

Compaq StorageWorks

Enterprise Virtual Array Initial Setup User Guide

Part Number: EK-E1SET-UA. A01

First Edition August 2001

Product Version: VCS 1.0

This manual contains step-by-step instructions for setting up the Enterprise Virtual Array Storage System and its online interface.

COMPAQ

© 2001 Compaq Computer Corporation.

Compaq, the Compaq logo, StorageWorks, and SANworks are trademarks of Compaq Information Technologies Group, L.P.

UNIX is a trademark of The Open Group.

All other product names mentioned herein may be trademarks of their respective companies.

Confidential computer software. Valid license from Compaq required for possession, use or copying. Consistent with FAR 12.211 and 12.212, Commercial Computer Software, Computer Software Documentation, and Technical Data for Commercial Items are licensed to the U.S. Government under vendor's standard commercial license.

Compaq shall not be liable for technical or editorial errors or omissions contained herein. The information in this document is provided "as is" without warranty of any kind and is subject to change without notice. The warranties for Compaq products are set forth in the express limited warranty statements accompanying such products. Nothing herein should be construed as constituting an additional warranty.

Compaq service tool software, including associated documentation, is the property of and contains confidential technology of Compaq Computer Corporation. Service customer is hereby licensed to use the software only for activities directly relating to the delivery of, and only during the term of, the applicable services delivered by Compaq or its authorized service provider. Customer may not modify or reverse engineer, remove, or transfer the software or make the software or any resultant diagnosis or system management data available to other parties without Compaq's or its authorized service provider's consent. Upon termination of the services, customer will, at Compaq's or its service provider's option, destroy or return the software and associated documentation in its possession.

Printed in the U.S.A.

Enterprise Virtual Array Initial Setup User Guide
First Edition August 2001
Part Number: EK-E1SET-UA. A01

Contents

About this Guide

Text Conventions	vii
Symbols in Text	ix
Symbols on Equipment	ix
Rack Stability	x
Getting Help	xi
Compaq Technical Support	xi
Compaq Website	xi
Compaq Authorized Reseller	xi

1 Introduction to the Enterprise Virtual Array

Functional Layout of the Storage System	1-1
Virtualization	1-2
The HSV Element Manager	1-3
Physical Layout of the Storage System	1-4
How Documentation Is Organized	1-8
Online Documentation	1-8
Hardcopy Documentation	1-8
Other Documentation You Might Need	1-9
Time for the Getting Started Flowchart	1-10

2 The Getting Started Flowchart

3 Gathering Information

4 Obtaining a License Key

VCS License Types and WWN	4-1
Basic License	4-1
Snapshot License	4-3
License Fulfillment Process	4-3

Basic Licensing Process	4-3
Snapshot Licensing Process	4-4
Licensing Additional Storage Systems	4-5
5 Installing the Storage System Hardware	
Prerequisites	5-1
Inventorying the System	5-1
Verifying Site Requirements	5-2
Moving a Rack	5-4
Stabilizing a Rack	5-6
Inspecting the Storage System	5-7
Installing the Controller Cache Batteries	5-9
Applying Power	5-11
Attaching the Controllers to the Fabric	5-15
6 Entering Data from the OCP	
Using the OCP	6-1
Displays	6-1
Startup Display	6-2
Initial Setup Display	6-2
OCP Pushbuttons	6-2
Entering the World Wide Name	6-4
Procedure for Entering the WWN	6-5
Procedure for Entering the WWN Checksum	6-7
Entering a Storage System Password	6-8
7 Setting Up the Element Manager	
Installing the Element Manager	7-1
An Overview of the Element Manager	7-2
Getting Started with the Element Manager	7-2

A Configurations

Glossary

Index

Figures

1-1	Basic functional layout of the storage system	1-2
1-2	Traditional RAID versus Enterprise virtualization techniques	1-3
1-3	Basic storage system components	1-5
1-4	Block diagram of the storage system's connections	1-7
2-1	Getting Started flowchart	2-2
4-1	Relationship of the license and the WWN to the storage system	4-2
4-2	Location of the World Wide Name label	4-4
5-1	IEC-309, 32 A, 3-pin, wall receptacles for 50-Hz installation	5-2
5-2	NEMA L6-30R wall receptacles for 60-Hz installation	5-2
5-3	Single rack configuration floor space requirements	5-3
5-4	Raising a leveler foot	5-5
5-5	Lowering a leveler foot	5-6
5-6	Location of the World Wide Name labels	5-8
5-7	Opening the battery compartment	5-9
5-8	Installing the batteries	5-10
5-9	Location of the PDU circuit breakers	5-11
5-10	Close-up of PDU circuit breakers	5-12
5-11	Indicators on a normal powerup (front view)	5-13
5-12	Indicators on a normal powerup (back view)	5-14
5-13	Dual-fabric configuration	5-15
6-1	OCP displays and controls	6-1
6-2	HSV110 Controller Startup display	6-2
6-3	Initial Setup display	6-2
6-4	Pushbutton icons	6-3
6-5	Location of the World Wide Name label	6-4
7-1	The HSV Element Manager	7-2
A-1	Loop 1B for six-enclosure configuration with no expansion bulkhead	A-2
A-2	Loop 2B for six-enclosure configuration with no expansion bulkhead	A-3
A-3	Loop 1A for six-enclosure configuration with no expansion bulkhead	A-4
A-4	Loop 2A for six-enclosure configuration with no expansion bulkhead	A-5

A-5	Twelve-enclosure configuration, showing location of the expansion bulkhead . . .	A-6
A-6	Loop 1B for twelve-enclosure configuration with expansion bulkhead	A-7
A-7	Loop 2B for twelve-enclosure configuration with expansion bulkhead	A-8
A-8	Loop 1A for twelve-enclosure configuration with expansion bulkhead	A-9
A-9	Loop 2A for twelve-enclosure configuration with expansion bulkhead	A-10

Tables

1	Text Conventions.	vii
6-1	WWN Pushbutton Functions.	6-5
6-2	System Password Pushbutton Functions	6-8

About this Guide

The following sections are covered:

- Text Conventions
- Symbols in Text
- Symbols on Equipment
- Rack Stability
- Getting Help
- Compaq Authorized Reseller

Text Conventions

This document uses the conventions in Table 1 to distinguish elements of text.

Table 1: Text Conventions

Element	Convention	Examples
<ul style="list-style-type: none">• Named Keys• Key Sequences	Bold	Home, Print Screen, Num Lock, Esc, PgUp A plus sign (+) between two keys means that you should press them simultaneously: Ctrl+A, Ctrl+Home, Alt+Ctrl+Del
<ul style="list-style-type: none">• Menu Items• Directory Names• Button Names• Dialog Box Names	Initial Caps (for UNIX and Solaris directory names, the exact case of every character is displayed).	On the File menu, choose Save. Save the file in the C:\StorageSets\Default directory. (UNIX and Solaris): Save the file in the /home/newuser/practice directory. To back up files, click the Backup Now button. In the Save As dialog box, choose the drive then the folder.

Table 1: Text Conventions (Continued)

Element	Convention	Examples
<ul style="list-style-type: none"> • User Input and System Responses (Output and Error Messages) • COMMAND NAMES • Drive Names 	<p>Initial Caps and monospace font.</p> <p>COMMAND NAMES appear in upper case, unless they are case sensitive (UNIX and Solaris command names are case sensitive and will not appear in uppercase).</p> <p>Entered <variables> are displayed in angle brackets (< >) and all lower case.</p>	<p>User Input and System Responses:</p> <ul style="list-style-type: none"> • To exit from the program, type <code>Exit</code>. • At the prompt, type this command: <code>SHOW THIS_CONTROLLER</code> (no variable) • To see your settings, give the command: <code>SHOW <storage sets> FULL</code> (with variable) • You will see the <code>Continue?</code> message. <p>Command Names</p> <ul style="list-style-type: none"> • Use <code>SET THIS_CONTROLLER</code> to change parameters. • To manage storage, enter <code>RUN sysmgr.exe</code> • (UNIX and Solaris): To list files, give the <code>ls</code> command. • Drive Names: Navigate to your CD-ROM drive (usually <code>D:</code> or <code>E:</code>).
<p><i>filenames</i></p>	<p>Unless case sensitive, use <i>lowercase italics</i>. If filenames are case-sensitive (UNIX and Solaris) or are easier to understand with some upper case letters, the exact case of each character is displayed.</p>	<p>To configure storage, edit <i>storage set.ini</i>. Changes are stored in <i>NewSystemConfigurationFile.ini</i>. (UNIX and Solaris): Errors are logged to <i>MixedCaseFile.txt</i>.</p>
<p>Menu Command Sequences</p>	<p>Initial Caps, with a right angle bracket (>) between items. Menu items are displayed as shown on screen.</p>	<p>To compare documents, choose: Tools > Documents > Compare.</p>
<p>URLs</p>	<p>Sans serif font.</p>	<p>http://www.compaq.com/storage</p>

Symbols in Text

These symbols may be found in the text of this guide. They have the following meanings.



WARNING: Text set off in this manner indicates that failure to follow directions in the warning could result in bodily harm or loss of life.



CAUTION: Text set off in this manner indicates that failure to follow directions could result in damage to equipment or loss of information.

IMPORTANT: Text set off in this manner presents clarifying information or specific instructions.

NOTE: Text set off in this manner presents commentary, sidelights, or interesting points of information.

Symbols on Equipment



Any surface or area of the equipment marked with these symbols indicates the presence of electrical shock hazards. Enclosed area contains no operator serviceable parts.

WARNING: To reduce the risk of injury from electrical shock hazards, do not open this enclosure.



Any RJ-45 receptacle marked with these symbols indicates a Network Interface Connection.

WARNING: To reduce the risk of electrical shock, fire, or damage to the equipment, do not plug telephone or telecommunications connectors into this receptacle.



Any surface or area of the equipment marked with these symbols indicates the presence of a hot surface or hot component. If this surface is contacted, the potential for injury exists.

WARNING: To reduce the risk of injury from a hot component, allow the surface to cool before touching.



Power Supplies or Systems marked with these symbols indicate the equipment is supplied by multiple sources of power.

WARNING: To reduce the risk of injury from electrical shock, remove all power cords to completely disconnect power from the system.



Any product or assembly marked with these symbols indicates that the component exceeds the recommended weight for one individual to handle safely.

WARNING: To reduce the risk of personal injury or damage to the equipment, observe local occupational health and safety requirements and guidelines for manual material handling.

Rack Stability



WARNING: To reduce the risk of personal injury or damage to the equipment, be sure that:

- The leveling jacks are extended to the floor.
 - The full weight of the rack rests on the leveling jacks.
 - In single rack installations, the stabilizing feet are attached to the rack.
 - In multiple rack installations, the racks are coupled together.
 - Only one rack component is extended at any time. A rack may become unstable if more than one rack component is extended for any reason.
-

Getting Help

If you have a problem and have exhausted the information in this guide, you can get further information and other help in the following locations.

Compaq Technical Support

In North America, call the Compaq Technical Phone Support Center at 1-800-OK-COMPAQ. This service is available 24 hours a day, 7 days a week.

NOTE: For continuous quality improvement, calls may be recorded or monitored.

Outside North America, call the nearest Compaq Technical Support Phone Center. Telephone numbers for world wide Technical Support Centers are listed on the Compaq website. Access the Compaq website by logging on to the Internet at: <http://www.compaq.com>.

Be sure to have the following information available before you call Compaq:

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

Compaq Website

The Compaq website has the latest information on this product as well as the latest drivers. You can access the Compaq website by logging on to the Internet at: <http://www.compaq.com/storage>

Compaq Authorized Reseller

For the name of your nearest Compaq Authorized Reseller:

- In the United States, call 1-800-345-1518.
- In Canada, call 1-800-263-5868.
- Elsewhere, see the Compaq website for locations and telephone numbers.

Introduction to the Enterprise Virtual Array

The Enterprise Virtual Array is a product that consists of one or more storage systems. A storage system consists of a pair of HSV controllers and the physical disk drives they manage. Each storage system is formally called an Enterprise Storage System. For the purposes of this manual, this name is frequently shorted to just “the storage system.”

This chapter gives an overview of what an Enterprise Storage System is both functionally and physically.

After you become familiar with the parts of the storage system, the flowchart in Chapter 2 will lead you through installation.

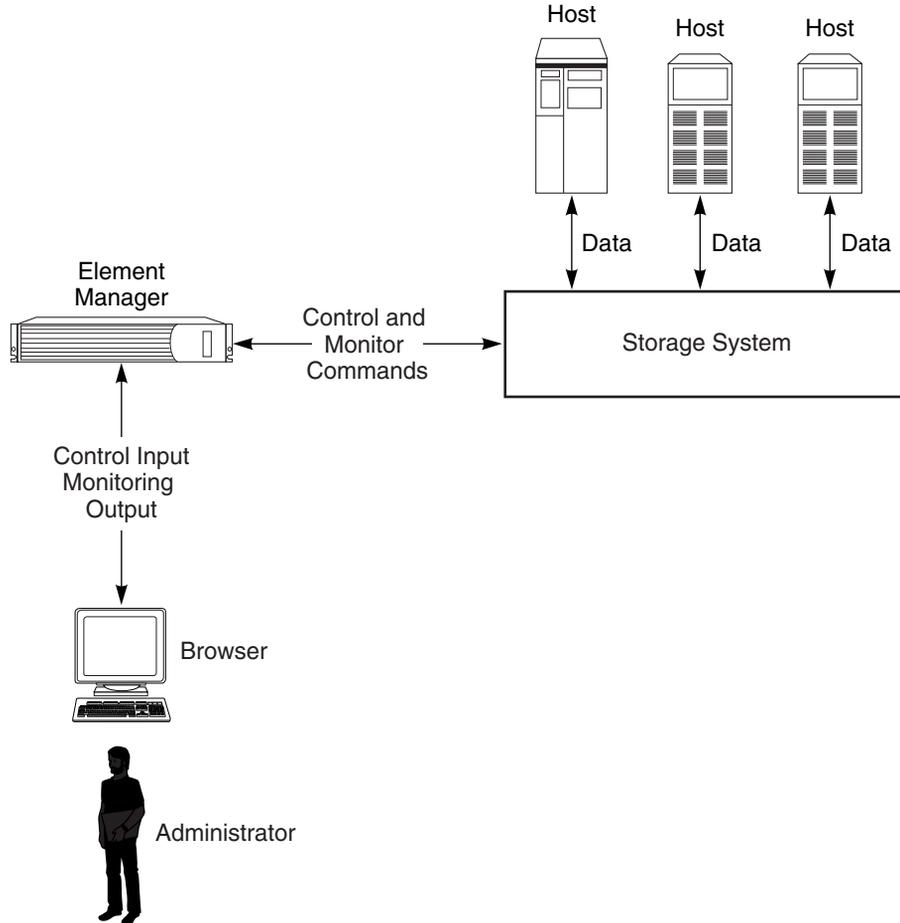
Functional Layout of the Storage System

The current trend is to view data storage as analogous to a utility, such as electricity or water. Like a utility, storage is centrally managed, always there (except in catastrophic instances), and can be expanded and reconfigured to fit changing needs.

