Compaq SANworks

Secure Path Version 3.0 for HP-UX
Installation and Reference Guide

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This guide describes the SANworks Secure Path software. It includes
information about Secure Path technology, installation procedures for
HP-UX, including specific technology information, and management
commands.

COMPAQ

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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

The conventions included in Table 1 apply in most cases.

Table 1: Text Conventions

Element	Convention	Examples
file names	*Italics,* unless the file name is included in a directory name/path.	• To configure storage, edit *storageset.ini*. • (Directory name/path): Errors are logged to \syslog\errors\config_errors.txt.
• `User Input` • Command Names	command names appear in helvetica, unless they are case sensitive. Entered `<variables>` are displayed in angle brackets (`<  >`) and all lowercase.	• To exit from the program, type `exit`. • At the prompt, type this command: show this_controller • Use set this_controller to change parameters. (no variable) • To see your settings, give the command: SHOW <storagesets> FULL (with variable)

Table 1: Text Conventions (Continued)

Element	Convention	Examples
• System Responses (Output and Messages) • Drive Names	Helvetica.	• You will see the Disk Full message.
URLs	Sans serif font.	For update notices, visit: http://www.compaq.com

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 data.

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 enclosed 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. Contact with this surface could result in injury.

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 presence of multiple sources of power.

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

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 manually handling material.

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.**
> - **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 still have a question after reading this guide, contact your service representative or visit our website.

Compaq Technical Support

In North America, call Compaq technical support at 1-800-OK-COMPAQ, available 24 hours a day, 7 days a week.

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

Outside North America, call Compaq technical support at the nearest location. Telephone numbers for worldwide technical support are listed on the Compaq website: http://www.compaq.com.

Be sure to have the following information available before calling:

- 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. Access the Compaq website at: http://www.compaq.com/storage. From this website, select the appropriate product or solution.

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.

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Secure Path Technology

Compaq *SANworks*^{TM} Secure Path is a server-based software product that enhances *StorageWorks*^{TM} RAID Array storage systems by providing automatic recovery of data from server-to-storage system connection failures. Secure Path supports multiple I/O paths between host and storage, which improves overall data availability. If any component in a path between host and storage fails, Secure Path redirects pending and subsequent I/O requests to an alternate path.

This chapter provides the following Secure Path information:

- Overview
- Features
- Controller Ownership
- Software Components
- Details
- Secure Path Operation
- Path Management Behavior Summary.

Overview

Compaq *SANworks* Secure Path for HP-UX is a high-availability software product that manages and maintains continuous data access to the following Compaq StorageWorks storage systems:

- RA8000
- ESA12000
- MA8000
- EMA12000
- MA6000.

Secure Path eliminates the RAID controller, host bus adapter (HBA), and interconnect hardware (cables, switches, and connectivity devices) as single points of failure in the storage system.

Through the deployment of redundant hardware and advanced RAID technology, Secure Path enhances fault tolerance and storage system availability by providing automated failover capability.

Redundant physical connections define separate physical "paths" in a Secure Path hardware configuration. Each path originates at a unique HBA port on a server, and ends at a unique RAID controller port in the storage system.

Figure 1–1 illustrates basic Secure Path hardware configurations. The physical connections define two separate paths. Each path originates at a unique Storage Area Network (SAN) host bus adapter on a server and ends at a port on a separate RAID controller on the storage system.

SHR-2456A
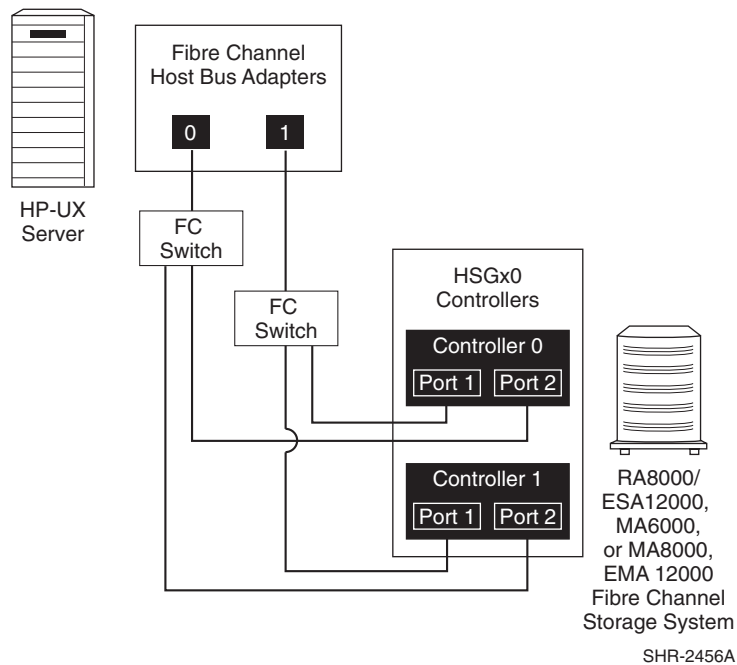
Figure 1–1: Basic Secure Path Fibre Channel configuration

Secure Path enables dual StorageWorks RAID controllers to operate in an active/active implementation, referred to as dual-redundant multiple-bus mode. Multiple-bus mode allows each controller to process I/O independently of the other controller under normal operation. A path consists of a unique connection from adapter to device. I/O is active on one path at a time and storage units (LUNs) may be moved between paths using the Secure Path Management Tool *spmgr*.

