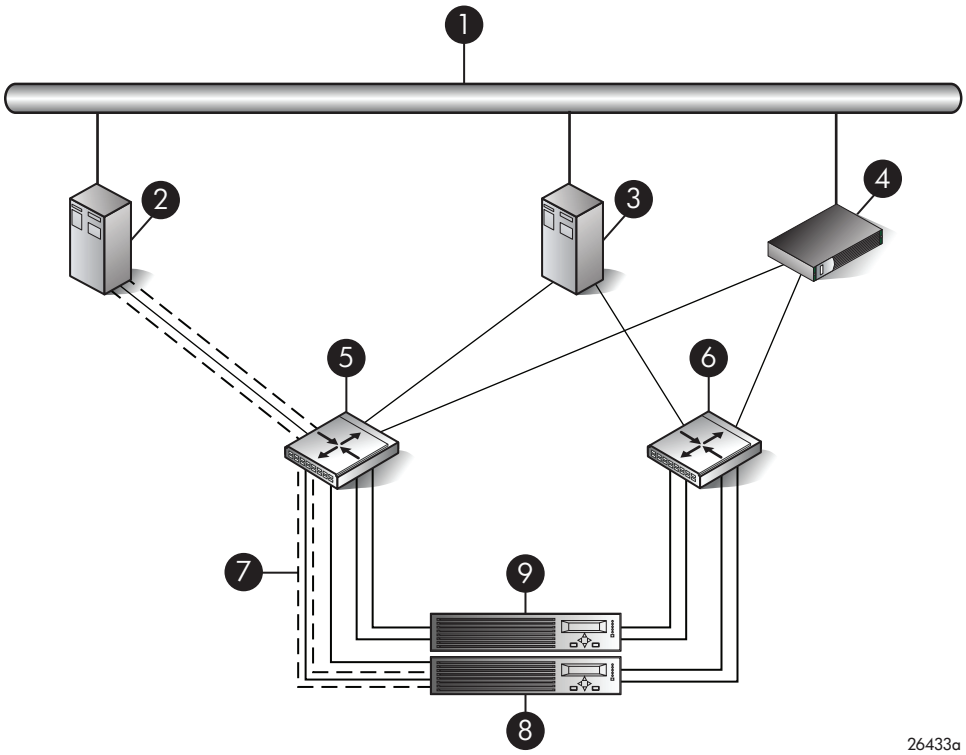


Figure 36 Single path HBA server without OpenVMS or Tru64 UNIX

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

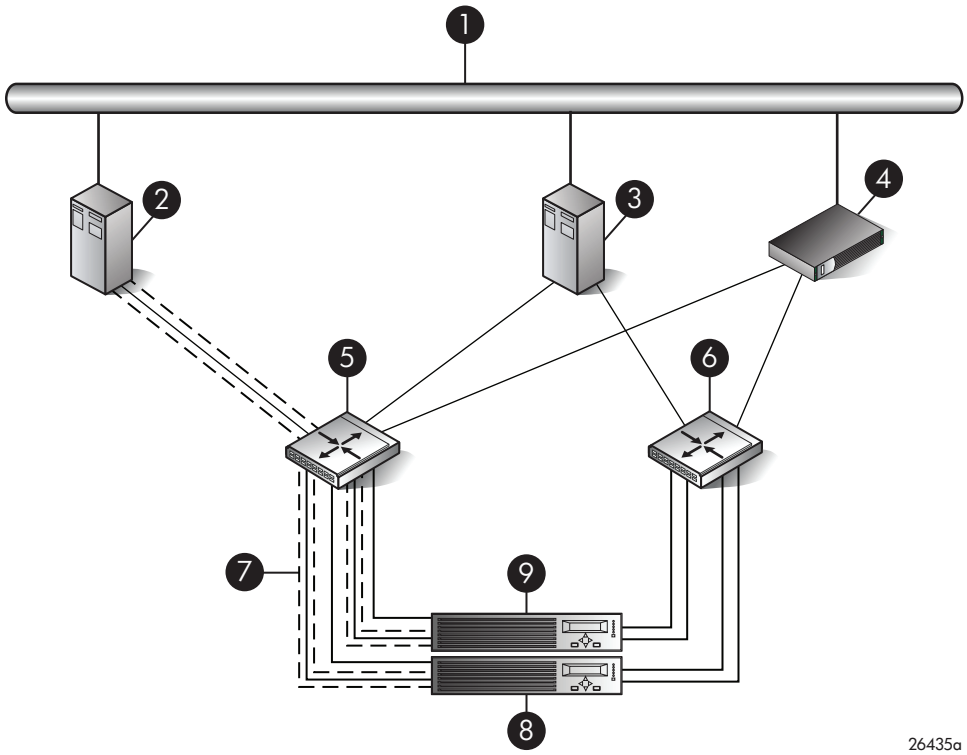


Figure 37 Single path HBA server with OpenVMS or Tru64 UNIX

1 Network interconnection	6 SAN switch 2
2 Single HBA server	7 Fabric zone
3 Dual HBA server	8 Controller A
4 Management server	9 Controller B
5 SAN switch 1	

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 38.

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 Table 30 on page 150.

Limitations

- HP Continuous Access EVA is not supported with single-path configurations.
- Single path HBA server is not part of a cluster.
- Booting from the SAN is not supported.

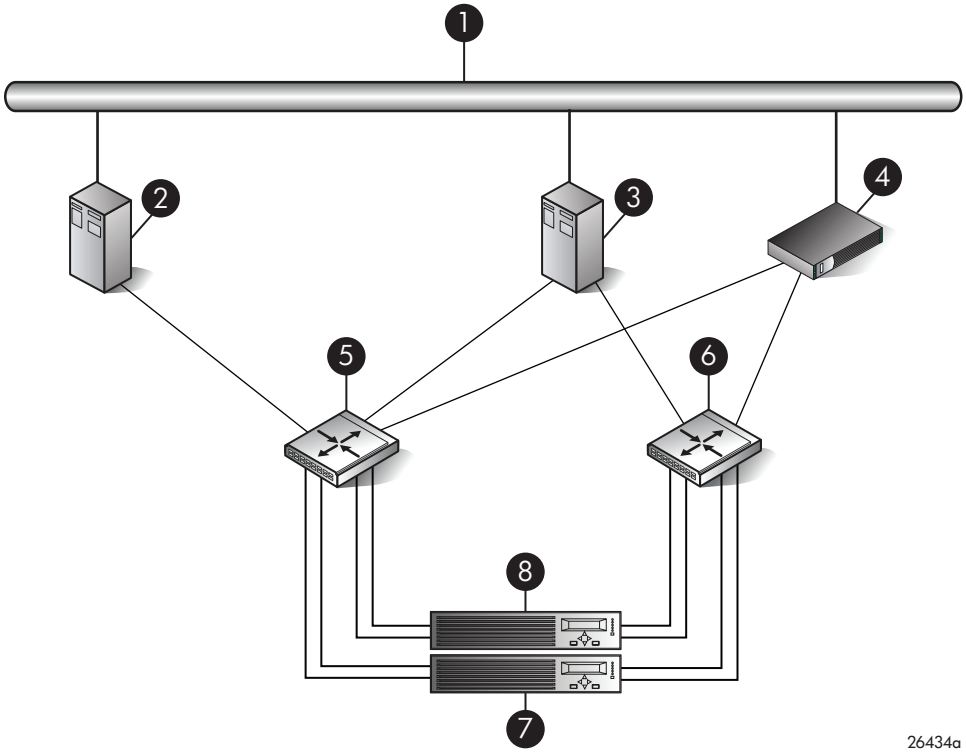


Figure 38 HP-UX configuration

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

Windows Server 2003 (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 39.