The Enterprise Virtual Array implements this strategy. Centralized management software controls the storage system and lets an administrator configure the storage required by various host computers. The management software creates pseudo disks, called virtual disks, and presents them to a host (or to two or more hosts). The host sees the virtual disk just as it sees any ordinary disk drive.

For example, say you need for your work computer a 300-GB disk drive with the highest possible reliability. An authorized administrator accesses the management software through a browser, creates the required virtual disk on the storage system, and presents it to your computer. All you see is that your computer suddenly is attached to a highly reliable 300GB disk drive.

What you don't see is virtualization—how the management software works with the controller software to create the virtual disk drive by distributing data among the physical disks of the array.



CXO7602A

Figure 1–1: Basic functional layout of the storage system

Virtualization

The Enterprise Storage Systems use a new virtualization technology that moves beyond traditional RAID. In this new virtualization technology, the physical disks are organized into disk groups. A disk group is a pool of raw capacity from which the administrator can allocate the capacity and data protection characteristics of a virtual

disk. The virtual disk will be presented as a LUN to a host for application use. The virtual disks that the controllers present to the host computers are created using the capacity of all the drives in the disk group, as shown in Figure 1–2.

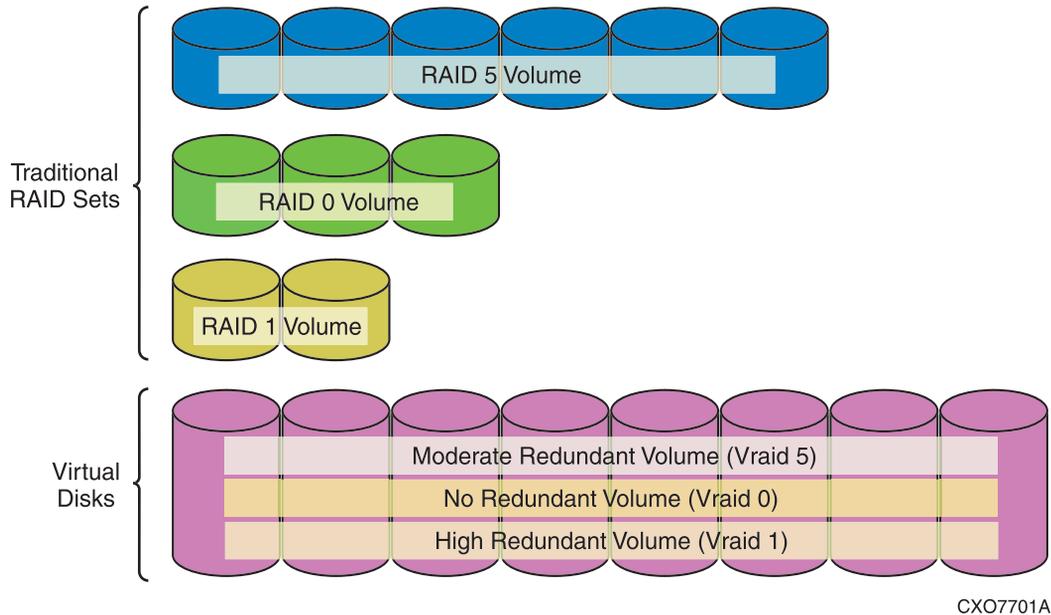


Figure 1–2: Traditional RAID versus Enterprise virtualization techniques

This new type of virtualization allows data to be distributed more evenly among the physical disks, thus avoiding hot spindles which occur when data is distributed unevenly. Each virtual disk's data is distributed evenly across as many physical disk drives (spindles) as the virtual disk's data protection policy will allow. The leveling process is dynamic and looks for opportunities to improve utilization, such as a change in the number of disks in the disk group.

The HSV Element Manager

An Enterprise Storage System is monitored and managed centrally through the HSV Element Manager, a user-friendly graphical user interface (GUI). The element manager is installed on a *Compaq SANworks™* Management Appliance that is attached to the fabric on which the hosts and the storage system reside.

The element manager's client is a standard web browser. The element manager uses the paradigm of folders to organize the various storage system components.

There is a help system associated with the element manager. The help guides you through specific actions and also presents conceptual information about the storage system.

Physical Layout of the Storage System

Physically the storage system consists of a pair of HSV controllers and their array of physical disk drives. The basic physical components are shown in Figure 1–3. The physical disk drives plug into disk drive enclosures. The controller pair is cabled to the disk drive enclosures. A backplane in the disk drive enclosures distributes commands and data to the drives.

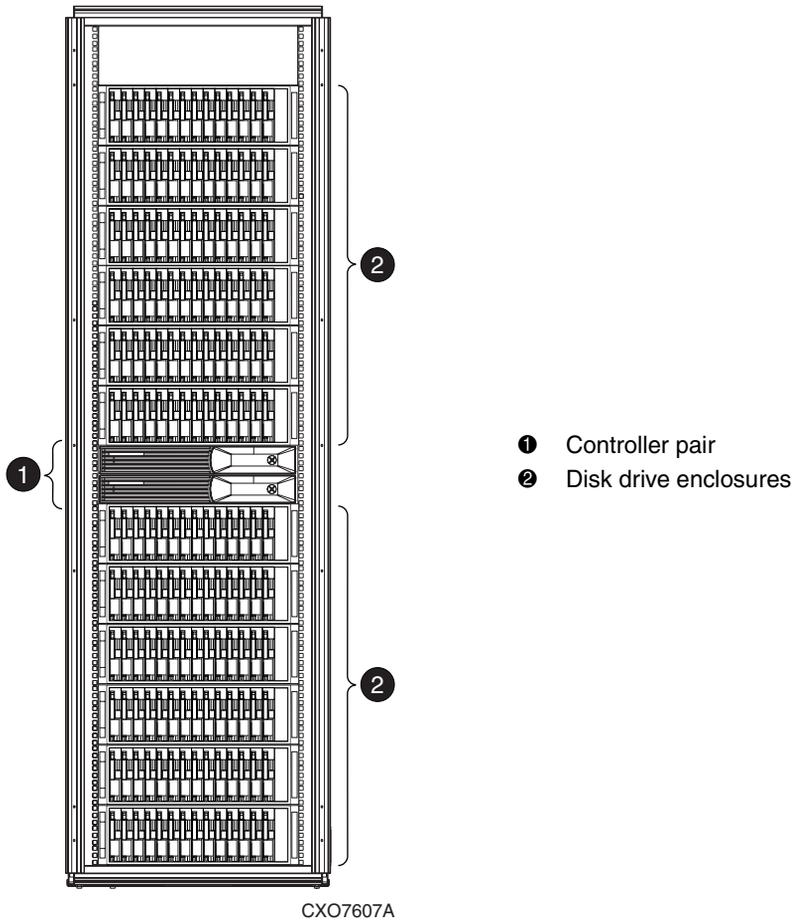
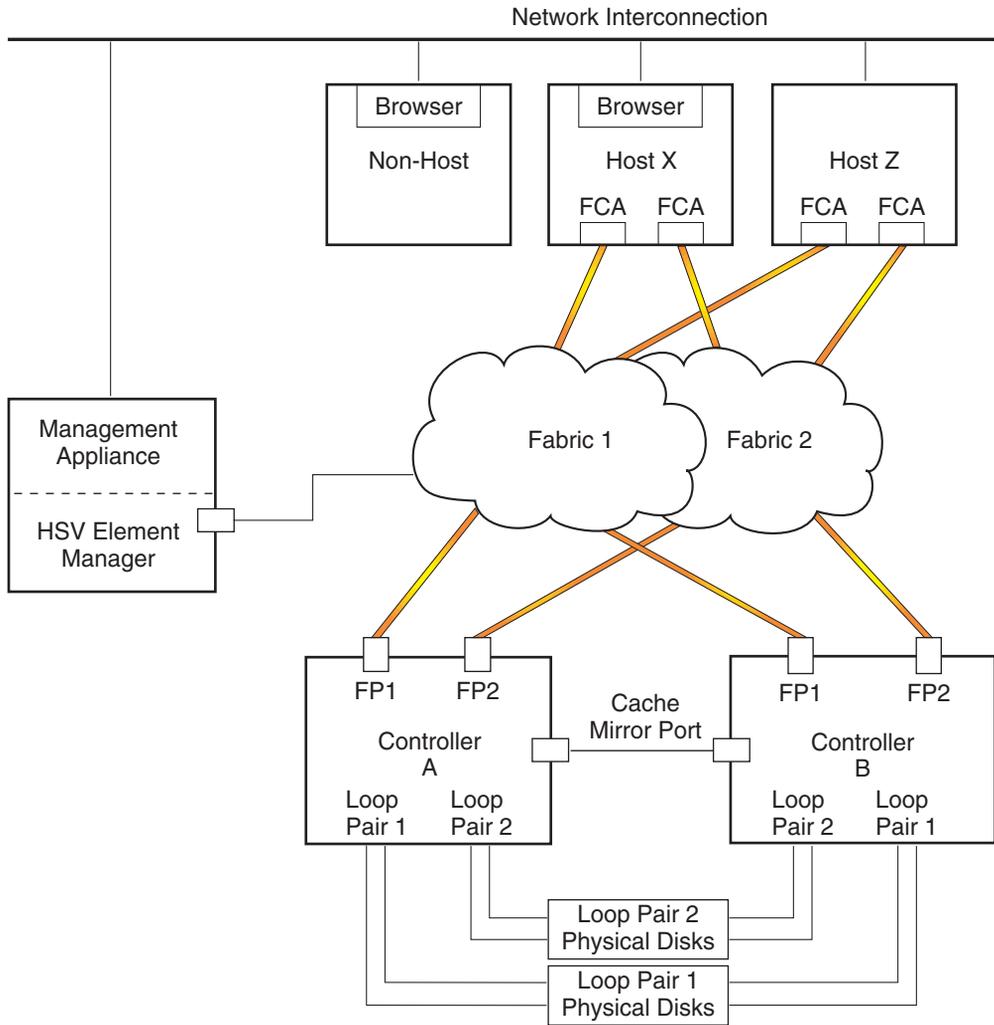


Figure 1–3: Basic storage system components

Figure 1–4 shows a block diagram of how the whole storage system works:

- The HSV controller pair connects to two Fibre Channel fabrics, to which the hosts also connect.
- The HSV Element Manager is the software that controls the storage system. It resides on the Management Appliance. The Management Appliance connects into the fabric.
- The controller pair connects to the physical disk array through Fibre Channel arbitrated loops. There are two separate loop pairs: loop pair 1 and loop pair 2. Each loop pair consists of 2 loops, each of which runs independently, but which can take over for the other loop in case of failure. The actual cabling of each loop is shown in Appendix A.



FP = Fibre (Host) Port
 FCA = Fibre Channel Adapter

CXO7603A

Figure 1-4: Block diagram of the storage system's connections

How Documentation Is Organized

The storage system documentation is divided into online help and hardcopy documentation.

Online Documentation

The help file of the element manager contains the main body of the storage system documentation. This online documentation presents:

- Detailed conceptual descriptions of the system.
- Considerations for planning virtual storage configurations.
- Procedures for configuring virtual storage.
- Help for using the element manager.

Hardcopy Documentation

The following hardcopy documents come with the storage system:

- A boxed kit of hardware documentation that provides generic information on the storage system.
 - Initial Setup Guide—This manual is the one you are reading now. It contains the Getting Started Flowchart in Chapter 2. This flowchart steps you through the installation process to the point of installing and communicating with the element management software. After you are communicating with the element manager software, help files will guide you through the rest of the steps in configuring storage.
 - Drive Enclosure User Guide—This manual contains information about the enclosures that contain the physical disk drives.
 - Drive Enclosure EMU User Guide—This manual contains information about the environmental monitoring unit (EMU) that monitors the condition of the drive enclosures.
 - Controller User Guide—This manual contains information on the controller hardware. Information about the operation of the controller is in the element manager's help file.
 - Rack User Guide—This manual contains information about the rack that contains the controller pair and the drive enclosures.

- **Hardware Release Notes**—These Release Notes contain device and version support information as well as the most recent updates to Enterprise Virtual Array Information.
- A boxed kit of documentation that is specific to a host operating system. Each host kit provides information about how a specific operating system works with the storage system.
- A bagged kit containing the *Compaq StorageWorks™ Enterprise Virtual Array World Wide Name (WWN) Label* and the *Compaq StorageWorks Enterprise Virtual Array Read Me First* document. You will need both of these documents to initialize the storage system.

Other Documentation You Might Need

In addition to the storage system documentation, you may need the following, which are not shipped with the storage system:

- **The Compaq SANworks VCS Software Kit.** This is a boxed kit that contains the necessary licensing information for Enterprise Storage System basic functionality, as well as the storage system's software recovery CD.
- **Compaq SANworks VCS Snapshot Software Kit.** This is a boxed kit that contains the necessary licensing information for the Snapshot functionality and is purchased as a value-added software feature.
- **The latest update kit for the Management Appliance.** This kit provides current drivers, element managers, and software updates for the management appliance and accompanying applications. It also includes instructions for installing the HSV Element Manager.

See the Release Notes or contact your Compaq Authorized Service Representative for the latest updates.

- **The Management Appliance documentation:**
 - Compaq SANworks Management Appliance Getting Started Guide
 - Compaq SANworks Management Appliance Troubleshooting Guide
 - Compaq SANworks Management Appliance Configuration Guide

This documentation ships with the Compaq SANworks Management Appliance.