Secure Path takes advantage of the HSG80 preferred path unit attribute. Available storage units are preferred to one or the other of the two controllers by setting a preferred path unit attribute. This attribute determines which controller is used for access at system boot time. During runtime, storage units may be moved between paths at any time through the use of the Secure Path Management utility. On HSG80 RAID devices, storage units may also be accessed on each controller through either of two available ports.

The Secure Path software detects the failure of I/O operations on a failed path and automatically re-routes traffic to other available paths. Secure Path software will seek alternate paths through available SAN switches, controllers, controller ports, and/or host bus adapters. Path failover is completed seamlessly, without process disruption or data loss.

Following a replacement of an adapter or cable component, failed controller, or switch, storage units can be restored or failed-back to their original path using the Secure Path Management utility.

To protect against drive failure in a Secure Path environment, storage units can be configured using RAID Levels 0+1, 1, 3/5, or 5.

Features

Secure Path provides the following features:

- Allows StorageWorks dual-controller RAID systems and host servers equipped with multiple HBA redundant physical connectivity along SAN-switched fabric paths.

- Monitors each path and automatically re-routes I/O to a functioning alternate path if an HBA, cable, switch or controller failure occurs.

- Determines the "health" of available storage units and physical paths through the implementation of path verification diagnostics.

- Monitors and identifies failed paths and failed-over storage units.

- Facilitates static load balancing, which allows manual movement of devices between paths.

- Automatically restores failed-over storage units to repaired paths with auto-failback capability enabled.

- Implements anti-thrash filters to prevent failover/failback effects caused by marginal or intermittent conditions.

- Exploits the potential for improved data throughput and increased bandwidth using dual RAID controllers configured in multiple-bus mode operation with load balancing capability enabled.

- Detects failures reliably without inducing false or unnecessary failovers.

- Implements failover/failback actions transparently without disrupting applications.

Software Components

The Secure Path Software Kit for HP-UX includes the following software components.

Drivers

The Secure Path drivers manage paths to a storage device while providing a single device target to applications.

- **swsp driver**–a failover driver that is presented as a pseudo-HBA driver to system SCSI disk drivers. This driver presents multiple paths as a single device to the host SCSI disk driver. It also initiates path failover when necessary and manages all kernel threads related to failover.

- **hsx driver**–an array-specific driver that provides paths from an HBA driver for specific arrays up to the swsp driver. This driver manages the separate paths to a LUN and encapsulates array-specific knowledge such as specific commands to migrate a LUN from one controller to the other. The hsx driver supports Compaq StorageWorks HSG controllers.

Figure 1–2 illustrates the driver model structure.
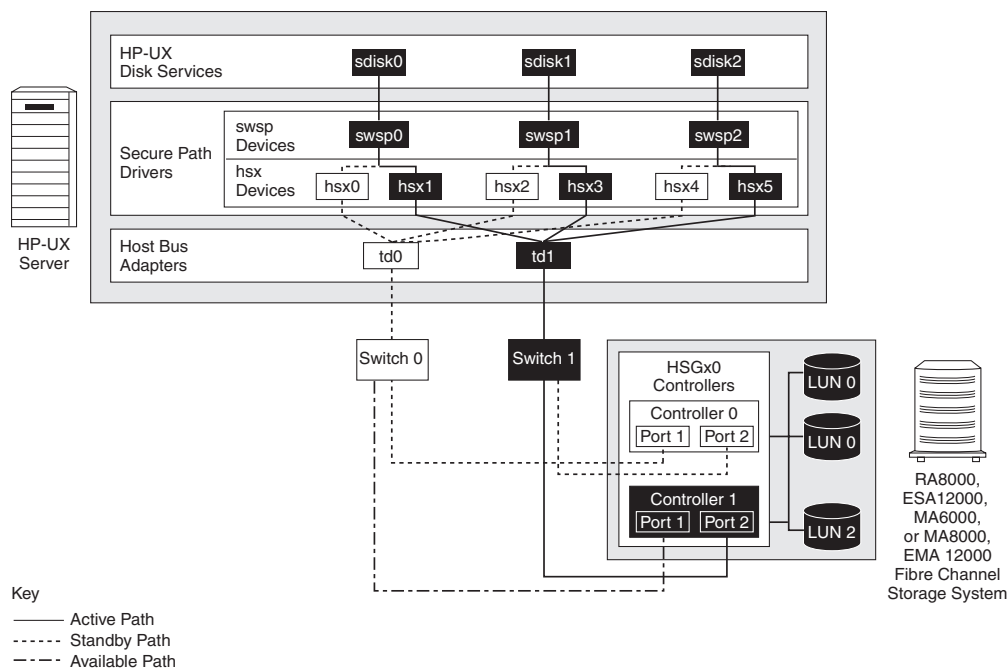
Figure 1–2: Driver Model Structure

Agent

The Secure Path agent (*spagent*) is a daemon process that provides an interface for Secure Path applications and utilities to communicate to the multipath drivers. The *spagent* also provides notification of path change events through e-mail. The *spagent* is not required to be running for Secure Path drivers to configure and provide full failover functionality; however, it must be running if e-mail event notification is desired.

Management Tools

The Secure Path Manager (*spmgr*) is a command line application that allows users to monitor and manage Secure Path devices and to change the configuration settings of the drivers. See Chapter 4 for a complete description of *spmgr* commands.

The *spinit* script is used to start and stop the Secure Path agent: /sbin/spagent.

Configuration Tool

The Secure Path configuration utility runs during Secure Path installation. It performs the following functions:

- Queries storage systems

- Enables the user to modify the storage configuration

- Modifies driver configuration files for Secure Path.