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 Table 31 on page 150.

Limitations

- HP Continuous Access EVA 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.

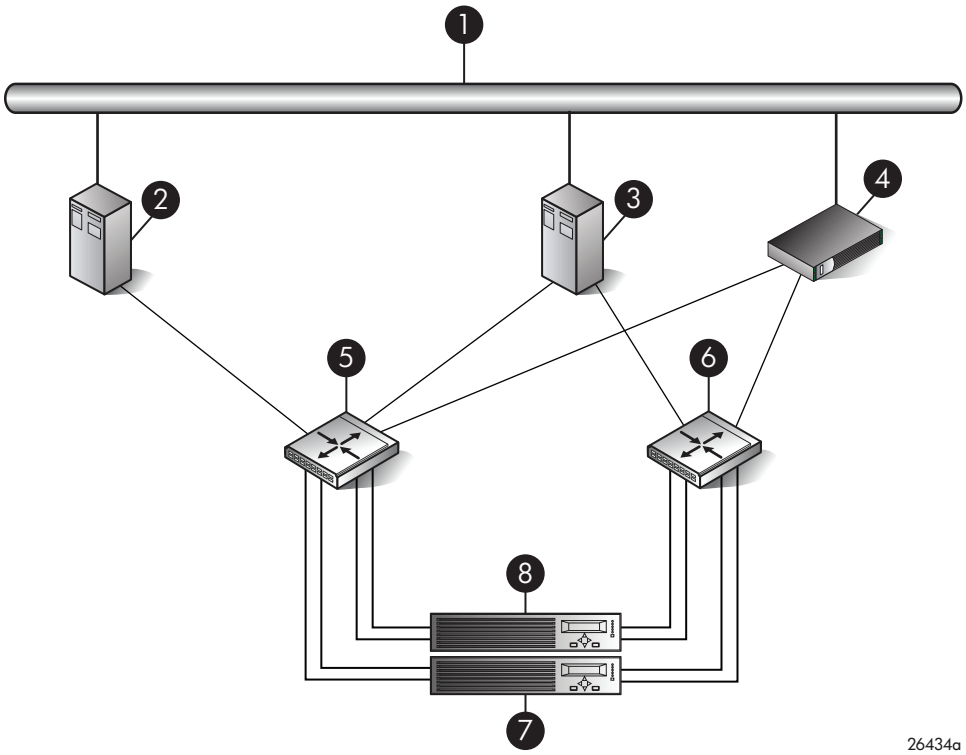


Figure 39 Windows Server 2003 (32-bit) configuration

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

Windows Server 2003 (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 40.

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 Table 31 on page 150.

Limitations

- HP Continuous Access EVA 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.

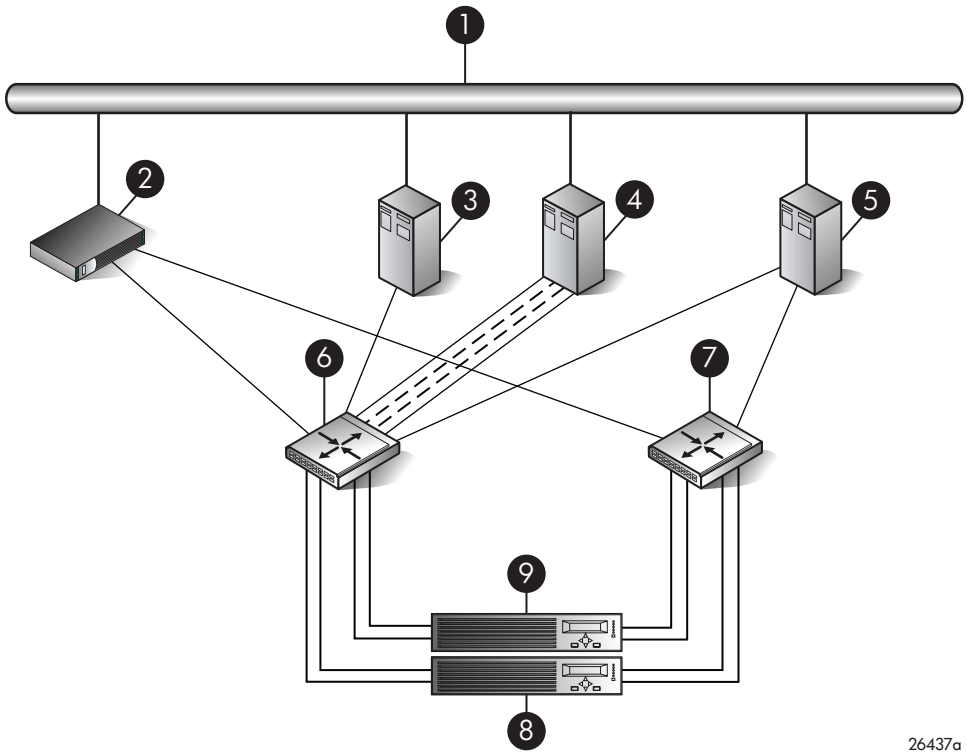


Figure 40 Windows Server 2003 (64-bit) configuration

1 Network interconnection

6 SAN switch 1

2 Management server

3 Host 1

4 Host 2

5 Host 3

7 SAN switch 2

8 Controller A

9 Controller B

SUN 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 must be properly configured to work in a single HBA server configuration. The user is required to:
  - Download and extract the contents of the TAR file.

HBA configuration

- Host 1 is a single path HBA host.
- Host 2 is a multiple HBA host with multi-pathing software.

See Figure 41.

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 Table 32 on page 151.

Limitations

- HP Continuous Access EVA is not supported with single path configurations.
- Single path HBA server is not part of a cluster.
- Booting from the SAN is not supported.