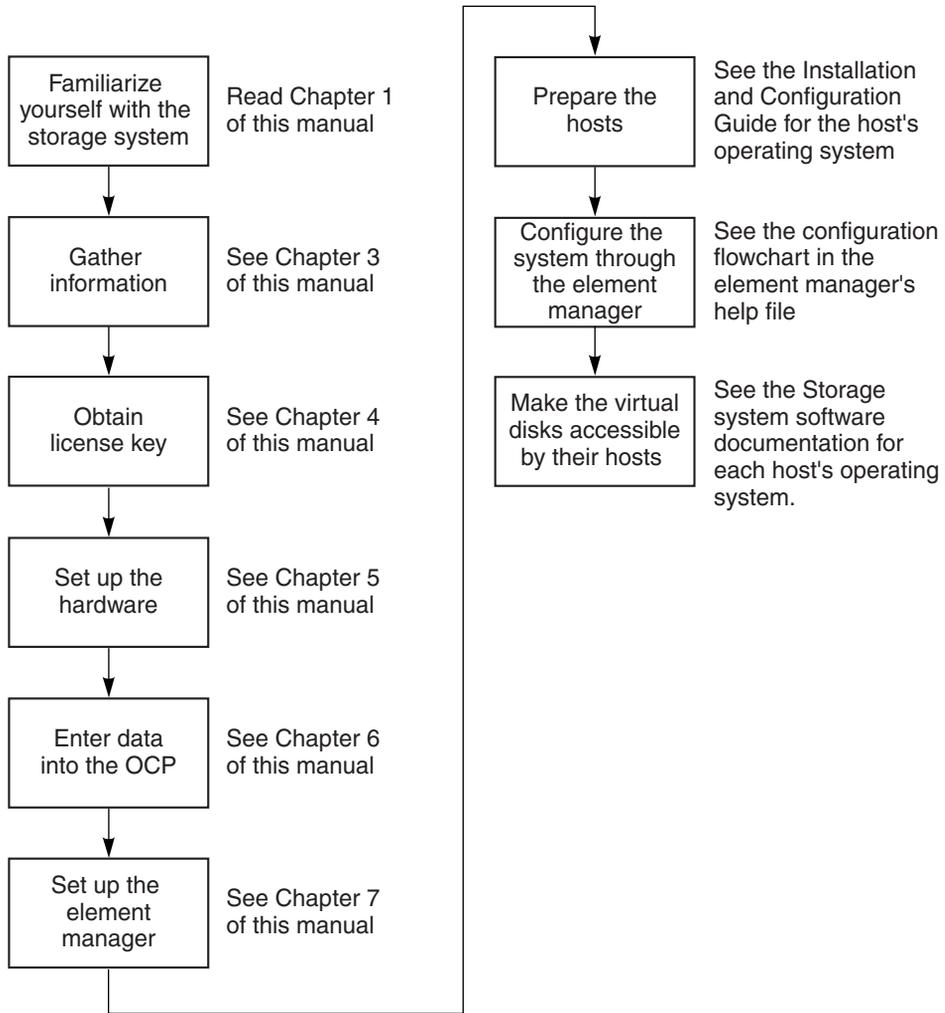
- **Documentation for the switches to which the controllers' fabric (host) ports connect.**

Time for the Getting Started Flowchart

Follow the Getting Started Flowchart in Chapter 2 to set up your storage system.

The Getting Started Flowchart

On the next page is a flowchart that will guide you through the installation of the storage system.



CXO7604A

Figure 2-1: Getting Started flowchart

Gathering Information

This chapter provides important setup information you need to know prior to operating the *Compaq StorageWorks™* Enterprise Virtual Array storage system. Retrieve the items described in this document and perform the procedures described in each. After you complete these procedures you will be able to initialize and operate the Enterprise Storage System.

You will need to locate the following items to install the storage system:

- *Compaq StorageWorks Enterprise Virtual Array World Wide Name (WWN) Label*, which is a separate sheet of paper shipped with the system.
- *Compaq StorageWorks Enterprise Virtual Array Read Me First* document, which is a separate sheet of paper shipped with the system.
- *License Key Retrieval Instruction Sheet*, which is a separate sheet of paper that ships in the Compaq SANworks VCS Software kit. This sheet provides instructions for obtaining a license for the basic storage system software.
- If you bought a license for the snapshot feature, there will be another *License Key Retrieval Instruction Sheet*. This is a separate sheet of paper that ships in the kit called Compaq SANworks VCS Snapshot V1.0 for Dual HSV Controllers
- The latest Compaq SANworks Management Appliance Update, which consists of the management appliance update CD and its associated documentation.

You can determine the latest update version available by checking your Release Notes or contacting your Compaq Authorized Service Representative to find out how to receive the latest information.

- The boxed kit for the operating system of the host computer. If there are hosts running different operating systems, you will need a boxed kit for each operating system. This kit ships separately from the storage system.
- The boxed kit that contains the hardware documentation and ships with the system. That is the box that this manual came in.

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

It is also advisable for you to make a list of information for each computer that will be used in the storage system. (Such a computer is called a host.) The information you will need for each host is as follows:

- The LAN name of the host
- A list of World Wide Names of the Fibre Channel adapters, also called host bus adapters, through which the host will connect to the fabric on which the storage system resides
- IP address (optional)
- Operating system
- Available LUN numbers

Obtaining a License Key

A license key is necessary to unlock the Virtual Controller Software (VCS) that runs on both controllers in a storage system. One license covers both controllers in a storage system.

Obtaining a License key requires several documents. See Chapter 3 for instructions on locating these documents.

- *Compaq StorageWorks Enterprise Virtual Array World Wide Name (WWN) Label.*
- *License Key Retrieval Instruction Sheet*, which includes the License Authorization ID.
- If you purchased the snapshot license, you will also need the snapshot *License Key Retrieval Instruction Sheet*, which includes the License Authorization ID.

VCS License Types and WWN

There are two types of VCS licenses:

- Basic
- Snapshot

These licenses are sold as part of a software kit. Snapshot is sold based upon the snapshot capacity the customer requires.

There is one WWN per controller pair on a storage system.

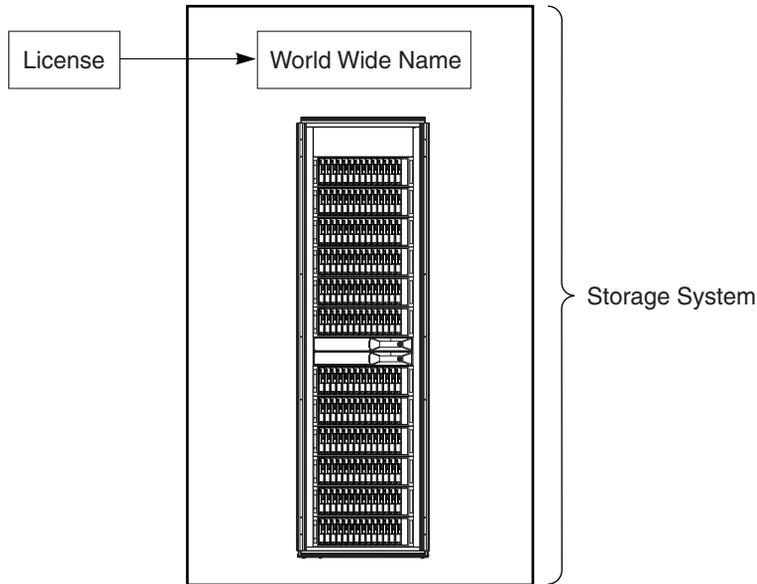
IMPORTANT: Both the license and the WWN are required to create an initialized storage system.

Basic License

The basic license provides the right to use VCS to create and operate an Enterprise Storage System whose Fibre Channel identity is the World Wide Name that was generated by manufacturing and attached to the hardware. A single VCS software kit provides the basic license which covers both controllers in the storage system.

The license is bound to the World Wide Name (WWN). The WWN is a characteristic of the entire storage system as an entity. This relationship is shown in Figure 4–1. The license and the WWN do not belong to any specific component of the storage system. Individual components can be removed and replaced—even the controllers—but the storage system remains and retains its World Wide Name identity.

Both the license and the WWN are required to create an initialized storage system.



CXO7708A

Figure 4–1: Relationship of the license and the WWN to the storage system

The WWN, which is generated by manufacturing and attached to the hardware, belongs to the storage system. It is entered into the operator control panel (OCP) of one of the controllers (described in Chapter 6), but it does not belong to the controllers. The controllers simply keep a record of the WWN until the storage system is initialized. At the time of initialization the WWN is tied to the storage system.

The basic license must be tied to the WWN. This is done through the License Fulfillment Process described in the next section. You will receive an Authorization ID on a *License Key Retrieval Instruction Sheet*. You will provide the Authorization ID and the WWN to the license fulfillment website. The license fulfillment website

will then generate and send back a license key. This license key ties the WWN to the license. When this license key is entered into the HSV Element Manager, it unlocks VCS on both controllers, and you can begin using your storage system.

Snapshot License

The snapshot license gives you the right and ability to use the value-added snapshot function. A snapshot is a fast virtual copy of a virtual disk at an instant in time. You must have the VCS basic functionality before enabling this value-added feature.

The Snapshot license follows the same licensing scheme as described for the Basic License.

License Fulfillment Process

The license fulfillment process can be completed manually through email or fax, or by visiting the Compaq website.

If you have more than one license or more than one storage system, you can obtain up to 10 license keys at the same time. Each license key is locked to the WWN of one storage system, so keep records that show the association of license keys with WWNs.

Basic Licensing Process

Follow the instructions on the *License Key Retrieval Instruction Sheet* to obtain a license key at the license fulfillment website. If you do not have web access, the *License Key Retrieval Instruction Sheet* describes how to obtain a license key manually through e-mail or fax.

IMPORTANT: The manual process could take up to 48 hours so obtaining your license key should be one of your first priorities.

The license fulfillment website will prompt you to enter the storage system's World Wide Name (WWN). This is the number that is on the sheet called *Compaq StorageWorks Enterprise Virtual Array World Wide Name (WWN) Label*. This number may also be on labels on both sides of the controllers (see Figure 4-2).



CAUTION: You must enter the WWN exactly as it is on the label before you submit the licensing information. The WWN entry is case-sensitive and the hyphens must be entered. Once the WWN is entered into the licensing database, the license key is irrevocably locked to that WWN.

Do not enter the checksum that appears on the label into the website. Doing so will invalidate the license key.



CXO7601A

Figure 4-2: Location of the World Wide Name label

When you obtain the license key, copy it or print it. You will need to enter the license key into the HSV Element Manager, as described in Chapter 7. The license key is made up of alphanumeric characters and may have as many as 4 lines of text. It is very important that the license key be entered exactly.

Snapshot Licensing Process

If you bought the snapshot feature, follow the same process as above using the snapshot *License Key Retrieval Instruction Sheet*.

Licensing Additional Storage Systems

If you have more than one license or more than one storage system, you can obtain up to 10 license keys at the same time. Each license key is locked to the WWN of one storage system, so keep records that show the association of license keys with WWNs.

Installing the Storage System Hardware

The information in this chapter explains how to install the storage system. Review the prerequisites before beginning to install the storage system hardware. Then follow the procedures in the remainder of the chapter to complete the installation.

The following procedures must be performed in order:

- “Prerequisites” on page 5-1
- “Verifying Site Requirements” on page 5-2
- “Moving a Rack” on page 5-4
- “Stabilizing a Rack” on page 5-6
- “Inspecting the Storage System” on page 5-7
- “Installing the Controller Cache Batteries” on page 5-9
- “Applying Power” on page 5-11
- “Attaching the Controllers to the Fabric” on page 5-15

Prerequisites

Complete the procedures printed on the shipping carton to unpack the rack and remove it from the pallet *before* implementing the procedures in this chapter.

Inventorying the System

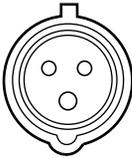
After unpacking the rack and removing it from the pallet, complete the following procedure:

1. Thoroughly inspect the rack and the major components, to ensure there is no physical damage.
2. Inventory the system per the packing list to ensure that the system is complete.

Verifying Site Requirements

Installation of a 9000-series rack is restricted to a Class A, open office environment. The site must meet the following general requirements:

- Each rack requires two separate AC power sources (one for each PDU).
- Each PDU requires 220–240 VAC $\pm 10\%$ (188–264 VAC), 50–60 Hz $\pm 5\%$ (47–63 Hz), single phase 24 A.
- Each 50 Hz installation requires IEC-309, 32 A, 3-pin, wall receptacles.



CXO5409B

Figure 5–1: IEC-309, 32 A, 3-pin, wall receptacles for 50-Hz installation

- 60 Hz installation requires NEMA L6-30R wall receptacles.



CXO7549A

Figure 5–2: NEMA L6-30R wall receptacles for 60-Hz installation

- Each 9000-series rack requires an area 603 mm (23.7 in) wide and 909 mm (35.8 in) deep (see Figure 5–3).