Controller Ownership

Storage systems that are multiple-bus capable generally contain a pair of redundant controllers and support one of the following basic operational models:

- **Active/passive**–In the active/passive model, all storagesets are assigned ownership to one controller of the pair for I/O processing. The other controller is inactive, but available as a substitute in case of failure on the original.

- **Active/active**–In the active/active model, I/O processing may be routed through both controllers simultaneously, providing better performance in addition to high availability. The RAID Arrays supported by Secure Path implement a modified version of the active/active model. While I/O can be processed simultaneously by both controllers, any given storageset is "owned" or online to a host through only one controller. Ownership of a storageset may be transferred to the other controller at any time through a host-initiated command sequence.

  However, since the ownership transfer results in controller cache flushing and I/O wind down, the storageset may become inaccessible for a period of several seconds to complete this sequence. Arbitrary ownership transfers are never automatically initiated by Secure Path and should be avoided by the user.

NOTE: Secure Path automatically retries I/O requests that terminated in error due to ownership transfers. It also queues new I/O requests until the ownership transfer has completed to ensure data integrity.

Path Definition

Within Secure Path, a path is defined as the collection (configuration) of physical interconnect components including HBAs, switches, cables, RAID controllers, and the ports on the controllers. Since the Secure Path driver component is positioned between the HBA driver and the system SCSI disk driver, the Secure Path driver can only distinguish physical paths when elements of the SCSI equivalent address are different.

Some configurations include multiple switches within a fabric with the switches connected by one or more inter-switch links. These paths are neither directly visible to nor manageable by Secure Path. While these inter-switch paths provide an additional level of redundancy within the fabric, their management is handled directly within the switch. Refer to the documentation received with your switch hardware for more information about inter-switch link routing and failover policies.

The Path State is set automatically by Secure Path and reflects the status of the current actual path, which may deviate from user expectations because of path failures. See Table 4–4 on page 4-5 for a list and description of Path states and attributes.

Secure Path Operation

Failover occurs automatically when a selected set of error conditions is detected. Secure Path normally performs path failover only when user I/O is active or if path verification is enabled. However, it is possible for Secure Path Manager to show some units with a common failed path in the fail-over state, while other units appear to remain accessible through that path. Units remain in the failed path if there is no I/O or until polled.

Failover follows a certain hierarchy, conditioned by the state of Load Balancing as described below. Secure Path does not change the mode of "Preferred" paths in failover situations, so you can restore original path assignments after making repairs.

*   Load Balancing *disabled*:

    Secure Path marks the path failed and switches to the next "Available" path connected to the same controller, if such exists.

    If there is no "Available" path on the same controller, Secure Path attempts to move the device to a "Standby" path on the other controller.

*   Load Balancing *enabled*:

    Initially, failover consists of marking a bad path "failed," which effectively removes it from the list of usable paths for the storageset.

— If no "Active" paths remain for the device, Secure Path activates an "Available" path on the same controller, if one exists.

— If no "Available" paths remain on the same controller Secure Path attempts to move the device to an "Standby" path on the other controller.

Failback Options

Secure Path enables the user to set the path failback option to manual or automatic.

- In manual mode, devices are restored to their preferred path through a management utility command. The operation is performed even if system I/O is in process to the selected device.

- In auto-restore mode, Secure Path tests a failed path at fixed intervals if I/O is in process for the affected device. If the path appears to be viable, the Path State is set to "Active" and I/O will again be routed through this path.

Load Balancing

When enabled, Load Balancing allows multiple paths between a host and a specific storageset to be utilized in parallel. Fibre Channel interconnection schemes result in multiple paths between a host and each controller. I/O intended for storagesets connected to a given controller alternately dispatches through the set of appropriate paths, spreading the load across all components in the RAID storage system and maximizing performance potential. Load Balancing may not be used in other environments that utilize device reservations as a lock mechanism since the RAID array controllers enforce reservations on a per-port basis.

Load Balancing requires a Fibre Channel configuration that results in at least four unique paths from the host node to the storage system. While this can be accomplished with several different physical configurations, maximum performance potential is achieved when all four ports of the RAID storage system are used.

When Load Balancing is enabled, the Secure Path driver causes all paths to the owning controller to be marked "Active" by default. This is true when the following conditions occur:

- A host boots up.

- Secure Path fails over a storageset from one controller to the other.

- A user manually moves a selected storageset between controllers using the Secure Path management utility, *spmgr*.

Path Verification

When enabled with *spmgr*, Path Verification causes Secure Path to periodically test the viability of all paths to all storagesets for paths marked "Available," "Failed," "Active, or "Standby." Path Verification does not test paths that are in a "Quiesced" state.

Path Verification is useful for detecting failures that affect overall path redundancy before they affect failover capability. If an "Active" path fails path verification, failover occurs. If an "Available" path fails path verification, its state will change from "Available" to "Failed."

If a path marked "Failed" passes path verification, the Path State is set to "Available." If auto-failback is enabled, the path becomes "Active." If the path is on the "Active" controller it is marked preferred.

Path Management Behavior Summary

Table 1–1 provides a summary of path management behavior conditioned by the optional features of Secure Path.

Table 1–1: Path Management Behavior Summary

Feature	Behavior/Action
Startup	1. Choose the "Preferred" path to the controller on which the LUN is online. 2. Mark it "Active." If no path is marked "Preferred" select one and make it the the "Active" Path.
Active Path Failure	• Secure Path marks the "Active" as failed. • Secure Path moves I/O through available paths. • If there are no "Available" paths, failover occurs to a "Standby" path on the other controller.
Available or Standby Path Failure	• Failed path is marked failed. • Behavior is result of background path verification.