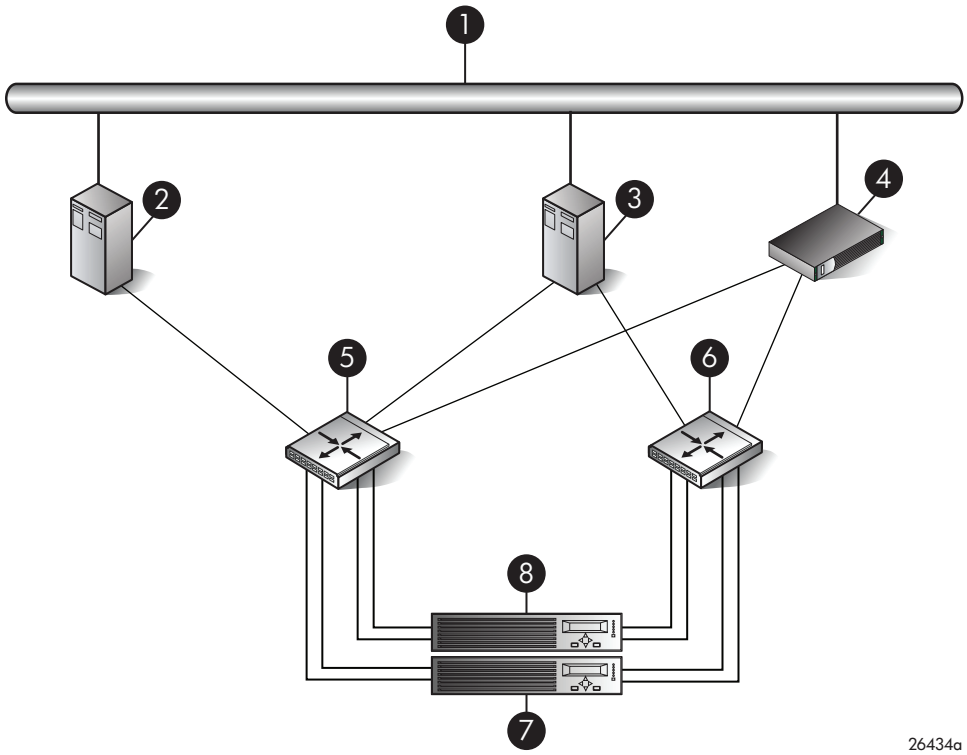


Figure 41 SUN Solaris configuration

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 42.

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 Table 33 on page 151.

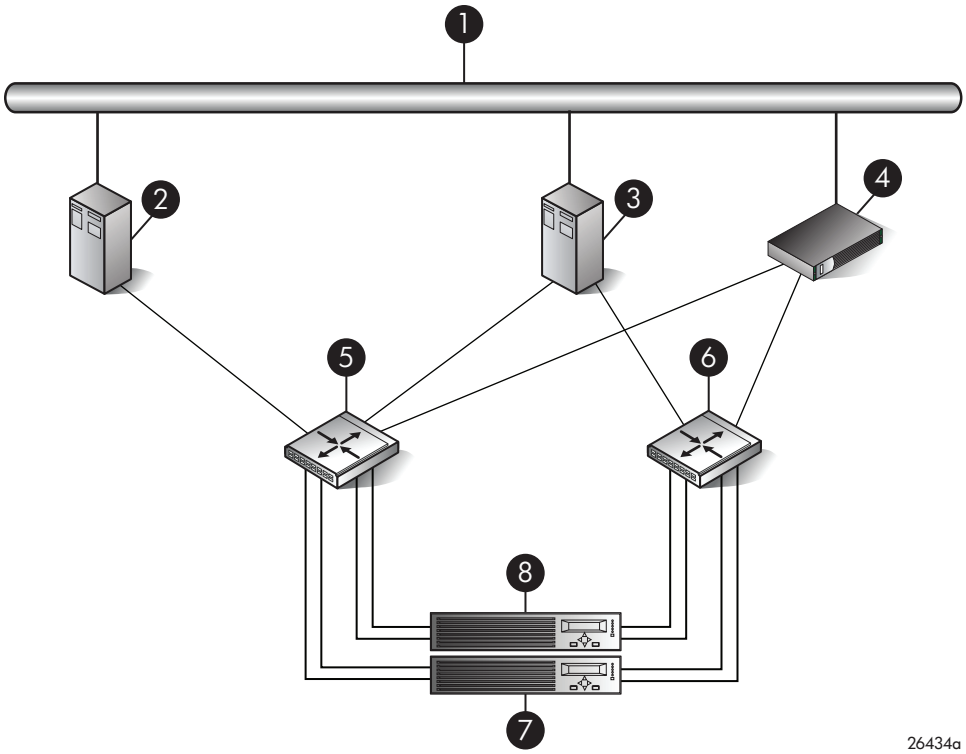


Figure 42 Tru64 UNIX configuration

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

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 43.

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 Table 33 on page 151.

Limitations

- HP Continuous Access EVA is not supported with single path configurations.

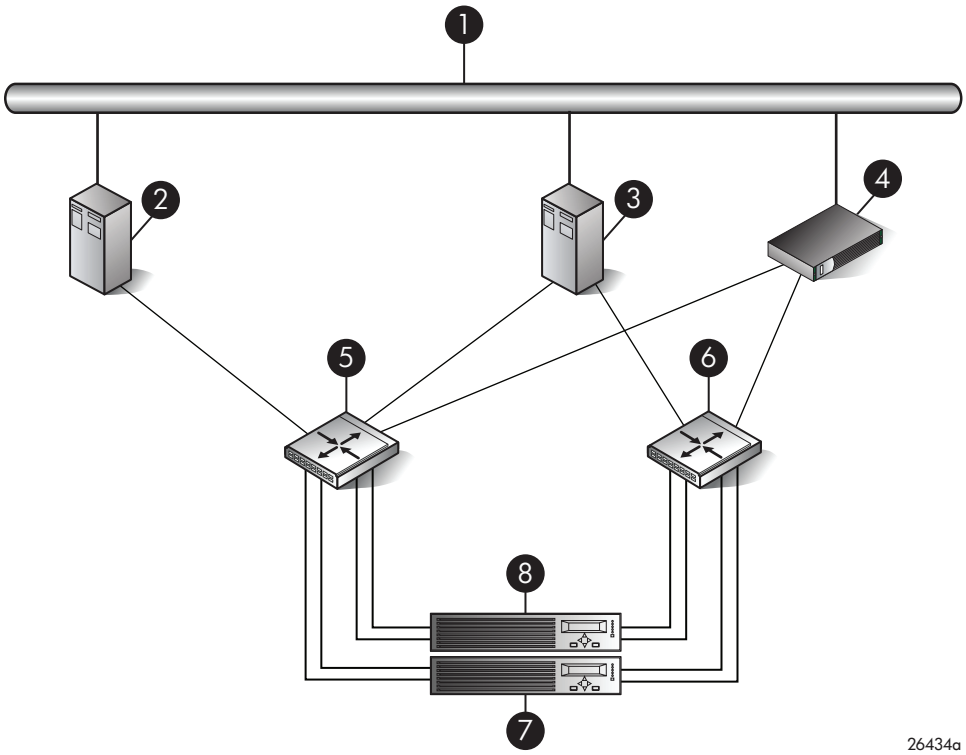


Figure 43 OpenVMS configuration

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

NetWare 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 cannot share LUNs with any other HBAs.