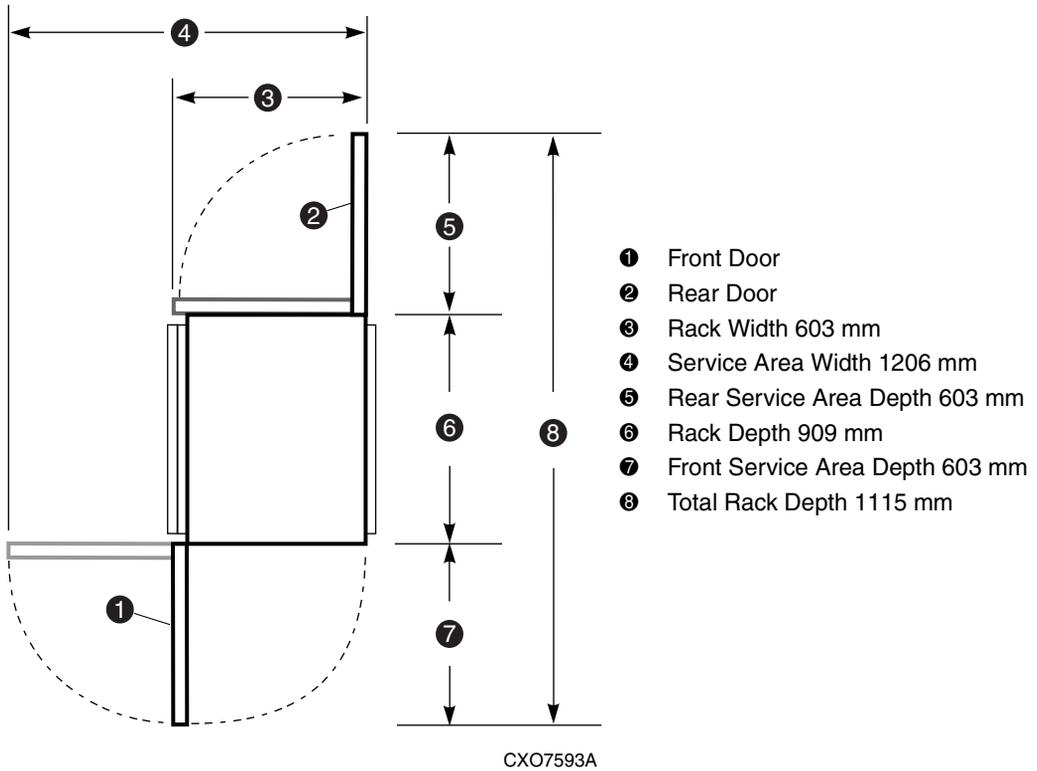


Figure 5-3: Single rack configuration floor space requirements

Moving a Rack

After completing the procedures listed in “Prerequisites” on page 5–1, you can move the rack to the installation area.



WARNING: The physical size and weight of the rack requires a minimum of two people to move it. If one person tries to move the rack, there is a potential for injury.

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 (for example: 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 mm (30 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.

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

1. Raise one foot by turning the leveler feet hex nut counterclockwise until the weight of the rack is fully on the casters. (Reference Figure 5–4 in performing this step.)
2. Repeat step 1 for the other feet.

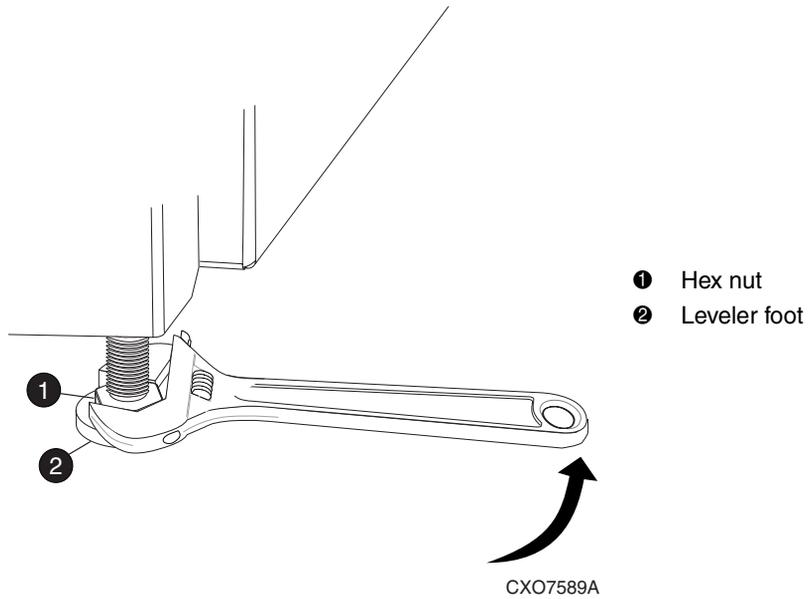


Figure 5-4: Raising a leveler foot

3. Carefully move the rack to the installation area and position it to provide the necessary service areas (see Figure 5-3).

Stabilizing a Rack

When the rack is in the final installation location, lower the feet to remove weight from the casters, thereby stabilizing the rack. Minor adjustment to the feet level the rack.

1. Use a wrench to lower a foot until the caster does not touch the floor (see Figure 5-5).
2. Repeat step 1 for the other feet.

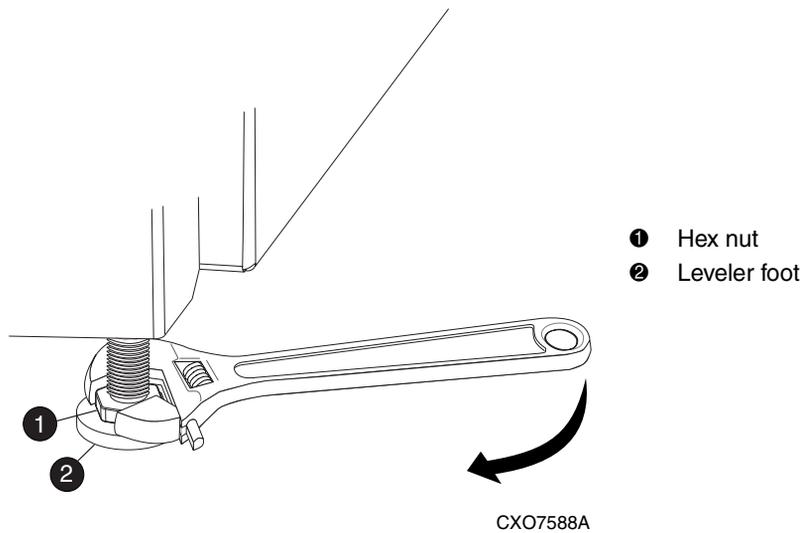


Figure 5-5: Lowering a leveler foot

3. After lowering the feet, check the rack to ensure it is stable and level.
4. Adjust the feet as necessary to ensure the rack is stable and level.

Inspecting the Storage System

1. Ensure that all disk drives are fully seated.
2. Ensure that all internal data cables are connected and fully seated.
3. Ensure that the power distribution unit (PDU) power cable connectors and the wall receptacles are compatible.
4. Ensure that the AC power distribution modules are connected to PDUs and fully seated.
5. Ensure that the controller and drive enclosure power cords are connected and fully seated.
6. Ensure that the power supplies, blowers, I/O modules, and EMUs are fully seated.
7. Ensure that all data cables are properly connected and fully seated.
8. Ensure that all panels, cable clamps, wire ties, and so forth, are fastened securely.
9. Verify that WWN labels are installed on either side of the controllers, as shown in Figure 5-6.

10. If the labels are not in the required location, get the label sheet, *Compaq StorageWorks Enterprise Virtual Array World Wide Name (WWN) Label*, that you located in Chapter 3 and install the labels. The sheet contains labels and instructions for installing them.



CXO7601A

Figure 5–6: Location of the World Wide Name labels

Installing the Controller Cache Batteries

Prior to applying power, you need to install cache battery pairs in both controllers, using the following procedure.

1. Refer to Figure 5–7. Grasp the bezel ❶ at both ends. Then pull it away from the controller.

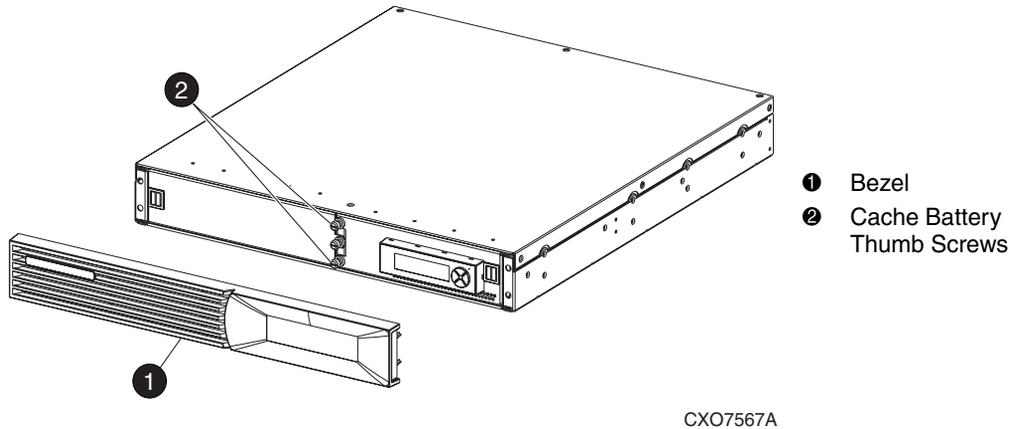


Figure 5–7: Opening the battery compartment

2. Loosen the two battery compartment door captive thumb screws ❷.
3. Pull out on the cache battery door until it is in the full open position.
4. Slide a battery ❶ into the battery compartment.

5. Be sure that the battery is fully seated in the backplane connector.

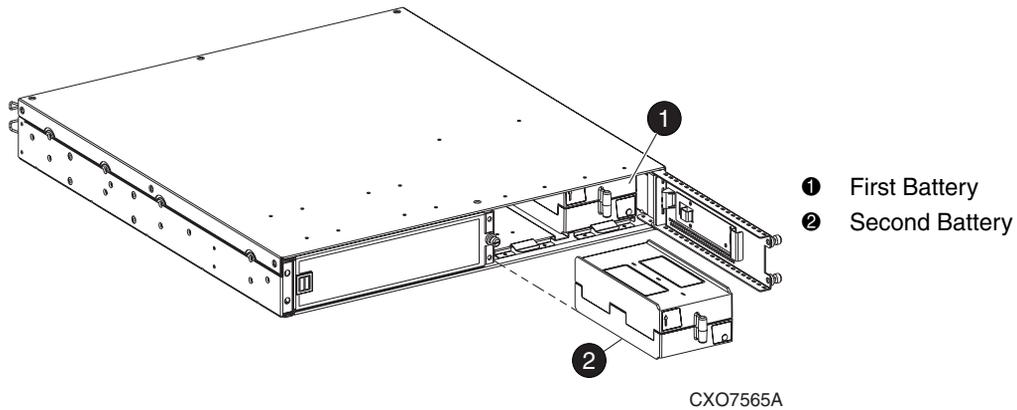


Figure 5–8: Installing the batteries

6. Slide the second battery ② into the battery compartment.
7. Be sure that the battery is fully seated in the backplane connector.
8. Close the cache battery door, and finger tighten the cache battery door captive thumbscrews.
9. Align the bezel mounting studs with the controller enclosure mounting holes. Firmly press on the bezel until it is fully seated on the controller enclosure.
10. Allow between 4–8 hours for the battery to become fully charged.
11. Repeat Steps 1 through 6 for the second controller enclosure.

Applying Power



CAUTION: Before applying power to the system be sure that the temperature has stabilized and is in the range +10°C to +35°C (+50°F to +95°F). If the system temperature is outside of this range, an error condition will exist when you apply power.

Applying power to the rack involves the following steps:

1. Place the circuit breakers on both power distribution units (PDUs) to the Off position.

The PDUs are located in the back of the rack. See Figure 5–9 for location of the circuit breakers and Figure 5–10 for a close-up view of the circuit breakers.

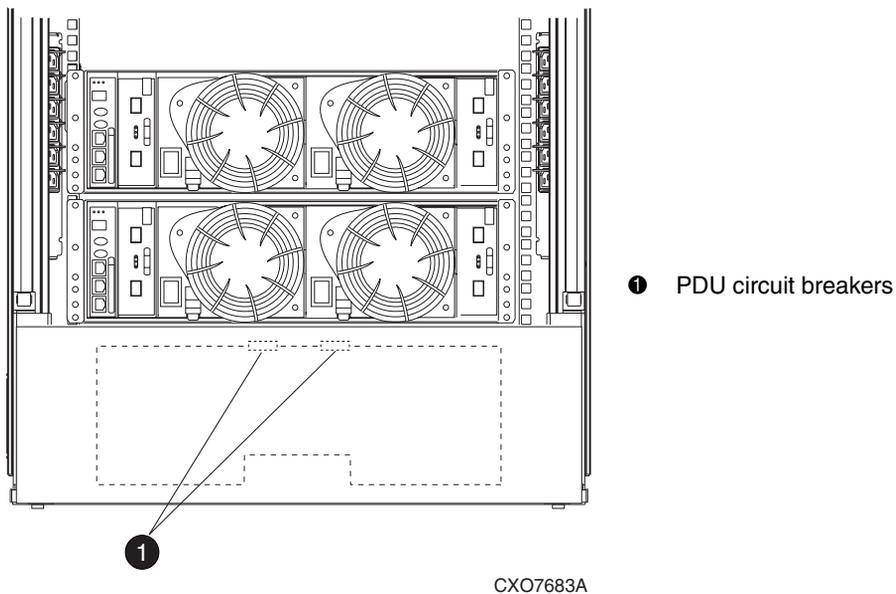
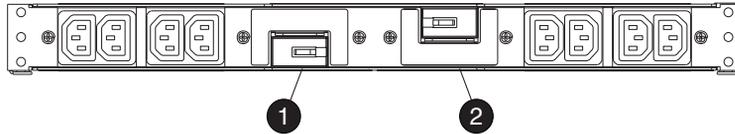


Figure 5–9: Location of the PDU circuit breakers



CXO7682A

Figure 5–10: Close-up of PDU circuit breakers

2. Place the controller enclosure power switches to the Off position.
3. Connect the PDU power cable to the wall receptacle.

At this time, you can apply power to the rack enclosures.

4. Place both the PDU circuit breakers to the On position.

At this time, the drive enclosure power supplies will start operating. The audible alarm will sound, but should turn off as soon as both controllers are fully powered up.

5. Verify that the power supply and blower status LEDs (green) are On.

The middle drive status LED should be On; the other two drive state LEDs should be Off. The I/O module status LED (middle) should be On.

The drives will start to spin up, during which time the top drive status LED will blink. When the two top drive status LEDs are On and the bottom drive status LEDs are Off, the drive has spun up. Wait until the drives have spun up before turning on the controllers.