Table 1–1: Path Management Behavior Summary (Continued)

Feature	Behavior/Action
Path Repaired	• Path is marked "Available" or "Standby" depending on to which controller the device is currently online. • If auto-failback is enabled, and the path was the "Active" path prior to the path failure, the path is made the "Active" path.

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Hardware Setup

This chapter provides the following Secure Path hardware setup information:

*   Hardware Setup Overview

*   Installing a New Secure Path Configuration

*   Configuring Switches

*   Adding Secure Path to an Existing Configuration

*   Configuring the StorageWorks Array

*   Performing set up information, as described in System Configuration

*   Configuring the StorageWorks Array

*   Configuring Optional Array Features

Hardware Setup Overview

The following procedure presents an overview of the hardware setup.

1. Prior to setting up your hardware, perform the following verificaitons:

    *   Be sure all users have logged off the server.

    *   All array file systems have been backed up and unmounted.

    *   All volume groups have been exported.

2. Perform one of the following procedures:

    *   If your StorageWorks array has not been configured with your HP server perform the procedure "Installing a New Secure Path Configuration" on page 2-2.

    *   If your array has been configured with your server with a Compaq 218409-B21 (QLC2200) Fabric, perform the procedures described in "Updating an Existing 218409-B21 (QLC2200) Fabric Configuration" on page 2-3.

- If your array has been configured with your server with an HP A5158A QuickLoop, perform the procedure described in "Updating an Existing A5158A QuickLoop Configuration" on page 2-5.

3. Configure switches, as described on page 2–6.

4. Configure the StorageWorks RAID array, as described on page 2–6.

5. Perform system configuration, as described on page 2–14.

Installing a New Secure Path Configuration

Before connecting the RA8000, MA6000/MA8000, ESA12000, or EMA12000 to your host system, perform the following verifications:

- Verify that HP-UX 11.0 is running.

- Verify that at least one A5158A or A6685A FC adapter has been installed with the version B.11.00.06 or B.11.00.08 FC driver respectively.

- Verify that the required patches (see Secure Path V3.0 for HP-UX Release Notes) have been installed.

Perform the following steps to connect the RA8000, MA6000, MA8000, ESA12000, or EMA12000 to your host system. Refer to the configuration schematic in Figure 2–1 on page 2-4 to create the correct connections.

NOTE: This configuration has been recommended to optimize storage component availability.

1. Shut down your HP system and ensure that all power switches on the HSG80/HSG60 array and on the host computer system are in the off position.

2. Connect FC cables between the A5158A or A6685A FC adapters and ports on the Compaq SAN switch.

3. Connect FC cables from each HSG80/HSG60 array controller port to the Compaq SAN switch.

4. Continue with "Configuring Switches" on page 2-6.

Adding Secure Path to an Existing Configuration

Updating an Existing 218409-B21 (QLC2200) Fabric Configuration

1. If running StorageWorks Command Console, stop the SWCC agent and disable Agent startup at boot. For details, see the *HSG80 ACS Solution Software for HP-UX Installation and Configuration Guide.*

2. Use Software Distributor (SD) to remove the BHPUX1100QLC2200 driver.

3. After the reboot, shutdown and halt the server and power it off.

4. Follow HP's procedures for removing the Compaq 218409-B21 (QLC2200) adapters and replacing them with at least one HP A5158A adapter.

5. Shut down the StorageWorks Array by performing the following steps:

   a. Access the array's command line interface by connecting a terminal or PC to the maintenance port of one of the controllers in the subsystem.

   b. Shut down the controllers by entering the following commands:

      HSG80> shutdown other_controller

      HSG80> shutdown this_controller

   When the controllers shut down, the reset buttons and the first three LEDs turn on. It might take several minutes for this indication to appear, depending on the amount of data that needs to be flushed from the cache modules.

   c. Remove power to the subsystem.

6. Refer to the configuration schematic in Figure 2–1 on page 2–4 and perform the following actions:

   a. Connect the FC cables between the A5158A FC adapters and ports on the Compaq SAN switch.

   b. Connect the FC cables from each HSG80/HSG60 array controller port to the Compaq SAN switch.

   NOTE: These configurations have been selected to optimize storage component availability.

7. Power on and boot the server.

8. Follow the procedures provided in the HP documentation for installing the A5158A version B.11.00.06 Fibre Channel driver.

9. Verify that the required patches (see Secure Path V3.0 Release Notes for HP-UX) have been installed using swlist patch_name.

10. Shut down the server and power it off.

11. Continue with "Configuring Switches" on page 2-6.
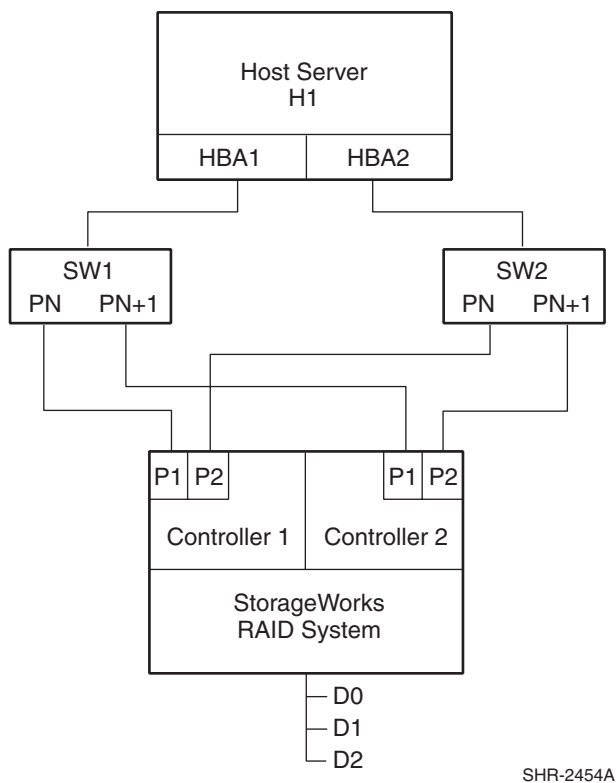
Figure 2–1: Configuration Schematic