HBA configuration

- Host 1 is a single path HBA host with NetWare.
- Host 2 is a dual HBA host with multi-pathing software.

See Figure 44.

Risks

- Single-path failure will result in a loss of connection with storage devices.

NOTE:

For additional risks, see Table 34 on page 152.

Limitations

- HP Continuous Access EVA 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.

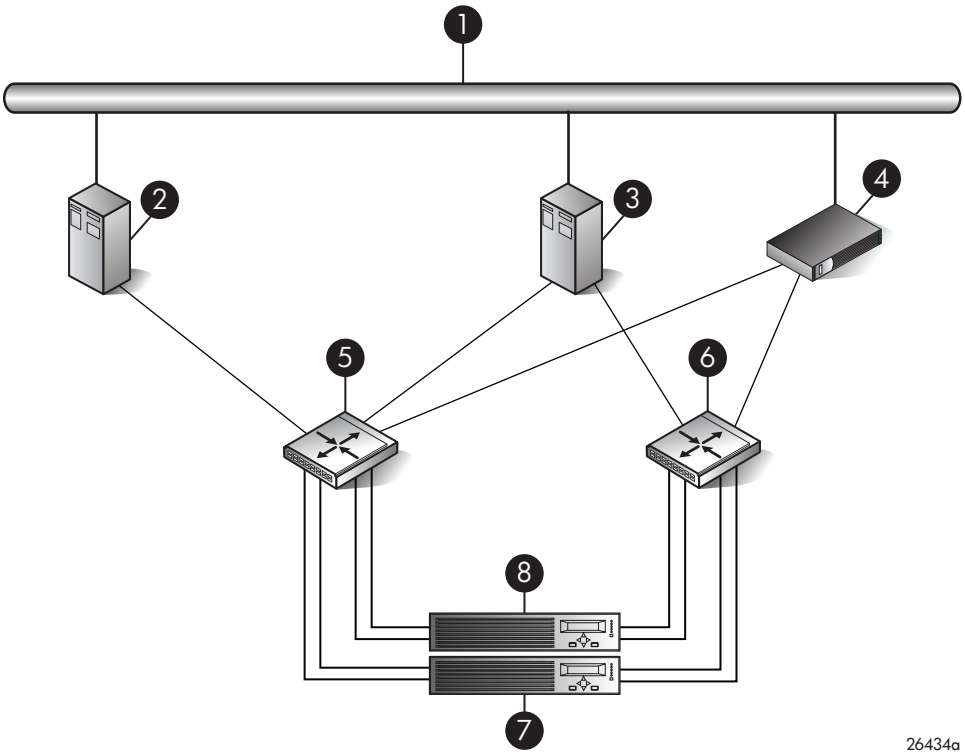


Figure 44 NetWare configuration

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

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 45.

Risks

- Single path failure may result in data loss or disk corruption.

NOTE:

For additional risks, see Table 35 on page 153.

Limitations

- HP Continuous Access EVA 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.

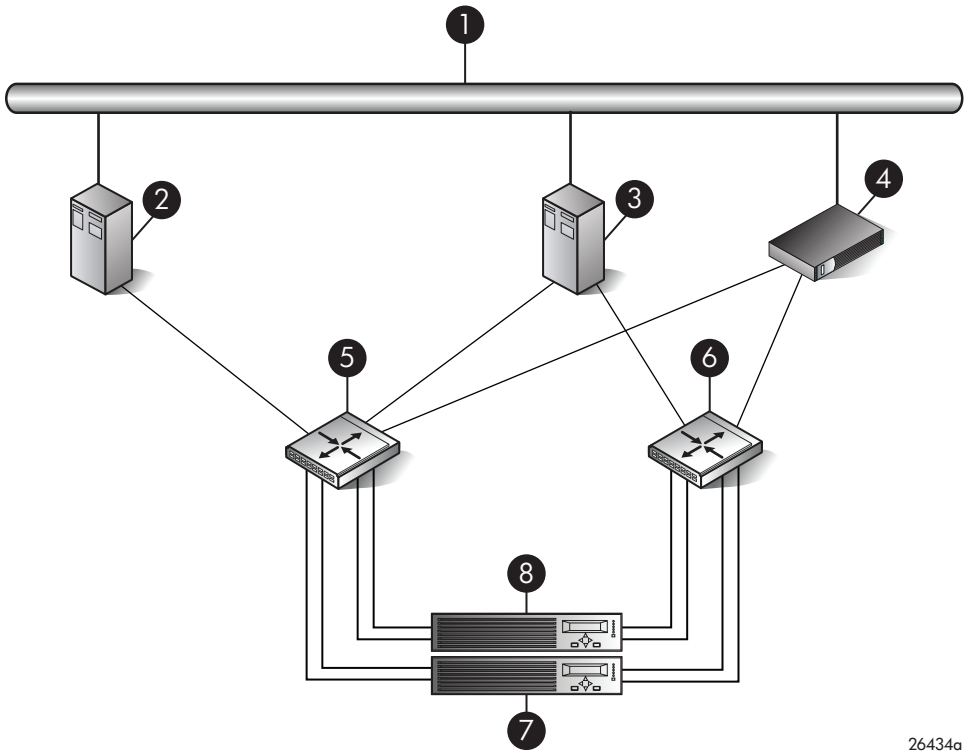


Figure 45 Linux (32-bit) configuration

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

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 46.

Risks

- Single path failure may result in data loss or disk corruption.

NOTE:

For additional risks, see Table 35 on page 153.

Limitations

- HP Continuous Access EVA 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.