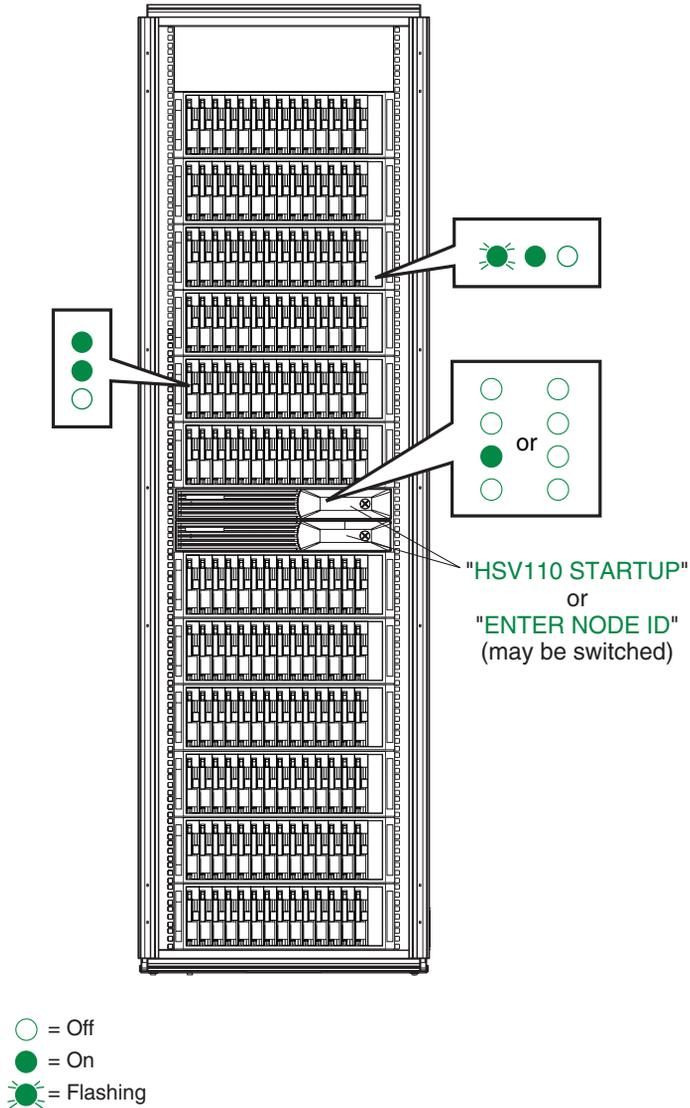
IMPORTANT: If you see any error indications, refer to the Drive Enclosure User Guide and the EMU User Guide for possible causes and corrective actions.

6. When all the drives are spun up, place the power switches of both controllers to the On position.

The LCD on the controller enclosure operator control panels (OCPs) should show “HSV Startup.” When one of the controller’s OCP displays the message “Enter Node WWN” the controllers are running their software and are operational.

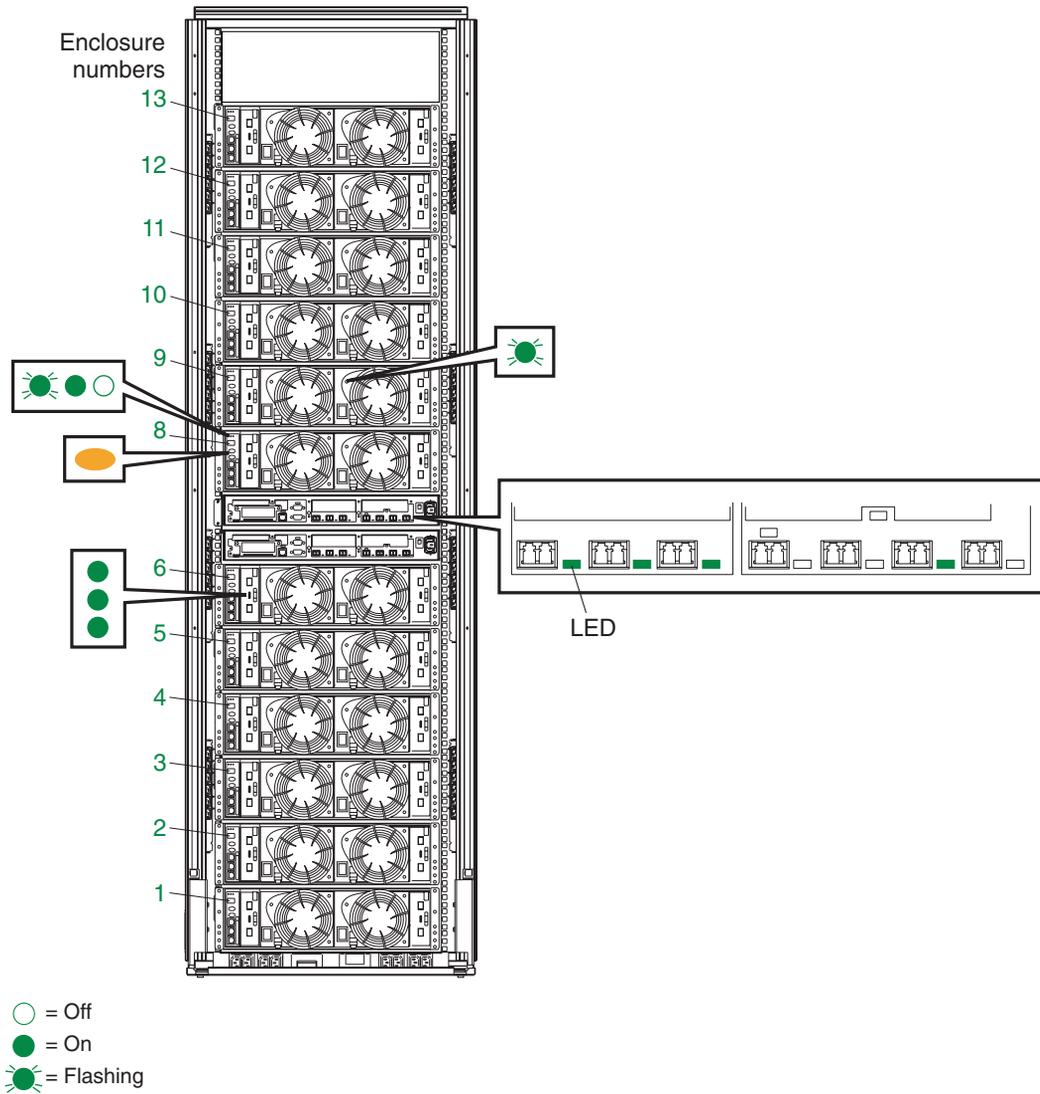
When both controllers are powered up, the audible alarm should turn off

Figure 5–11 and Figure 5–12 show the state of various LEDs and indicators for a normal powerup.



CXO7684A

Figure 5–11: Indicators on a normal powerup (front view)



CXO7685A

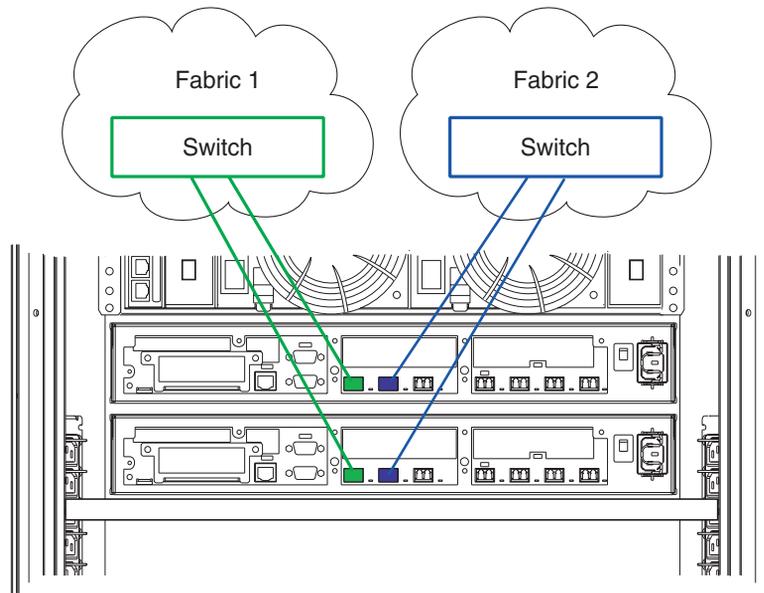
Figure 5-12: Indicators on a normal powerup (back view)

Attaching the Controllers to the Fabric

The controller pair attaches to its hosts through a Fibre Channel fabric. A fabric consists of a switch or a group of interconnected switches. The convention is to represent a fabric as a cloud.

For redundancy, the controllers should be cross-connected to two fabrics; that way, if one fabric becomes nonoperational the hosts still can get to the data through the other fabric.

NOTE: Some operating systems have specific requirements for how switches are configured. Consult the Installation and Reference Guide for the operating systems of your hosts. The specific operating system constraints always take precedence over this generic description.



CX07618A

Figure 5–13: Dual-fabric configuration

Use a cabling scheme that is easy for you to remember and be sure to label both ends of the cables.

Entering Data from the OCP

This chapter presents an overview of the controller operator control panel (OCP) and provides detailed instructions for entering into the OCP two pieces of data critical to initial setup of the storage system:

- World Wide Name (WWN)—mandatory and very important.
- Storage system password—optional. A password is a security interlock that allows only specific instances of the element manager to access the storage system.

Using the OCP

Setting up the controller pair requires using the operator control panel, the OCP, to display and enter information.

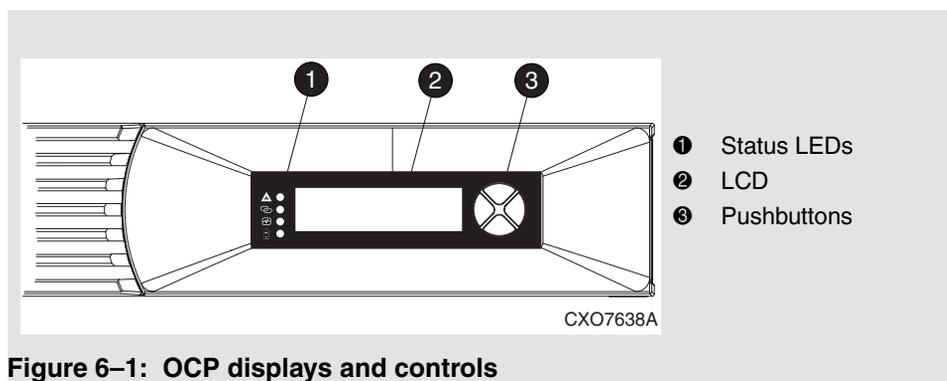


Figure 6–1: OCP displays and controls

Displays

The OCP display contains LEDs and a liquid crystal display (LCD).

- The status LEDs, ①, indicate the internal status of the controller. During initial setup, the status LEDs may not be fully operational.

- The LCD, , can display 20 alphanumeric characters per each of the two rows.

Startup Display

Resetting or applying power to the storage system controller pair creates the display shown in Figure 6–2.

The first line defines the controller model number. The second line is a series of asterisks. An asterisk is displayed when one of the 20 startup procedures is successfully completed. After completing all the startup procedures, the display automatically changes to the display shown in Figure 6–3.



Figure 6–2: HSV110 Controller Startup display

Initial Setup Display

The display shown in Figure 6–3 is active after the successful completion of the controller startup procedure.

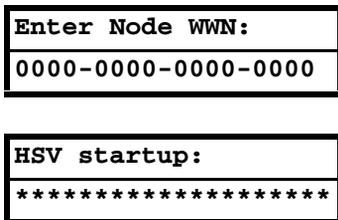


Figure 6–3: Initial Setup display



CAUTION: An Enterprise Virtual Array cannot operate properly with the HSV Element Manager until you enter a valid WWN.

OCF Pushbuttons

The four OCF pushbuttons enable you to select and display different controller information. In some cases, you can enter data. The active function can change a pushbutton function.

To simplify presentation and to avoid confusion, the pushbutton reference names, regardless of labels, are left, right, top, and bottom (see Figure 6–4).

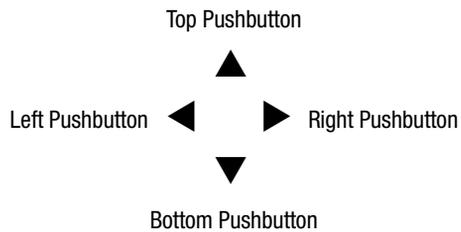


Figure 6–4: Pushbutton icons

Entering the World Wide Name

The WWN is a Fibre Channel identifier that is unique to the storage system and is assigned during manufacturing. You need to enter the storage system's World Wide Name (abbreviated as WWN; also called Node WWN) into the OCP of the controller with a display that says "Enter Node WWN."

The WWN is printed on a label on the side rails of the rack. You should find a label on each side of the controller pair, as shown in Figure 6–5.



CXO7601A

Figure 6–5: Location of the World Wide Name label

If for some reason the WWN labels are not on the rack, you can get the WWN off the label document that you collected in Chapter 3.

Procedure for Entering the WWN

Table 6–1 defines the pushbutton functions when entering the WWN or the WWN checksum.

Table 6–1: WWN Pushbutton Functions

	<p>Use this pushbutton to:</p> <ul style="list-style-type: none"> Select a WWN or checksum character by scrolling up through the character list one character at a time. <p>If you select an incorrect character, you can use either  or  to select the correct character.</p>
	<p>Use this pushbutton to:</p> <ul style="list-style-type: none"> Accept the current character and select the next character. <p>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.</p>
	<p>Use this pushbutton to:</p> <ul style="list-style-type: none"> Select a WWN or checksum character by scrolling down through the character list one character at a time. <p>If you select an incorrect character, you can use either  or  to the select correct character.</p>
	<p>Use this pushbutton to:</p> <ul style="list-style-type: none"> Accept all the WWN or checksum characters.

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



CAUTION: Applying power to the rack when the controller power switches are on can prevent proper controller initialization.

The following procedure will enter the WWN 5000-1FE1-0000-0000.

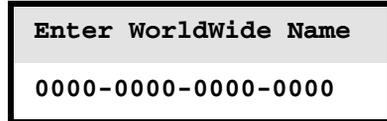
1. Place the power switches on both controllers to the Off position.
2. Apply power to the rack.

3. On both controllers, place the power switch to On.

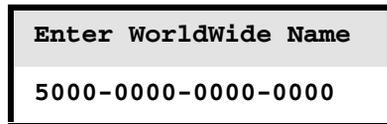
NOTE: This display may not occur for up to two minutes.



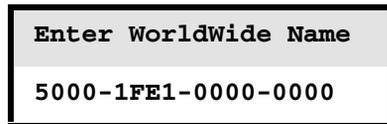
4. The WWN entry display has a 0 in each of the 16 positions.