Updating an Existing A5158A QuickLoop Configuration

Before updating an existing A5158A QuickLoop configuration, perform the following verifications:

- Verify that HP-UX 11.0 is running.
- Verify that at least one A5158A FC adapter has been installed with the version B.11.00.06 Fibre Channel driver, using swlist.
- Verify that the required patches (see Secure Path V3.0 Release Notes for HP-UX) have been installed using swlist patch_name.

Perform the following steps to update an existing A5158A QuickLoop configuration.

1. Update the driver and patches.

2. If running StorageWorks Command Console, stop the SWCC agent and disable Agent startup at boot. For details see the *HSG80 ACS Solution Software for HP-UX Installation and Configuration Guide*.

3. Shut down and halt the server and power it off.

4. Shut down the StorageWorks Array by performing the following steps:

    a. Access the array's CLI by connecting a terminal or PC to the maintenance port of one of the controllers in the subsystem.

    b. Shut down the controllers by entering the following commands:

       HSG80> shutdown other_controller

       HSG80> shutdown this_controller.

       When the controllers shut down, the reset buttons and the first three LEDs turn on. It might take several minutes for this indication to appear depending on the amount of data that needs to be flushed from the cache modules.

    c. Remove power to the subsystem.

5. Refer to the configuration schematic in Figure 2–1 on page 2–4 to perform the following actions:

    a. Connect the FC cables between the A5158A FC adapters and ports on the Compaq FC switch.

    b. Connect the FC cables from each HSG80/HSG60 array controller port to the Compaq FC switch.

    NOTE: These configurations have been selected to optimize storage component availability.

6. Continue with the "Configuring Switches" procedure below.

Configuring Switches

1. Turn on the power to the SAN switches.

2. Log on to the switch.

   NOTE: For more information, refer to the *Fibre Channel SAN Switch Management Guide* that was shipped with your Compaq switch.

3. At the switch:admin prompt, verify that the switch is in Fabric mode and not in QuickLoop mode by entering the following command:

   switch:admin> qlShow

   a. If the switch responds: `Switch is not in QuickLoop mode.`, go to Step 4.

   b. If the switch is in QuickLoop mode, disable QuickLoop by entering the following command:

   switch:admin> qlDisable

   The switch should respond by displaying the following information:

   Setting switch to Fabric mode.

   Committing configuration...done.

   Re-enable FL_ports

4. Turn on the power to the StorageWorks array and continue with the "Configuring the StorageWorks Array" procedure below.

Configuring the StorageWorks Array

1. Establish a terminal connection to the top controller's Command Line Interpreter (CLI) port. See your *HSG80 ACS Solution Software for HP-UX Installation and Configuration Guide* for help in making that connection.

2. To see your existing array configuration, enter the following CLI commands:

   HSG80> show this_controller

   HSG80> show other_controller

3. Determine whether your array is in transparent failover or multibus mode and whether it is configured for loop or fabric. Based on this result, execute all or part of the following steps.

4. Configure the RA8000, MA6000, MA8000, ESA12000, or EMA12000 array for fabric and for multibus operation by accessing the CLI. For more information about the CLI and configuring the array, see the *HSG80 ACS Solution Software for HP-UX Installation and Configuration Guide* and the *HSG80 Array Controller CLI Reference Guide.* These documents came with your *HSG80 ACS Solution Software for HP-UX Solution Software Platform Kit.*

5. To set the array for SAN-switched fabric, enter the following commands:

   HSG80> set this_controller port_1_topology=offline

   HSG80> set this_controller port_1_topology=fabric

   HSG80> set other_controller port_1_topology=offline

   HSG80> set other_controller port_1_topology=fabric

   HSG80> set this_controller port_2_topology=offline

   HSG80> set this_controller port_2_topology=fabric

   HSG80> set other_controller port_2_topology=offline

   HSG80> set other_controller port_2_topology=fabric

6. Configure the RAID system controllers for multiple-bus failover mode by entering the following commands and performing the following actions:

   HSG80> set nofailover

   IMPORTANT: The "other" controller will shut down and must be manually restarted by momentarily depressing the reset button on the controller's front panel. Wait for two minutes for the controller to boot before proceeding. Ignore the "controller misconfigured" messages.

   HSG80> set multibus_failover copy=this_controller

7. The controllers will restart in multiple-bus mode. Wait two minutes for the controllers to reboot before proceeding.

8. After the controllers restart, verify that both controllers are configured for multiple-bus mode by entering the following commands:

   HSG80> show this_controller

   HSG80> show other_controller

9. If this is a new factory-configured array or one that is being reconfigured, the array's internal connection table probably contains connections that are out of date. Therefore, perform the following steps:

   a. Review the array's internal connection table by entering the following command:

      HSG80> show connections

   b. Delete all connections to this host that are shown in the array's internal connection table. The first time the server scans the Fibre Channel bus during boot, the new connections will be registered.

      Delete each connection by entering the following command:

      HSG80> delete connection_name

      Where: connection_name is one of the names listed in the array's internal connection table that displayed when you issued the show connections command in Step 9a.