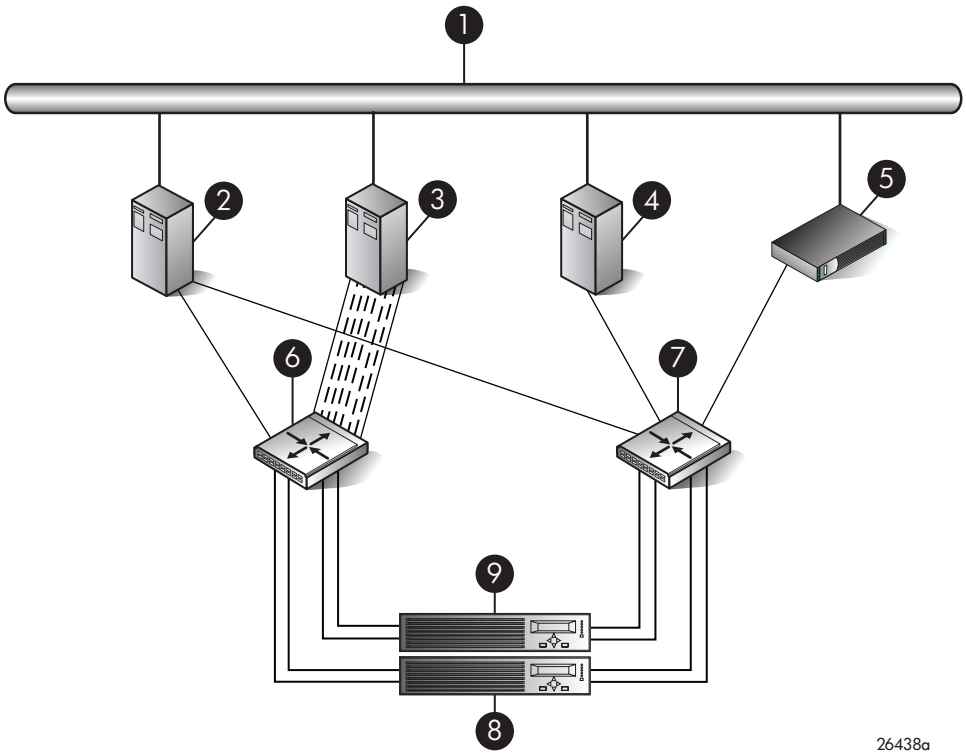


Figure 46 Linux (64-bit) configuration

1 Network interconnection	6 SAN switch 1
2 Host 3	7 SAN switch 2
3 Host 2	8 Controller A
4 Host 1	9 Controller B
5 Management server	

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 47.

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 Table 36 on page 153.

Limitations

- HP Continuous Access EVA is not supported with single path configurations.
- Single path HBA server is not part of a cluster.
- Booting from the SAN is not supported.

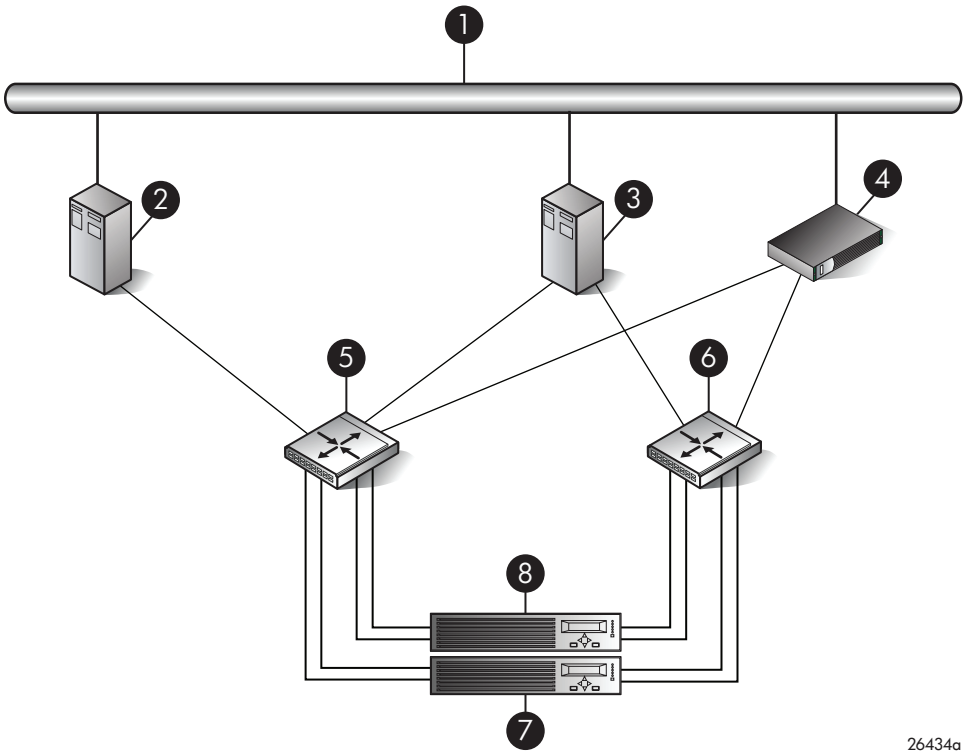


Figure 47 IBM AIX Configuration

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 48.

Risks

- Single path failure may result in data loss or disk corruption.

NOTE:

For additional risks, see Table 37 on page 154.

Limitations

- HP Continuous Access EVA 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.

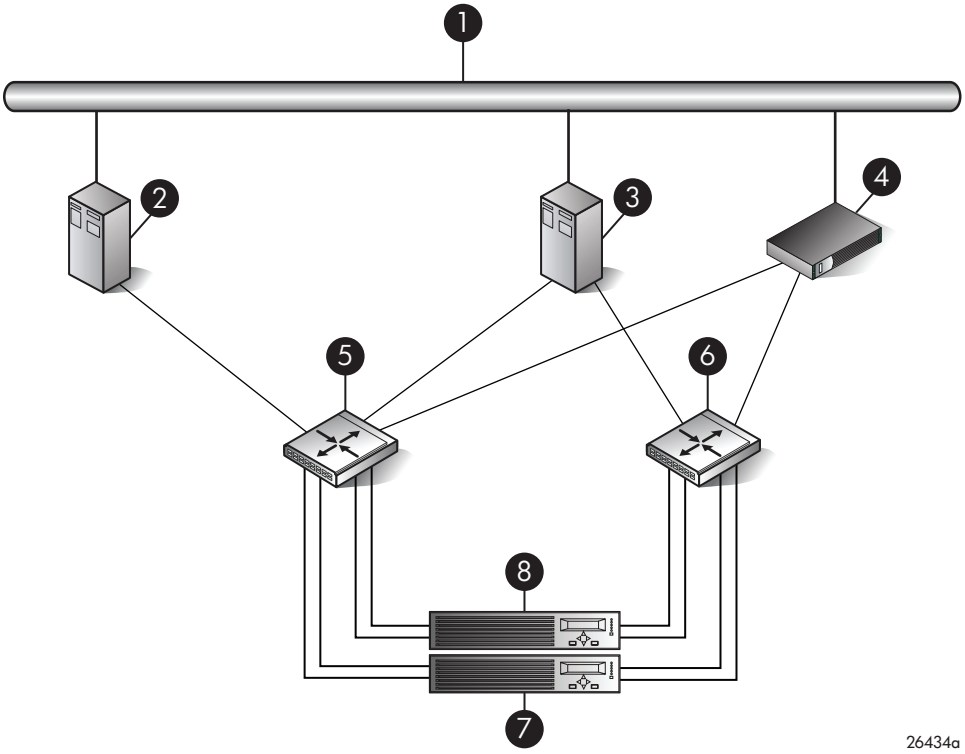


Figure 48 VMware configuration

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

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. 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. 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. Long term: Job hangs, cannot umount disk, fsck failed, disk corrupted, need mkfs disk.
Server path failure	Short term: Data transfer stops. Possible I/O errors. 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. Long term: Job hangs, replace cable, I/O continues. Without cable replacement job must be aborted; disk seems error free.