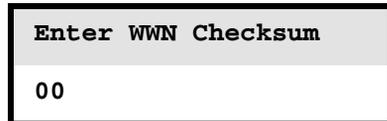
5. Press ▲ or ▼ until the first character display is 5.
Press ► to accept this character and select the next.



6. Repeat Step 5 to enter the remaining characters 000-1FE1-0000-0000.



7. Press ◀ to enter the WWN and select the checksum entry mode.



See the section titled “Procedure for Entering the WWN Checksum” for details.

Procedure for Entering the WWN Checksum

The second part of the WWN entry procedure is to enter the 2-character checksum, HS, as follows.

1. Verify the initial WWN checksum displays 0 in both positions.

Enter WWN Checksum

00

2. Press ▲ or ▼ until the character H displays.
Press ► to accept H and select the second character.

Enter WWN Checksum

H0

3. Press ▲ or ▼ until the second character displays S.
Press ◀ to accept the checksum and exit.

Enter WWN Checksum

HS

4. Verify that the default display is automatically selected. This indicates the checksum is valid.

Storage System Name:

<No Storage System>

Node WorldWide Name:

5000-1FE1-0000-0000

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

IMPORTANT: An active (flashing) display, an error condition, or a user entry (pressing a pushbutton) overrides the default display.

When none of these conditions exist, the default display appears after approximately 15 seconds.

This completes the mandatory procedures for setting up a controller.

Entering a Storage System Password

A management agent is one installation of the element manager on a management appliance. Only one management agent can be installed on a management appliance, but a storage system can contain more than one management appliance, and a management agent can be installed on each one.

The storage system password is a security interlock that allows only specific management agents to access the storage system. If you want to use password protection, you must choose a password and enter it in the OCP on one of the controllers of the controller pair. You enter this password in any management agent that you want to access the storage system.

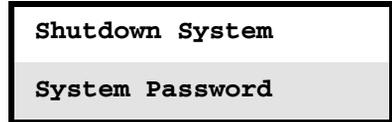
The eight-character storage system password feature enables you to restrict certain functions to selected Element Managers. Table 6–2 describes the pushbutton functions when using the password feature.

Table 6–2: System Password Pushbutton Functions

▲	<p>Use this pushbutton to:</p> <ul style="list-style-type: none"> • Select a password character by scrolling up through the character list one character at a time. <p>If you select an incorrect character, you can use ▼ to select the correct character.</p>
▶	<p>Use this pushbutton to:</p> <ul style="list-style-type: none"> • Move from the default display to the system menu tree. • Move from the system password display to the password entry display. • Accept the current character and select the next character. <p>If you accept an incorrect character, you can loop through the display, one position at time, to select the character to be changed.</p>
▼	<p>Use this pushbutton to:</p> <ul style="list-style-type: none"> • Select a password character by scrolling down through the character list one character at a time. <p>If you select an incorrect character, you can use ▲ to the select correct character.</p>
◀	<p>Use this pushbutton to:</p> <ul style="list-style-type: none"> • Accept all the password characters.

Complete the following procedure to set the password to JWMfzJjP using the pushbuttons as described in Table 6–2.

1. Determine a unique, eight-character password using the upper- or lowercase letters A through Z.
2. With either of the default menus (Storage System Name, or Node WorldWide Name) displayed, press any pushbutton to select the menu tree.
3. Press ▼ to cycle through the displays until System Password is active (flashing).



Press ► to select the system password function.

4. When the System Password function is flashing:
Press ► to select the change password function.



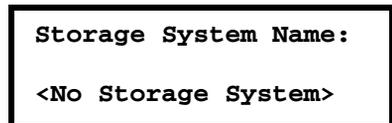
The default Enter Password function displays the default password, AAAAAAAAAA.



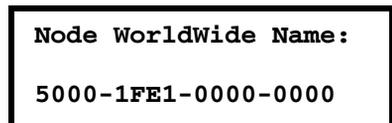
5. Enter the first character of the new password by pressing the ▲ or ▼ until J displays.
6. Press ► to accept this character and select the next character.
7. Repeat the process to enter the remaining password characters, WMfzJjP.



8. Press ◀ twice to enter the password and return to the default menu display.



The controller pair setup is complete.



Setting Up the Element Manager

The HSV Element Manager is the graphical user interface to the storage system, accessible through a standard internet browser.

Installing the Element Manager

This step may be skipped if you have the latest version of the HSV Element Manager already running on the Management Appliance.

If you need to install a new version, find the Management Appliance update CD and the associated documentation. Chapter 3 includes details about where to find this documentation. Follow the instructions in the *Management Appliance Update Installation Card* to install the new software.

You will also need a supported browser on the same network as the management appliance. This network can be anything from a LAN to the Internet. The documentation that comes with the update CD contains information on which versions of which browsers are supported.

An Overview of the Element Manager

The element manager screen is divided into three panes, as shown in Figure 7–1:

- 1 Session pane
- 2 Navigation pane
- 3 Content pane

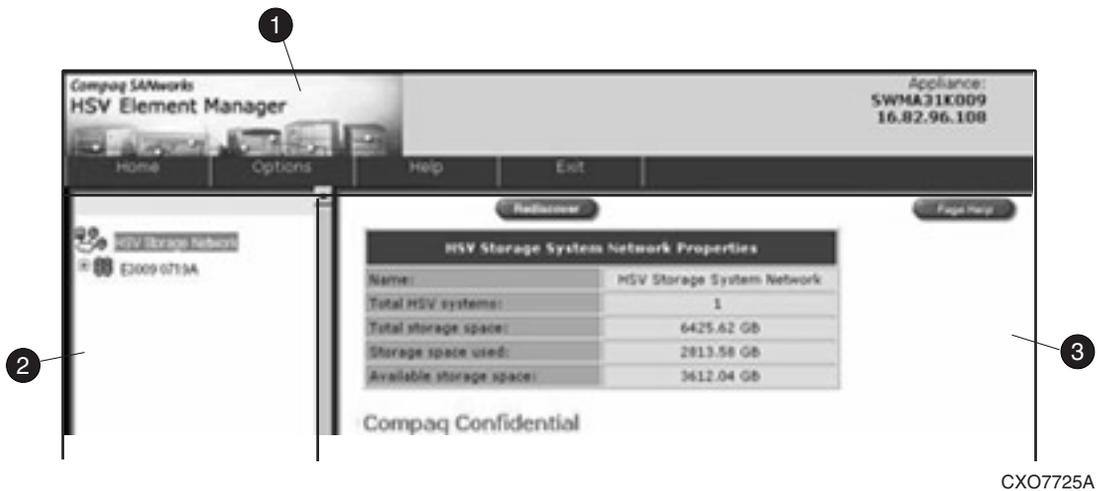


Figure 7–1: The HSV Element Manager

Getting Started with the Element Manager

Click Help in the Session pane to go to the online help. In the online help, click on the topic called “Getting Started.” A sequence of links will guide you through the important steps in starting up the storage system, which include:

1. Entering the license key obtained in Chapter 4.
2. Entering the password, if you assigned a password to the storage system in Chapter 6.
3. Initializing the storage system.
4. Updating the storage system software, if necessary.

After the storage system is initialized, the online help will guide you through configuring the storage system.

A

Configurations

This appendix contains rules and diagrams for attaching Fibre Channel cables between the disk drive enclosures and the controller pair.

Fibre Channel cables are fragile and susceptible to breakage, particularly if they are bent too sharply. Follow the guidelines in the rack guide for precautions on handling and bending the cables.

The rules:

- Loop pair 2 enclosures are at the top of the rack, above the controller pair.
- Loop pair 1 enclosures are at the bottom of the rack, below the controller pair.
- The A loops are connected from the topmost drive enclosure downward.
- The B loops are connected from the bottommost drive enclosure upward.

Also note:

- The A loop attachments are on the right side of the disk drive enclosures (looking from the back.)
- The B loop attachments are on the left side of the disk drive enclosures (looking from the back.)
- If an expansion bulkhead is present, the loops should be daisy chained through the bulkhead in order to make future expansion easier.

For example, Figure A-1 shows loop 1B for a 6-enclosure configuration. The loop is at the bottom because it is part of loop pair 1. The loop is connected from the bottommost enclosure upward because it is a B loop.

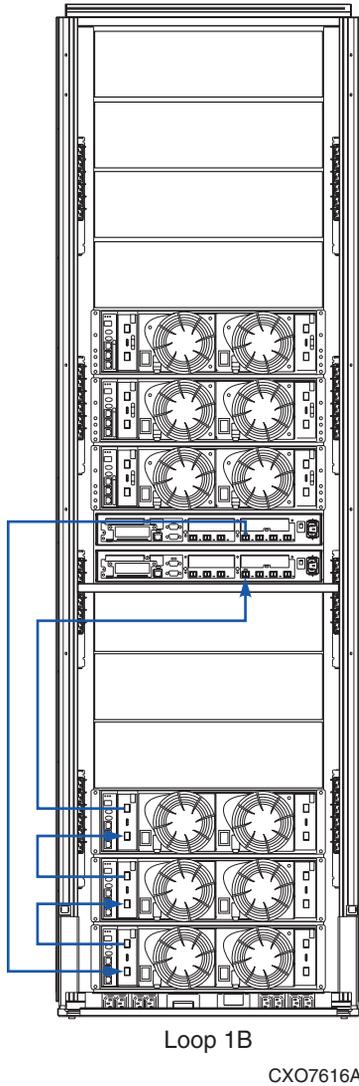
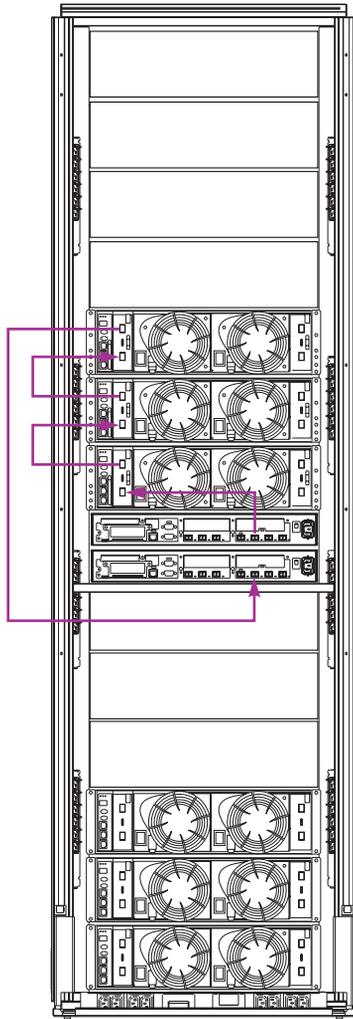


Figure A-1: Loop 1B for six-enclosure configuration with no expansion bulkhead



Loop 2B

CXO7610A

Figure A-2: Loop 2B for six-enclosure configuration with no expansion bulkhead

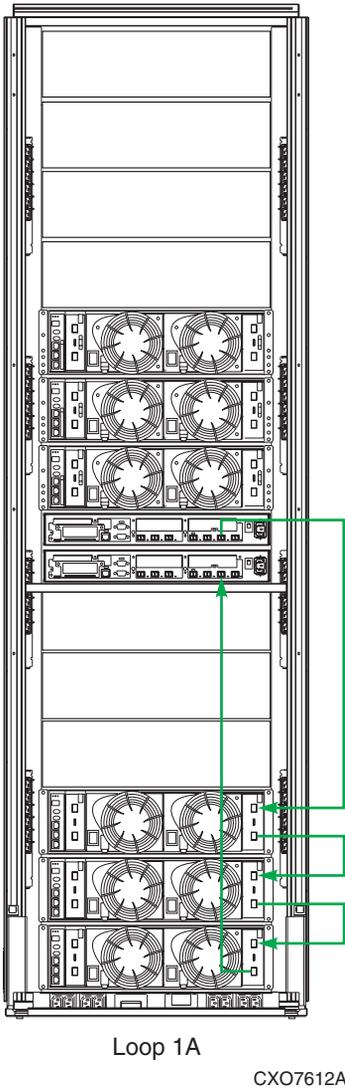
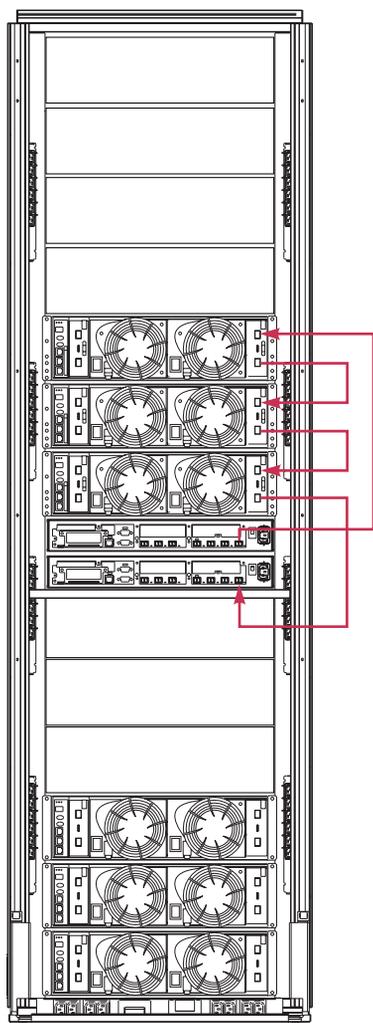