10. Complete readying the array by creating storagesets and assigning LUN unit numbers, noting the following information:

    • Refer to the *HSG80 ACS Solution Software for HP-UX Installation and Configuration Guide* that came with your StorageWorks Solution Software Kit for details.

    • If you are reconfiguring an array that already had storagesets configured, you may use these units without reconfiguring as long as you are using units D0 through D7. If you are using offset LUNs, D8 through D199, you must re-configure these units.

    • You may configure up to 8 LUNs for each array in this part of the installation. See "Setting Up Additional LUNs" on page 2-9, if you require up to 8 additional LUNs.

Configuring Optional Array Features

This section provides the following optional RA8000, MA6000, MA8000, ESA12000, or EMA12000 array feature setup information and procedures:

- "Setting Up Additional LUNs" on page 2-9

- "Preferring a Unit to a Controller" on page 2-12

- "Using SCSI-3" on page 2-12

- "Managing the Command Console LUN (in SCSI-2 Mode)" on page 2-13

Setting Up Additional LUNs

The HP-UX 11.0 *sdisk* driver allows only 8 LUNs per target. The RA8000, MA6000, MA8000, ESA12000, or EMA12000 array normally presents the LUNs as a single target. The array can be set up to present a second target of another 8 LUNs for a maximum of 16 LUNs for the array.

When deciding which configuration to use, refer to the following table.

Table 2–1: Target/LUNS per Array Comparison Chart Assuming Dual Fabric

Highest Availability	Lower Availability	Highest Availability
8 LUNs/array 2 HBAs/server	16 LUNs/array 2 HBAs/server	16 LUNs/array 4 HBAs/server
4 paths/LUN	2 paths/LUN	4 paths/LUN
load balancing (across 2 HBAs and 2 controller ports)	no load balancing	load balancing (across 2 HBAs)

Due to the architecture of the RA8000, MA6000, MA8000, ESA12000, or EMA12000 array, load balancing can only be accomplished across ports of the selected controller in a redundant controller pair.

NOTE: Review Figure 2–1 on page 2-4 for a pictorial understanding of these tradeoffs.

Use Figure 2–1 on page 2-4 to map the physical adapter connections to the array through each switch.

1. Complete all configuration steps described in "Hardware Setup Overview" on page 2-1.

The *ioscan* during the boot sets up the connection table in the array. Modifications to the array's connection table enable the second target of LUNs.

2. Enter the following command for each A5158A or A6685A adapter:

   # fcmsutil /dev/td#

3. Record the adapter's N_Port Port World Wide Name (the last 4 hex digits should suffice) on the configuration drawing.

4. Establish a CLI connection to the array and enter the following command:

   HSG80> show connections

   A connection table (similar to the following) displays:

Connection				Unit		
Name	Operating system	Controller	Port	Address	Status	Offset
!NEWCON13	HP	THIS	1	011000	OL this	0
HOST_ID=5006-0B00-0009-DB13			ADAPTER_ID=5006-0B00-0009-DB12			
!NEWCON14	HP	OTHER	1	021000	OL other	0
HOST_ID=5006-0B00-0009-DB13			ADAPTER_ID=5006-0B00-0009-DB12			
!NEWCON15	HP	OTHER	2	021000	OL other	0
HOST_ID=5006-0B00-0009-DD71			ADAPTER_ID=5006-0B00-0009-DD70			
!NEWCON16	HP	THIS	2	011000	OL this	0
HOST_ID=5006-0B00-0009-DD71			ADAPTER_ID=5006-0B00-0009-DD70			

   On this sample table you can see that the adapter...-DB12 is connected to port 1 of "This" controller with a connection name of !NEWCON13 and to port 1 of "Other" controller with a connection name of !NEWCON14.

   The connection names are assigned by the array and can be changed for your convenience or for setting up Selective Storage Presentation for using the array as part of a SAN. For more information, see "Restricting Host Access" in the *HSG80 ACS Solution Software for HP-UX Installation and Configuration Guide*.

5. Select two paths that you will assign to the second target on the configuration map.

   IMPORTANT: This assignment MUST allow each adapter to reach opposite controllers (this and other) through opposite switches.

   For example: In the above table, select either !NEWCON13 and !NEWCON15, or !NEWCON14 and !NEWCON16.

6. Enter the following commands for the selected pair :

   HSG80> set !newcon13 unit_offset=10

   HSG80> set !newcon15 unit_offset=10

7. Initialize the storagesets that you want to define for the second target, using procedures found in the *HSG80 ACS Solution Software for HP-UX Installation and Configuration Guide*.

8. To see all the storagesets, enter:

   HSG80> sho devices

   Up to 8 devices should be shown as "used by" units D0 through D7 and your new devices should be shown as having no "used by" assignment.

9. Add the new devices as units D10 through (or up to) D17, by entering:

   HSG80> add unit D10 M9

   HSG80> add unit D11 DISK40300

   etc. up to a maximum of D17.

   The array will now identify units D10 to D17 with a unit offset of 10, as a second target of LUNs 0 to 7.

10. Enter the following command at the server console:

    # ioscan –fn (to see the new units)

    # insf –e (to install special files for each new unit)

    An ioscan -fnk now shows all new LUNs. These LUNs will only be seen on half of the original paths, and the old LUNs will be seen on the other half of the original paths.

11. If you do not see all or part of the new LUNs following the ioscan, follow the procedure described in "What To Do if Ioscan Does Not See All Paths to the Array" on page 2-17.