Windows Server 2003

Table 31 Windows Server 2003 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.

Sun Solaris

Table 32 Sun 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. 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. 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. 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. 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. 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. 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. 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.

Fault stimulus	Failure effect
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. 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. Tru64 UNIX—I/O fails over to the surviving path. No data is lost or corrupted.

NetWare

Table 34 NetWare failure scenarios.

Fault stimulus	Failure effect
Server failure (host power-cycled)	OS reboots. When mounting volumes, volume repair or NSS rebuild executes to cleanup volumes. Data loss, data that finished writing survived.
Switch failure (SAN switch disabled)	I/O to device stops with I/O errors indicated on server console. Applications using lost connection halts. Server restart recommended but may not be necessary. Volume repair or NSS rebuild runs when volumes are mounted.
Controller failure	I/O to device stops with I/O errors indicated on server console. Applications using lost connection halts. Server restart recommended but may not be necessary. Volume repair or NSS rebuild runs when volumes are mounted.
Controller restart	I/O to device stops with I/O errors indicated on server console. Applications using lost connection halts. Server restart recommended but may not be necessary. Volume repair or NSS rebuild runs when volumes are mounted.
Server path failure	I/O to device stops with I/O errors indicated on server console. Applications using lost connection halts. Server restart recommended but may not be necessary. Volume repair or NSS rebuild runs when volumes are mounted.
Storage path failure	I/O to device stops with I/O errors indicated on server console. Applications using lost connection halts. Server restart recommended but may not be necessary. Volume repair or NSS rebuild runs when volumes are mounted.

Linux

Table 35 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. 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. 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. 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.
Server path failure	Short: I/O suspended, possible data loss. 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. 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 36 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. 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. Long term: Repeated error messages in errpt output. System reboot causes loss of data on disk. Must crfs disk.

Fault stimulus	Failure effect
Controller restart	Short term: Data transfer stops. Possible I/O errors. 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. 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. Long term: Repeated error messages in errpt output. System reboot causes loss of data on disk. Must crfs disk.

VMware

Table 37 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. 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. 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. 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.
Server path failure	Short: I/O suspended, possible data loss. 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. 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.

µm — A symbol for micrometer; one millionth of a meter. For example, 50 µm is equivalent to 0.000050 m.

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 5.25 inches (133 mm).
See also rack-mounting unit.

active member of a virtual disk family — An active member of a virtual disk family is 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 — Storage system rules that govern how virtual disks are created. Allocate Completely and Allocate on Demand are the two rules used in creating virtual disks.

- 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.

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 media. 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 — All the physical disk drives in a storage system that are known to and under the control of a controller pair.

array controller — *See* controller.

asynchronous — Events scheduled as the result of a signal requesting the event or that which is without any specified time relation.

backplane — An electronic printed circuit board that distributes data, control, power, and other signals to element connectors.

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 — Part of the power supply AC receptacle that engages the AC power cord connector to ensure that the cord cannot be accidentally disconnected.

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 — A variable speed airflow device that pulls air into an enclosure or element. It usually pulls air in from the front and exhausts the heated air out the rear.

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 Command View EVA graphical user interface (GUI) display component that defines the action required to correct a problem. *See also* read cache,write cache, and mirrored cache.

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 A rechargeable unit mounted within a controller enclosure that supplies back-up power to the cache module in case of primary power shortage.

cache battery indicator

1. An orange light emitting diode (indicator) that illuminates on the controller operator control panel (OCP) to define the status of the HSV Controller cache batteries.
2. An amber status indicator that illuminates on a cache battery. When illuminated, it indicates that one or more cache battery cells have failed and the battery must be replaced with a new battery.

carrier A drive-enclosure-compatible assembly containing a disk drive or other storage devices.

client A software program that uses the services of another software program. The HP Command View EVA client is a standard internet browser.

clone *See* Virtual Disk Copy.

communication logical unit number (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.
See also console LUN.

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, cache batteries, transceivers, and connectors.

controller event A significant occurrence involving any storage system hardware or software component reported by the controller to HP Command View EVA.

controller fault indicator An amber fault indicator that illuminates on the controller OCP to indicate when there is an HSV Controller fault.

controller pair Two interconnected controller modules which together control the disk enclosures in the storage system.

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.

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 first disk group created at the time the system in initialized. The default disk group can contain the entire set of physical disks in the array or just a few of the disks.
See also disk group.

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 — 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.

drive enclosure — A unit that holds storage system devices such as disk drives, power supplies, blowers, I/O modules, transceivers, or EMUs.

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.

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 physical disk drive set or pool in which a virtual disk is created. A disk group may contain all the physical disk drives in a controller pair array or a subset of the array.

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.

drive blank *See* disk drive blank.

drive enclosure *See* drive enclosure.

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.

dual power supply configuration *See* redundant power configuration.

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).

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

1. In a drive enclosure, a device such as an EMU, power supply, disk, blower, or I/O module. The object can be controlled, interrogated, or described by the enclosure services process.
2. In the Open SAN Manager, a controllable object, such as the Enterprise storage system.

HP Command View EVA GUI The graphical user interface (GUI) through which a user can control and monitor a storage system. HP Command View EVA can be installed on more than one storage management server in a fabric. Each installation is a management agent. The client for the agent is a standard browser.

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, blowers, an EMU, I/O modules, or 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.

Enterprise Virtual Array The Enterprise Virtual Array is a product that consists of one or more storage systems. Each storage system consists of a pair of HSV controllers and the disk drives they manage. A storage system within the Enterprise Virtual Array can be formally referred to as an Enterprise storage system, or generically referred to as the storage system.

Enterprise Virtual Array rack A unit that holds controller enclosures, disk drive enclosures, power distribution supplies, and enclosure address buses that, combined, comprise an Enterprise storage system solution. *Also* called the Enterprise storage system rack.
See also rack.

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 StorageWorks 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 Command View EVA.
See also controller event, drive enclosure event, management agent event, and termination event.

Event Information Packet *See* EIP.

Event Number *See* Evt No.

Evt No. Event Number. A sequential number assigned to each Software Code Identification (SWCID) event. It is a decimal number in the range 0-255.