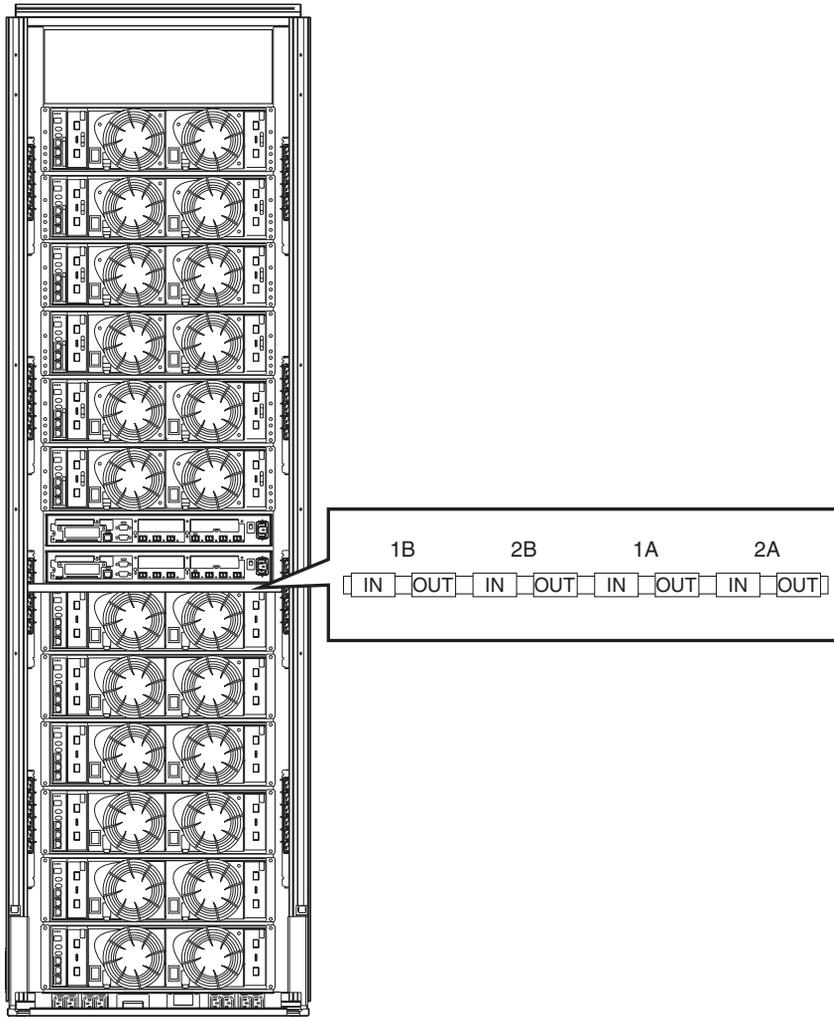
Figure A-3: Loop 1A for six-enclosure configuration with no expansion bulkhead



Loop 2A

CXO7615A

Figure A-4: Loop 2A for six-enclosure configuration with no expansion bulkhead



CXO7608A

Figure A-5: Twelve-enclosure configuration, showing location of the expansion bulkhead

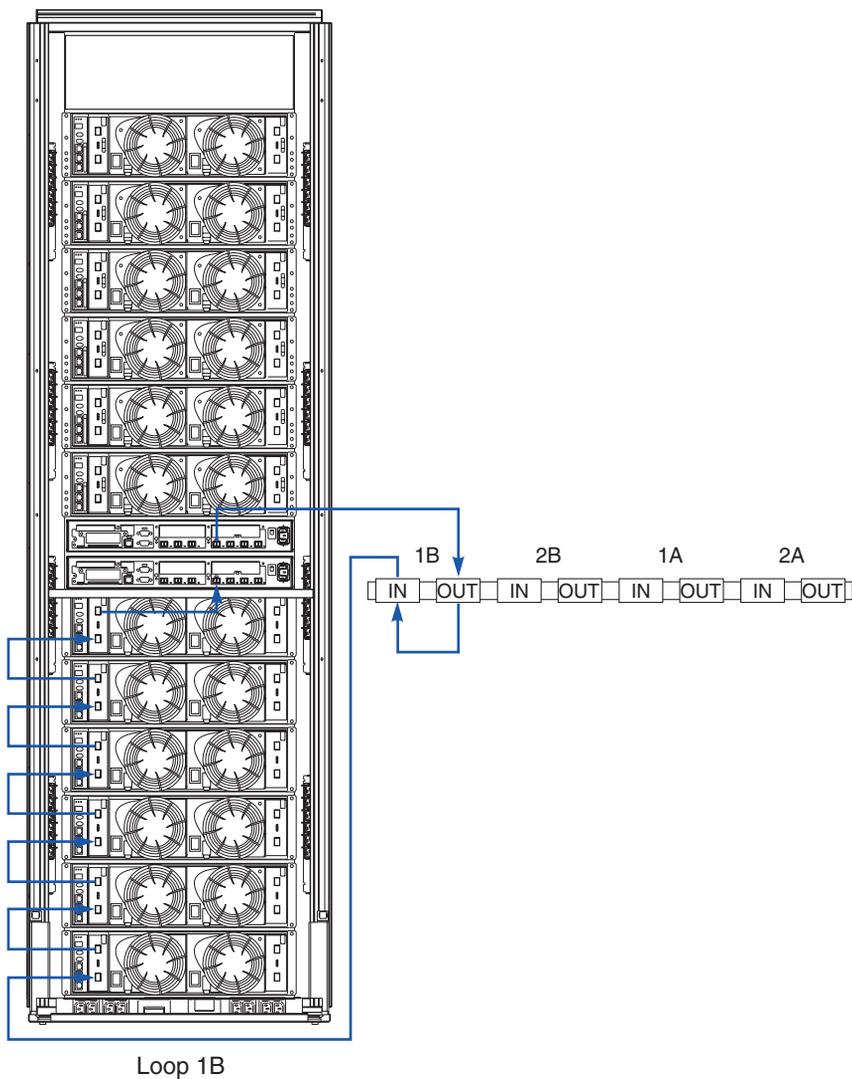


Figure A-6: Loop 1B for twelve-enclosure configuration with expansion bulkhead

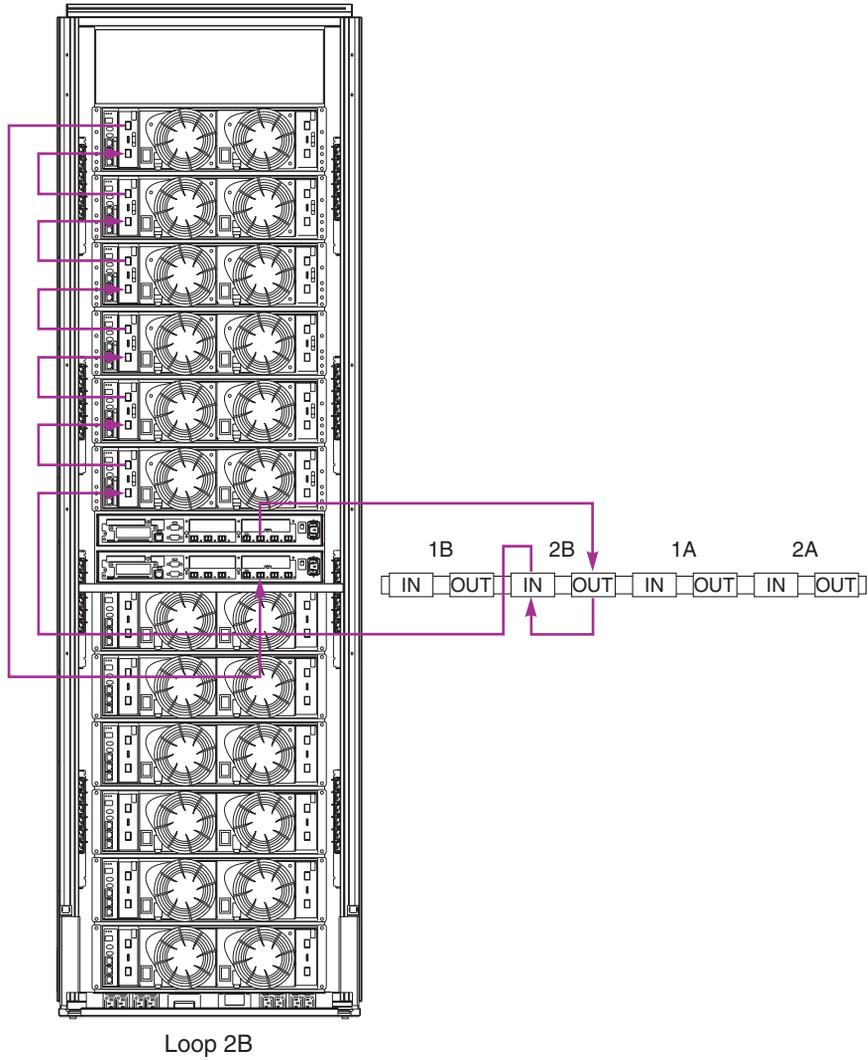


Figure A-7: Loop 2B for twelve-enclosure configuration with expansion bulkhead

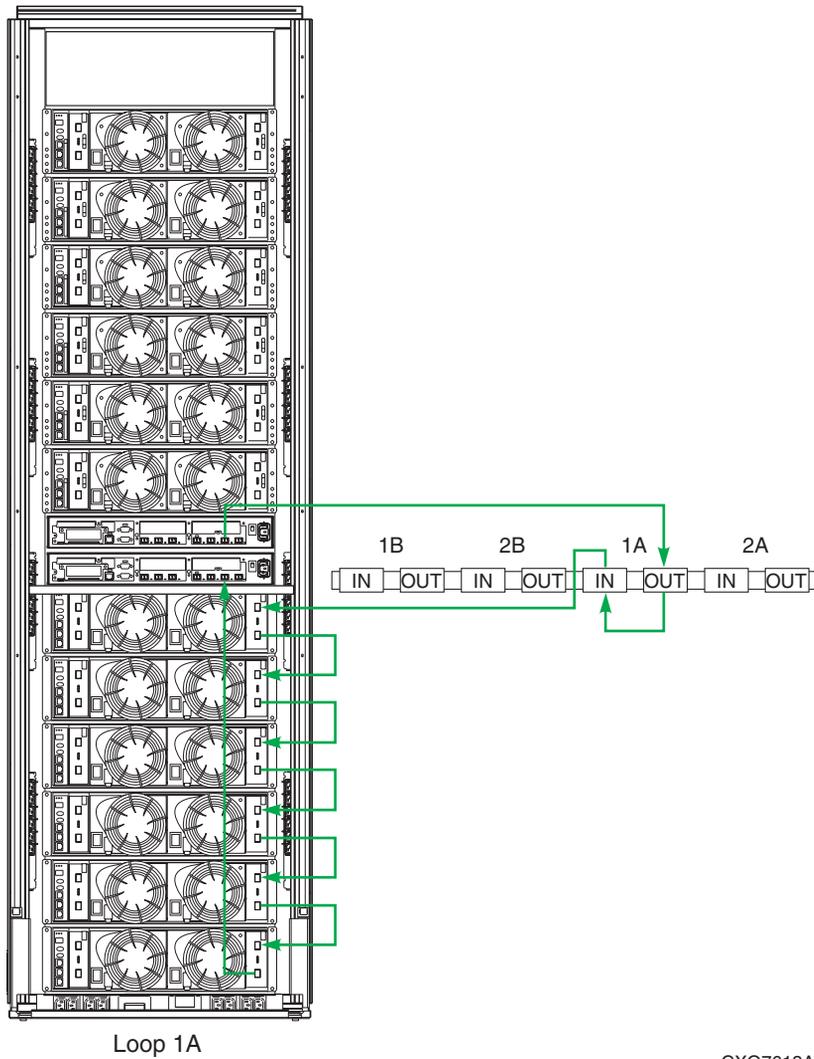


Figure A-8: Loop 1A for twelve-enclosure configuration with expansion bulkhead

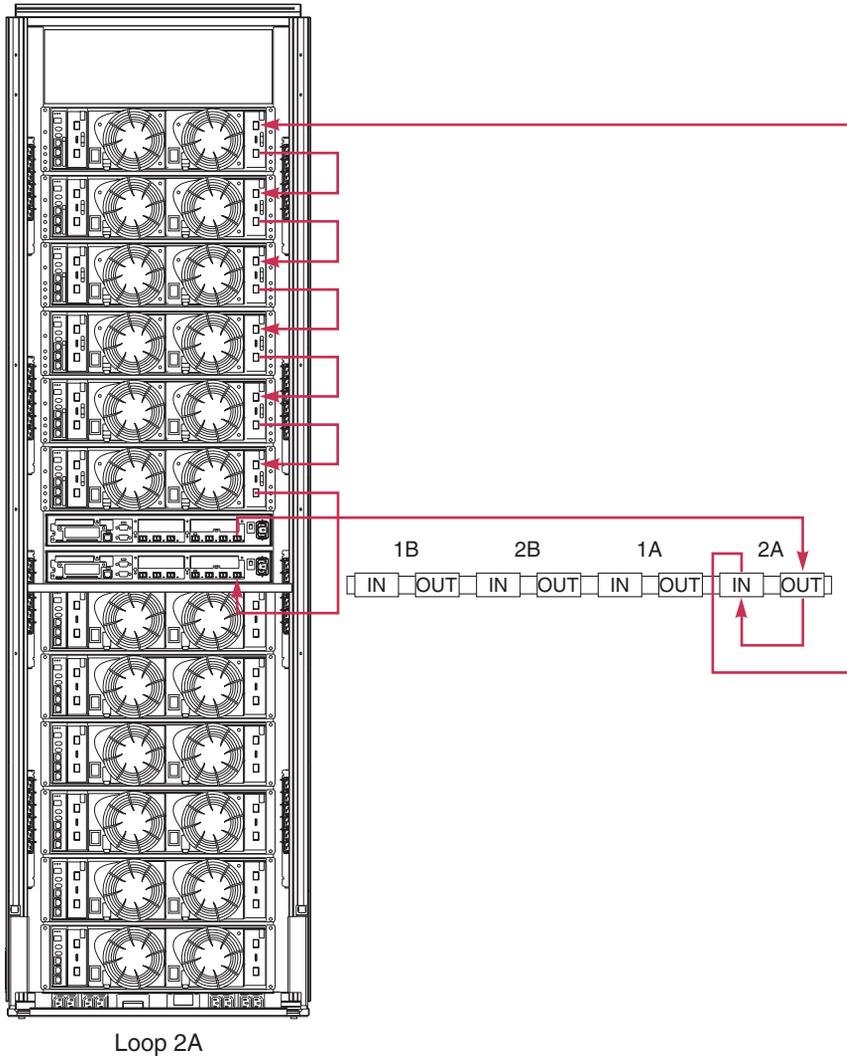


Figure A-9: Loop 2A for twelve-enclosure configuration with expansion bulkhead

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 micro meter; 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 virtual disk

A virtual disk (VD) is a simulated disk drive created by the controllers as storage for one or more hosts. An active virtual disk is accessible by one or more hosts for normal storage. An active virtual disk and its snapshot, if one exists, constitute a virtual disk family. An active virtual disk 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.

audible alarm

The environmental monitoring unit (EMU) alarm that sounds when there is a disk drive enclosure element condition report. The audible alarm can be muted or disabled.