NOTE: This anomaly results from HP-UX tables that are used by the OS for maintaining accurate I/O system persistence across reboots and is not a cause for concern.

Preferring a Unit to a Controller

In multiple-bus failover mode, you can specify units to be normally selected by a specific controller of a controller pair. This process is called preferring and is useful in static load balancing. Units can be preferred to one controller or the other by the preferred_path switch of the ADD UNIT or SET UNIT command. This option of preferring a unit to a controller is necessary if you intend to use the "preferred path" feature in Secure Path.

For example, enter the following command to prefer unit D5 to "this controller" and then later set a preferred path to that unit using the Secure Path *spmgr* utility prefer command:

    HSG80> set D5 preferred_path=this_controller

Using SCSI-3

This section describes how to set up the array for SCSI-3 and discusses the impact to Secure Path. If you are installing Secure Path on a system that will be sharing a StorageWorks array through a SAN that requires SCSI-3, the array must be in SCSI-3 mode.

IMPORTANT: The most significant impact to the Secure Path configuration is that the Command Console LUN (CCL) is not optional for SCSI-3 and the CCL is the first array LUN (D0). This reduces by one the number of available LUNs on the HP-UX system.

HP-UX sees the StorageWorks array as a SCSI-3 controller class device and erroneously claims it as an FCP array. As a result, prior to installing Secure Path, ioscan claims 64 instances of each SCSI-3 LUN it finds. This results in a very long and confusing ioscan. Fortunately, unique hardware path characteristics of real array LUNs allow easy filtering using *grep,* as shown in the following procedure. Also, the Secure Path installation program eliminates the erroneous LUNs before presenting Secure Path devices.

To place the StorageWorks array in SCSI-3 mode, perform the following procedure using the array's CLI interface:

1. Verify that the array is presently in SCSI-2 mode.

    HSG80> show this_controller

2. If in SCSI-3, skip steps 3 through 6; otherwise, verify that unit D0 is unassigned and if assigned, delete (and reassign) D0.

    HSG80> delete D0

3. If you have set up an additional targets as shown in ("Setting Up Additional LUNs" on page 2-9) you must also delete the LUN zero that is associated with this target. For example, enter:

    HSG80> delete D10

4. Set the array to SCSI-3 mode.

    HSG80> set this_controller scsi_version=scsi-3

5. Restart the controllers to have the SCSI-3 change take effect.

    HSG80> restart other_controller

    HSG80> restart this_controller

        Wait 2 minutes for the controllers to reboot before proceeding.

6. Verify that the controllers are now in SCSI-3 mode.

    HSG80> show this_controller

Continue with other "Optional Array Feature" setups or with the "System Configuration." Remember that all *ioscan* outputs prior to Secure Path installation will contain erroneous FCP array LUNs. One way of isolating just the HSG80 LUNs is to grep for the number 255 which is unique to HSG80 devices claimed by the FC Mass Storage driver. For example: # ioscan –fnk | grep 255

Managing the Command Console LUN (in SCSI-2 Mode)

The array is factory configured with a virtual LUN, located on Controller A, LUN 0. This device, called the Command Console LUN (CCL), enables the array to be recognized by some host systems as soon as it is attached to the Fibre Channel and configured into the operating system. The CCL also serves as a communications device for the StorageWorks Command Console (SWCC) Agent. The CCL identifies itself to the host via a unique identification string. This string, HSG80CCL or HSG60CCL, is returned in response to the SCSI Inquiry command.

•   When the CCL is enabled, as it is upon delivery, determine its address by entering the CLI command:

    HSG80> show this_controller

•   The CCL can be disabled by entering the CLI command:

    HSG80> set this_controller nocommand_console_lun

- The CCL is enabled by entering the CLI command:

  HSG80> set this_controller command_console_lun

In dual-redundant controller configurations, these commands alter the setting of the CCL on both Controllers.

When the CCL is enabled, its ID is the lowest numbered available LUN. When creating storagesets and logical units on the RAID array using the CLI, the address of the CCL should be reserved to D0 and that address (D0) should not be used for a data LUN. However, if the CCL's LUN is assigned to a storageset, the CCL will "float" to the next lowest LUN that is available.

IMPORTANT: On HP Servers running Secure Path, this could result in unreliable unit assignments when adding or deleting units due to the floating nature of the CCL. Compaq strongly recommends that D0 BE LEFT UNASSIGNED if the CCL is required or that THE CCL BE DISABLED if it is not going to be used.

System Configuration

1. Power on the Server and boot HP-UX.

   During the boot process, device special files are created for each logical unit configured on the HSG80/HSG60 array controller, and a LUN is assigned to each storageset configured on the HSG80/HSG60 array controller. Since the controller is in multibus mode and Secure Path is not yet installed, you should see an instance of a LUN for every path you have to the array. For example: if you have 2 adapters, 2 switches and 2 connections from each switch to the array, you have 4 distinct paths to each LUN that is configured on the array.

2. Before proceeding with the installation of Secure Path, verify that you can see all your HSG80/HSG60 storage by entering the following command:

   # ioscan -fnk

   You should see up to a maximum of 8 LUNs per array per path. If you do not see all or part of the new LUNs following the ioscan, perform the procedure "What To Do if Ioscan Does Not See All Paths to the Array" on page 2-17. This anomaly results from HP-UX tables that are used by the OS for maintaining accurate I/O system persistence across reboots and is not a cause for concern.

NOTE: *ioscan* establishes the connection table on the array and the array operating system mode defaults to WINNT.