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.

fabric A Fibre Channel fabric or two or more interconnected Fibre Channels allowing data transmission.

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 The process that takes place when one controller assumes the workload of a failed companion controller. Failover continues until the failed controller is operational.

fan The variable speed airflow device that cools an enclosure or element by forcing ambient air into an enclosure or element and forcing heated air out the other side.
See also blower.

Fault Management Code *See* FMC.

Fibre Channel drive enclosure Fibre Channel Arbitrated Loop. The American National Standards Institute's (ANSI) document that specifies arbitrated loop topology operation.

FC HBA Fibre Channel Host Bus Adapter. An interchangeable term for Fibre Channel adapter.
See also FCA.

FCA Fibre Channel Adapter. An adapter used to connect the host server to the fabric. *Also* called a Host Bus Adapter (HBA) or a Fibre Channel Host Bus Adapter (FC HBA).
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. The mapping of SCSI-3 operations to Fibre Channel.

fiber The optical media used to implement Fibre Channel.

fiber optics The technology where light is transmitted through glass or plastic (optical) threads (fibers) for data communication or signaling purposes.

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.

fibre The international spelling that refers to the Fibre Channel standards for optical media.

Fibre Channel A data transfer architecture designed for mass storage devices and other peripheral devices that require very high bandwidth.

Fibre Channel adapter *See* FCA.

Fibre Channel Loop An enclosure that provides twelve-port central interconnect for Fibre Channel Arbitrated Loops following the ANSI Fibre Channel drive enclosure standard.

field replaceable unit *See* FRU.

flush The act of writing dirty data from cache to a storage media.

FMC Fault Management Code. The HP Command View EVA display of the Enterprise Storage System error condition information.

form factor A storage industry dimensional standard for 3.5inch (89 mm) and 5.25inch (133 mm) high storage devices. Device heights are specified as low-profile (1inch or 25.4 mm), half-height (1.6inch or 41 mm), and full-height (5.25inch or 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. A hardware element that can be replaced in the field. This type of replacement can require special training, tools, or techniques. Therefore, FRU procedures are usually performed only by an Authorized Service Representative.

Gb Gigabit. A measurement of the rate at which the transfer of bits of data occurs. Sometimes referred to as Gbps. Nominally, a Gb is a transfer rate of 1,000,000,000 (10^9) bits per second.
For Fibre Channel transceivers or FC loops the Gb transfer rates are:

- 1 Gb is a transmission rate of 1,062,500,000 bits per second.
- 2 Gb is a transmission rate of 2,125,000,000 bits per second.

GB Gigabyte. A unit of measurement defining either:

- A data transfer rate.
- A storage or memory capacity of 1,073,741,824 (2^{30}) bytes.

See also GBps.

Gbps Gigabits per second. A measurement of the rate at which the transfer of bits of data occurs. Nominally, a Gb is a transfer rate of 1,000,000,000 (10^9) bits per second.
See also Gb.

GBps Gigabytes per second. A measurement of the rate at which the transfer of bytes of data occurs. A GBps is a transfer rate of 1,000,000,000 (10^9) bytes per second.
See also GB.

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.

gigabit *See* Gb.

gigabit per second *See* Gbps.

graphical user interface *See* GUI.

GUI Graphical User Interface. Software that displays the status of a storage system and allows its user to control the storage system.

HBA Host Bus Adapter.
See also FCA.

host A computer that runs user applications and uses (or can potentially use) one or more virtual disks created and presented by the controller pair.

Host Bus Adapter *See* FCA.

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. A host is a computer that runs user applications and that uses (or can potentially use) one or more of the virtual disks that are created and presented by the controller pair.

host-side ports *See* host ports.

hot-pluggable A method of element replacement whereby the complete system remains operational during element removal or insertion. Replacement does not interrupt data transfers to other elements.

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/O module Input/Output module. The enclosure element that is the Fibre Channel drive enclosure interface to the host or controller. I/O modules are bus speed specific, either 1 Gb or 2 Gb.

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.
See also param and TC.

in-band communication The method of communication between the EMU and controller that utilizes the Fibre Channel drive enclosure bus.

INFORMATION condition A drive enclosure EMU condition report that may require action. This condition is for information only and does not indicate the failure of an element. All condition reports have precedence over an INFORMATION condition.

initialization A process that prepares a storage system for use. Specifically, the system binds controllers together as an operational pair and establishes preliminary data structures on the disk array. Initialization also sets up the first disk group, called the default disk group.

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.

JBOD Just a Bunch of Disks. A number of disks connected to one or more controllers.

K Kilo. A scientific notation denoting a multiplier of one thousand (1,000).

KB Kilobyte. A unit of measurement defining either storage or memory capacity.

1. For storage, a KB is a capacity of 1,000 (10^3) bytes of data.
2. For memory, a KB is a capacity of 1,024 (2^{10}) bytes of data.

LAN Local area network. A group of computers and associated devices that share a common communications line and typically share the resources of a single processor or server within a small geographic area.

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.

LCD Liquid Crystal Display. The indicator on a panel that is associated with an element. The LCD is usually located on the front of an element.

indicator Light Emitting Diode. A semiconductor diode, used in an electronic display, that emits light when a voltage is applied to it.

License Key
A WWN-encoded sequence that is obtained from the license key fulfillment website.

light emitting diode
See indicator.

link
A connection between ports on Fibre Channel devices. The link is a full duplex connection to a fabric or a simplex connection between loop devices.

logon
Also called login, it is 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 (not all 256 hexadecimal values are allowed as AL_PA values per Fibre Channel).

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 SCSI convention used to identify elements. The host sees a virtual disk as a LUN. The LUN address a user assigns to a virtual disk for a particular host will be the LUN at which that host will see the virtual disk.

management agent
The HP Command View EVA software that controls and monitors the 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
Significant occurrence to or within the management agent software, or an initialized storage cell controlled or monitored by the management agent.

Mb
Megabit. A term defining a data transfer rate.
See also Mbps.

MB
Megabtye. A term defining either:
- A data transfer rate.
- A measure of either storage or memory capacity of 1,048,576 (2^{20}) bytes.

See also MBps.

Mbps
Megabits per second. A measure of bandwidth or data transfers occurring at a rate of 1,000,000 (10^6) bits per second.

MBps
Megabytes per second. A measure of bandwidth or data transfers occurring at a rate of 1,000,000 (10^6) bytes per second.

mean time between failures
See MTBF.

Mega A notation denoting a multiplier of 1 million (1,000,000).

metadata Information that a controller pair writes on the disk array. This information is used to control and monitor the array and is not readable by the host.

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.

Network Storage Controller *See* NSC.