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 both ends of the cable, the cable assembly is referred to as a jumper.

CAC

Corrective Action Code. An HSV Element Manager graphical user interface (GUI) display component that defines the action required to correct a problem.

cache

High-speed memory that sets aside data as an intermediate data buffer between a host and the storage media. The purpose of cache is to improve performance.

See also **read cache**, **write cache**, and **mirrored cache**.

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 LED

1. An orange light emitting diode (LED) that illuminates on the controller operator control panel (OCP) to define the status of the HSV Controller cache batteries.
2. An amber status LED 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 HSV Element Manager client is a standard internet browser.

communication logical unit number (LUN)

See console LUN.

Compaq SANWorks HSV Element Manager

See HSV Element Manager.

Compaq StorageWorks

The Compaq trademarked name used to describe the set of rack-mounted enclosures containing controllers, transceivers, I/O modules, EMUs, disk drives, cables, blowers, and power supplies used to design and configure a solution-specific storage system.

condition report

A three-element code generated by the EMU in the form where *et* 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 the HSV Element Manager.

controller fault LED



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

controller heartbeat LED



A green LED that flashes on the controller OCP to indicate that the HSV controller is operational.

controller pair

Two interconnected controller modules which together control a physical disk array. A controller pair and the disk array together constitute a storage system.

corrective action code

See CAC.

CRITICAL Condition

A disk drive enclosure EMU condition that occurs when one or more disk 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 is 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 FC-AL. *Also* called a device-side port.

device-side ports

See **device ports**.

DIMM

Dual Inline Memory Module. A small circuit board holding memory chips.

dirty data

The write-back cached data that has not been written to storage media even though the host operation processing the data has completed.

disk drive

A carrier-mounted storage device supporting random access to fixed size blocks of data.

disk drive blank

A carrier that replaces a disk drive to control airflow within a drive enclosure whenever there is less than a full complement of storage devices.

disk drive enclosure

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

disk drive enclosure event

A significant operational occurrence involving a hardware or software component in the disk drive enclosure. The disk 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 **disk 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**.

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 disk 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 Compaq Open SAN Manager, a controllable object, such as the Compaq StorageWorks Enterprise Storage System.

Element Manager GUI

The graphical user interface (GUI) through which a user can control and monitor a storage system. The HSV Element Manager software can be installed on more than one management appliance in a fabric. Each installation of the HSV Element Manager software 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 junction boxes and cables to assign enclosure numbers to each enclosure. Communications over this bus do not involve the FC-AL bus and are, therefore, classified as out-of-band communications.

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 Compaq StorageWorks products. A bus that connects the EMU to the 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 the HSV Element Manager.

See also controller event, disk 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 1,152,021,504,606,846,976 bytes. One exabyte is equivalent to 1,024 petabytes.

fabric

A Fibre Channel fabric switch or two or more interconnected Fibre Channel switches 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.

FC-AL

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

FC HBA

Fibre Channel Host Bus Adapter. An interchangeable term for Fibre Channel adapter.

See also FCA.

FCA

Fiber 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**.

field replaceable unit

See **FRU**.

flush

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

FMC

Fault Management Code. The HSV Element Manager display of the Enterprise Storage System error condition information.

form factor

A storage industry dimensional standard for 3.5-inch (89 mm) and 5.25-inch (133 mm) high storage devices. Device heights are specified as low-profile (1-inch or 25.4 mm), half-height (1.6-inch or 41 mm), and full-height (5.25-inch 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 provider.

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.
See also GBps
- A storage or memory capacity of 1,073,741,824 (2^{30}) bytes.

GBIC

Gigabit Interface Converter.

See transceiver.

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 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 LED

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.

HSV Element Manager

See **Element Manager**.

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 FC-AL 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 FC-AL bus.

See also **out-of-band communication**.

INFORMATION condition

A disk 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.

just a bunch of disks

See JBOD.

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.

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.

LED

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

light emitting diode

See **LED**.

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 contiguously from 0 to 126 decimal and represent the 127 valid AL_PA values on a loop (not all 256 hexadecimal values are allowed as AL_PA values per FC-AL).

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 HSV Element Manager software that controls and monitors the Enterprise Storage System. The software can exist on more than one management appliance in a fabric. Each installation of the HSV Element Manager software is a management agent.

management agent eventA 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

Megabyte. A term defining either:

- A data transfer rate.
See also MBps.
- A measure of either storage or memory capacity of 1,048,576 (2^{20}) bytes.

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 disk 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.

OCF

Operator Control Panel. The element that displays the controller's status using LEDs and an LCD. Information selection and data entry is controlled by the OCF pushbuttons.

operator control panel

See **OCP**.

OSM

Open SAN Manager. 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 Appliance, a single aggregation point for data management.

out-of-band communication

Communication between an enclosure and reporting group elements that does not use the FC-AL bus, such as the enclosure address bus.

See also **in-band communication**.

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**.

parity

A method of checking if binary numbers or characters are correct by counting the ONE bits. In odd parity, the total number of ONE bits must be odd; in even parity, the total number of ONE bits must be even. Parity information can be used to correct corrupted data.

parity bit

A binary digit added to a group of bits that checks to see if there are errors in the transmission.

parity check

A method of detecting errors when data is sent over a communications line. With even parity, the number of ONE bits in a set of binary data should be even. With odd parity, the number of ONE bits should be odd.

password

A security interlock whose purpose is to allow:

- a management agent control only certain storage systems
- only certain management agents control a storage system

PDM

Power Distribution Module. A thermal circuit breaker equipped power strip that distribute 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 disk 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.

port-wine colored

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

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 through the element manager 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 switch 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 floor-standing 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 RS-310-C*.

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 RS-310-C*. For example, a 3U unit is 5.25-inches (133.35 mm) high, and a 4U unit is 7.0-inches (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.

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 work 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 disk 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 FC-AL or SCSI on a 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 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.

short wave

A 2 Gb Compaq StorageWorks Fibre Channel system that transmits data using multi-mode fiber cables (orange) at distances up to 984 ft (300 m).

small computer system interface

See SCSI.

SMART

Self-Monitoring, Analysis, and Reporting Technology. An industry standard for running internal diagnostics on disk drives and making predictive failure analysis. If a physical disk drive reports an imminent failure, the controllers redistribute data to other drives. The SMART message is reported and should trigger the immediate corrective action to replace the drive.

snapshot

A temporary virtual disk (VD) 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. Only one snapshot 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**.

solutions rack

A rack containing controller enclosures, disk drive enclosures, power distribution, enclosure address buses, and so forth that provide a specific solution such as the Modula Solutions rack or the Enterprise Storage System rack.

See also **rack**.

spin down

A process that begins when disk drive power is removed and data transfer stops. The process ends when the head retracts and the media stops rotating. Until this occurs, the disk drive cannot be moved.

spin up

A process that begins when a disk drive's power is initiated and ends when the drive is determined to be operational and ready for data transfer operations.

SSN

Storage System Name. An HSV Element Manager-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.
See also TBps.
- A measure of either storage or memory capacity of 1,099,5111,627,776 (2^{40}) bytes.

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 switched 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. *Also* called a Gigabit Interface Converter (GBIC).

uninitialized system

A state in which the storage system is not ready for use.

See also **initialization**.

units

See **rack-mounting units**.

UNRECOVERABLE Condition

A disk 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.

VD

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 **VD**.

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 whose 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.

Index

A

alarm (audible) 5–12
Authorization ID 4–2
authorized reseller, Compaq xi

B

browser 7–1
button names, convention defined vii

C

cache battery installation 5–9
Caution, symbol and definition ix
checksum (of World Wide Name)
 enter into OCP (operator control panel) 6–5
command names, convention defined viii
Compaq
 authorized reseller xi
 technical support xi
 website xi
Compaq StorageWorks Enterprise Virtual Array
 World Wide Name (WWN) Label 3–1, 4–1,
 4–3
configurations
 dual-fabric 5–15
 rules and diagrams A–1
 single rack 5–3
content pane (of HSV Element Manager) 7–2
controller model number, OCP 6–2
conventions
 button names, defined vii
 command names, defined viii
 dialog box names, defined vii
 directory names, defined vii
 drive names, defined viii

filenames, defined viii
key sequences, defined vii
keyboard keys, defined vii
menu command sequences, defined viii
menu items, defined vii
named keys, defined vii
system responses, defined viii
URLs, defined viii
user input, defined viii

D

dialog box names, convention defined vii
directory names, convention defined vii
disk group 1–3
disk groups 1–2
documentation 1–8
drive names, convention defined viii

E

electrical requirements 5–2
electrical shock hazard, symbol and definition ix
element manager 1–3, 6–8
Enterprise Storage System
 definition 1–1
 overview 1–1
Enterprise Virtual Array
 basic layout 1–2
 definition 1–1
equipment symbols ix
excessive weight, symbol and definition x
expansion bulkhead
 cabling rule A–1
 diagram A–6
 diagram of location A–1

F

- fabric
 - attaching controllers 5–15
 - definition 5–15
 - dual configuration 5–15
- Fibre Channel cables
 - loop 1A
 - six-enclosure rack A–4
 - twelve-enclosure rack A–9
 - loop 1B
 - six-enclosure rack A–2
 - twelve-enclosure rack A–7
 - loop 2A
 - six-enclosure rack A–5
 - twelve-enclosure rack A–10
 - loop 2B
 - six-enclosure rack A–3
 - twelve-enclosure rack A–8
- filenames, convention defined viii

G

- getting help xi
 - Compaq technical support xi
 - Compaq website xi
- getting started 2–1

H

- Help, obtaining xi
- hot surface, symbol and definition x
- HSV controllers 1–1
- HSV Element Manager
 - content pane 7–2
 - definition 1–6
 - description 1–3
 - installation 7–1
 - license key entry 4–4
 - location of install instructions 1–9
 - Management Appliance 1–6
 - navigation pane 7–2
 - overview 7–2
 - session pane 7–2

I

- Important, defined ix
- indicators
 - back view on power up 5–14
 - front view on powerup 5–13
- installation
 - 50-Hz 5–2
 - 60-Hz 5–2
 - apply power 5–11
 - attach to fabric 5–15
 - electrical requirements 5–2
 - install cache batteries 5–9
 - inventory 5–1
 - lower a leveling foot 5–6
 - move a rack 5–4
 - normal powerup 5–14
 - state of front indicators 5–13
 - raise a leveling foot 5–5
 - site requirements 5–2
 - space requirements 5–3
 - stabilize the rack 5–6
 - temperature stabilization 5–11

K

- key sequences, convention defined vii
- keyboard keys, convention defined vii

L

- LEDs
 - state on normal powerup
 - back view 5–14
 - front view 5–13
- leveling 1–3
- license
 - basic 4–1
 - definition 4–1
 - license key 4–3
 - snapshot
 - definition 4–3
 - key 4–1
 - process 4–4
- license fulfillment process 4–3

license fulfillment website 4-2, 4-3
license key 4-1, 4-3, 4-4, 7-2
License Key Retrieval Instruction Sheet 3-1,
4-1, 4-2, 4-3, 4-4

loop cabling

loop 1A

six-enclosure rack A-4
twelve-enclosure rack A-9

loop 1B

six-enclosure rack A-2
twelve-enclosure rack A-7

loop 2A

six-enclosure rack A-5
twelve-enclosure rack A-10

loop 2B

six-enclosure rack A-3
twelve-enclosure rack A-8

rules A-1

loop pairs 1-6

lower a leveling foot 5-6

M

management

agent 6-8
software 1-1

Management Appliance

element manager 1-3
HSV Element Manager 1-6
installation of update 1-9

management appliance 6-8, 7-1

menu command sequences, convention defined
viii

menu items, convention defined vii

move a rack 5-4

multiple power source, symbol and definition x

N

named keys, convention defined vii

navigation pane (of HSV Element Manager) 7-2

network interface connection, symbol and
definition ix

normal powerup

state of back indicators 5-14

state of front indicators 5-13

Note, defined ix

O

OCP (operator control panel)

displays and controls (illustration) 6-1
pushbuttons 6-2
reference icons 6-2
startup display 6-2

online help 1-8

P

password 7-2

password (storage system)

definition 6-8
entry into controller OCP 6-9

power distribution units

circuit breakers 5-12
location 5-11

power up 5-11

pushbuttons 6-2

R

rack stability x

raise a leveling foot 5-5

S

session pane (of HSV Element Manager) 7-2

single rack configuration 5-3

site prerequisites 5-1

site requirements 5-2

snapshot

feature 3-1
license 4-1

software

update 7-2
VCS 4-1

space requirements 5-3

stabilize the rack 5-6

state of back indicators 5-14

storage system

connections 1-7
documentation 1-8

- electrical requirements 5–2
- facric attachment 5–14
- functional layout 1–2
- host ports 5–15
- moving 5–4
- password 6–8
- physical layout 1–5
- software update 7–2
- space requirements 5–3
- storage system password
 - entry into OCP 6–9
- switches (Fibre Channel) 5–15
- symbols
 - in text ix
 - on equipment ix
- system responses, convention defined viii

T

- technical support, Compaq xi
- temperature stabilization 5–11
- text symbols ix

U

- URLs, convention defined viii
- user input, convention defined viii

V

- VCS
 - definition 4–1
 - license keys 4–3
- Virtual Controller Software

- see VCS 4–1
- virtual disk 1–2, 1–3
- virtualization 1–1
 - defined 1–1
 - disk orgainzation 1–2
 - techniques 1–3

W

- Warning
 - electrical shock hazard symbol, defined ix
 - excessive weight symbol, defined x
 - hot surface symbol, defined x
 - multiple power source symbol, defined x
 - network interface connection symbol, defined ix
 - symbol and definition ix
- websites
 - Compaq storage xi
 - Compaq technical support xi
- World Wide Name
 - enter into OCP (operator control panel) 6–5
 - entry into controller OCP 6–4
 - license fulfillment 4–3
 - node 6–4
 - origin 4–1
 - relationship to storage system 4–2
- World Wide Name label
 - document 6–4
 - installation instructions 5–7
 - location 4–4