NONCRITICAL Condition A drive enclosure EMU condition report that occurs when one or more elements inside the enclosure have failed or are operating outside of their specifications. The failure does not affect continued normal operation of the enclosure. All devices in the enclosure continue to operate according to their specifications. The ability of the devices to operate correctly may be reduced if additional failures occur. UNRECOVERABLE and CRITICAL errors have precedence over this condition. This condition has precedence over INFORMATION condition. *Early correction can prevent the loss of data.*

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 Enterprise storage system transceivers are non-OFC compatible.

NSC Network Storage Controller. The HSV Controllers used by the 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.

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 push-button.

online/nearonline An online drive is a normal, high-performance drive, while a near-online drive is a lower-performance drive.

operator control panel — *See* OCP.

OpenView Storage Management Server — A centralized, appliance-based monitoring and management interface that supports multiple applications, operating systems, hardware platforms, storage systems, tape libraries and SAN-related interconnect devices. It is included and resides on the SANWorks Management Server, a single aggregation point for data management.

param — That portion of the HSV controller termination code display that defines:

- The 2-character parameter identifier that is a decimal number in the 0 through 30 range.
- The 8-character parameter code that is a hexadecimal number.

See also IDX and TC.

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 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 Fibre Channel connector on a Fibre Channel device.

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.

pushbutton A button that is engaged or disengaged when it is pressed.

quiesce The act of rendering bus activity inactive or dormant. For example, "quiesce the SCSI bus operations during a device warm-swap."

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 1.75 inches (44.45 mm) and based on EIA's *Standard RS310C*. For example, a 3U unit is 5.25inches (133.35 mm) high, and a 4U unit is 7.0inches (177.79 mm) high.

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.

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.

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.

red wine-colored A convention of applying the color of red wine to a CRU tab, lever, or handle to identify the unit as hot-pluggable.

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 Enterprise storage system racks and enclosures to allow continuous system operation by preventing single points of power failure.

- For a rack, two AC power sources and two power conditioning units distribute primary and redundant AC power to enclosure power supplies.
- For a controller or drive enclosure, two power supplies ensure that the DC power is available even when there is a failure of one supply, one AC source, or one power conditioning unit. Implementing the redundant power configuration provides protection against the loss or corruption of data.

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.

room temperature *See* ambient temperature.

SCSI
1. Small Computer System Interface. An American National Standards Institute (ANSI) interface which defines the physical and electrical parameters of a parallel I/O bus used to connect computers and a maximum of 16 bus elements.
2. The communication protocol used between a controller pair and the hosts. Specifically, the protocol is Fibre Channel drive enclosure or SCSI on Fibre Channel. SCSI is the higher command-level protocol and Fibre Channel is the low-level transmission protocol. The controllers have full support for SCSI-2; additionally, they support some elements of SCSI-3.

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 in which each bit of information is sent sequentially on a single channel rather than simultaneously as 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.

small computer system interface *See* SCSI.

Snapclone A virtual disk that can be manipulated while the data is being copied. Only an Active member of a virtual disk family can be snapcloned.
The Snapclone, like a snapshot, reflects the contents of the source virtual disk at a particular point in time. Unlike the snapshot, the Snapclone is an actual clone of the source virtual disk and immediately becomes an independent Active member of its own virtual disk family.

snapshot A temporary virtual disk (Vdisk) that reflects the contents of another virtual disk at a particular point in time. A snapshot operation is only done on an active virtual disk. Up to seven snapshots of an active virtual disk can exist at any point. The active disk and its snapshot constitute a virtual family.
See also active virtual disk, virtual disk copy, and virtual disk family.

SSN Storage System Name. An HP Command View EVA-assigned, unique 20-character name that identifies a specific storage system.

storage carrier *See* carrier.

storage pool The aggregated blocks of available storage in the total physical disk array.

storage system The controllers, storage devices, enclosures, cables, and power supplies and their software.

Storage System Name *See* SSN.

Switch An electro-mechanical device that initiates an action or completes a circuit.

TB Terabyte. A term defining either:

- A data transfer rate.
- A measure of either storage or memory capacity of 1,099,5111,627,776 (2^{40}) bytes.

See also TBps.

TBps Terabytes per second. A data transfer rate of 1,000,000,000,000 (10^{12}) bytes per second.

TC Termination Code. An Enterprise Storage System controller 8-character hexadecimal display that defines a problem causing controller operations to halt.
See also IDX and param.

Termination Code *See* TC.

termination event 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 FC elements such as hubs, controllers, or adapters.

uninitialized system A state in which the storage system is not ready for use.
See also initialization.

UNRECOVERABLE Condition A drive enclosure EMU condition report that occurs when one or more elements inside the enclosure have *failed* and have disabled the enclosure. The enclosure may be incapable of recovering or bypassing the failure and will require repairs to correct the condition.
This is the highest level condition and has precedence over all other errors and requires *immediate corrective action*.

unwritten cached data *Also* called 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.

Vdisk Virtual Disk. A simulated disk drive created by the controllers as storage for one or more hosts. The virtual disk characteristics, chosen by the storage administrator, provide a specific combination of capacity, availability, performance, and

accessibility. A controller pair simulates the characteristics of the virtual disk by deploying the disk group from which the virtual disk was created.
The host computer sees the virtual disk as "real," with the characteristics of an identical physical disk.
See also active virtual disk, virtual disk copy, virtual disk family, and virtual disk snapshot.

virtual disk *See* Vdisk.

virtual disk copy A clone or exact replica of another virtual disk at a particular point in time. Only an active virtual disk can be copied. A copy immediately becomes the active disk of its own virtual disk family.
See also active virtual disk, virtual disk family, and virtual disk snapshot .

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.
See also active virtual disk, virtual disk copy, and virtual disk snapshot.

virtual disk snapshot *See* snapshot.

Vraid0 A virtualization technique that provides no data protection. Data host is broken down into chunks and distributed on the disks comprising the disk group from which the virtual disk was created. Reading and writing to a Vraid0 virtual disk is very fast and makes the fullest use of the available storage, but there is no data protection (redundancy) unless there is parity.

Vraid1 A virtualization technique that provides the highest level of data protection. All data blocks are mirrored or written twice on separate physical disks. For read requests, the block can be read from either disk, which can increase performance. Mirroring takes the most storage space because twice the storage capacity must be allocated for a given amount of data.

Vraid5 A virtualization technique that uses parity striping to provide moderate data protection. Parity is a data protection mechanism for a striped virtual disk. A striped virtual disk is one where the data to and from the host is broken down into chunks and distributed on the physical disks comprising the disk group in which the virtual disk was created. If the striped virtual disk has parity, another chunk (a parity chunk) is calculated from the set of data chunks and written to the physical disks. If one of the data chunks becomes corrupted, the data can be reconstructed from the parity chunk and the remaining data chunks.

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 Fibre Channel identifier consisting of a 16-character hexadecimal number. A WWN is required for each Fibre Channel communication port.

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