The following example shows a normal array with a single LUN:

ioscan -fnk

Class	I	H/W Path	Driver	S/W State	H/W Type	Description
==
Ba	1	0/2	lba	CLAIMED	BUS_NEXUS	Local PCI Bus Adapter (782)
Fc	0	0/2/0/0	td	CLAIMED	INTERFACE	HP Tachyon TL/TS Fibre
Channel Mass Storage Adapter						
			/dev/td0			
fcp	0	0/2/0/0.1	fcp	CLAIMED	INTERFACE	FCP Domain
ext_bus	7	0/2/0/0.1.18.255.0	fcpdev	CLAIMED	INTERFACE	FCP Device Interface
target	7	0/2/0/0.1.18.255.0.0	tgt	CLAIMED	DEVICE	
disk	239	0/2/0/0.1.18.255.0.0.0	sdisk	CLAIMED	DEVICE	DEC HSG80
		/dev/dsk/c7t0d0 /dev/rdsk/c7t0d0				
ext_bus	9	0/2/0/0.1.19.255.0	fcpdev	CLAIMED	INTERFACE	FCP Device Interface
target	8	0/2/0/0.1.19.255.0.0	tgt	CLAIMED	DEVICE	
disk	241	0/2/0/0.1.19.255.0.0.0	sdisk	CLAIMED	DEVICE	DEC HSG80
		/dev/dsk/c9t0d0 /dev/rdsk/c9t0d0				
ba	2	0/4	lba	CLAIMED	BUS_NEXUS	Local PCI Bus Adapter (782)
fc	1	0/4/0/0	td	CLAIMED	INTERFACE	HP Tachyon TL/TS Fibre
Channel Mass Storage Adapter						
			/dev/td1			
fcp	1	0/4/0/0.1	fcp	CLAIMED	INTERFACE	FCP Domain
ext_bus	13	0/4/0/0.1.18.255.0	fcpdev	CLAIMED	INTERFACE	FCP Device Interface
target	9	0/4/0/0.1.18.255.0.0	tgt	CLAIMED	DEVICE	
disk	346	0/4/0/0.1.18.255.0.0.0	sdisk	CLAIMED	DEVICE	DEC HSG80
		/dev/dsk/c13t0d0 /dev/rdsk/c13t0d0				
ext_bus	15	0/4/0/0.1.19.255.0	fcpdev	CLAIMED	INTERFACE	FCP Device Interface
target	10	0/4/0/0.1.19.255.0.0	tgt	CLAIMED	DEVICE	
disk	348	0/4/0/0.1.19.255.0.0.0	sdisk	CLAIMED	DEVICE	DEC HSG80
		/dev/dsk/c15t0d0 /dev/rdsk/c15t0d0				

3. Set the "Operating system" mode for each "connection name" path shown in this example:

HSG80> show connections

Connection Name	Operating System	Controller	Port	Address	Status	Unit Offset
!NEWCON1	WINNT	OTHER	1	011500	OL other	0
HOST_ID=5006-0B00-0009-CE61			ADAPTER_ID=5006-0B00-0009-CE60			
!NEWCON2	WINNT	THIS	1	021500	OL this	0
HOST_ID=5006-0B00-0009-CE61			ADAPTER_ID=5006-0B00-0009-CE60			
!NEWCON3	WINNT	THIS	2	021500	OL this	0
HOST_ID=5006-0B00-0009-D8C7			ADAPTER_ID=5006-0B00-0009-D8C6			
!NEWCON4	WINNT	OTHER	2	011500	OL other	0
HOST_ID=5006-0B00-0009-D8C7			ADAPTER_ID=5006-0B00-0009-D8C6			

4. Change the operating system mode for each path shown to HP. For example enter the following set of commands:

HSG80> set !NEWCON1 operating_system=HP
HSG80> set !NEWCON2 operating_system=HP
HSG80> set !NEWCON3 operating_system=HP
HSG80> set !NEWCON4 operating_system=HP

5. Verify that all connections are now in HP mode by entering the following command:

HSG80> show connections

What To Do if Ioscan Does Not See All Paths to the Array

If your server has been factory integrated, or if you are adding units with SCSI-2 CCL enabled, changing array unit offsets, or adding array unit offsets, ioscan may not see part or all of the added or changed paths. This problem is caused by HP-UX tables that are used by the OS for maintaining accurate I/O system persistence across reboots. Enter the following series of commands to update system tables for accurate subsequent ioscans:

```
# fcmsutil /dev/td0 get remote all(to obtain all Target N_Port_id's (in the
                              form 0x011200) for attached arrays)

# fcmsutil /dev/td0 replace_dsk Target N_Port_id#1

# fcmsutil /dev/td0 replace_dsk Target N_Port_id#2

# fcmsutil /dev/td0 replace_dsk Target N_Port_id#n

…

…

# fcmsutil /dev/td1 get remote all(to obtain all Target N_Port_id's (in the
                       form 0x011200) for attached arrays)

# fcmsutil /dev/td1 replace_dsk Target N_Port_id#1

# fcmsutil /dev/td1 replace_dsk Target N_Port_id#2

# fcmsutil /dev/td1 replace_dsk Target N_Port_id#n

…

…

# fcmsutil /dev/tdn get remote all   (to obtain all Target N_Port_id's (in the
                                  form 0x011200) for attached arrays)

…

…

# ioscan -fn
```

3

Installing Secure Path Software

The installation process installs Secure Path drivers, management utilities, and manual pages. This chapter provides the following procedures and information:

- Installing Secure Path
- Completing the Secure Path Installation
- Configuration Menu options.

Installing Secure Path

The Secure Path for HP-UX Kit CD contains scripts which can be executed with super-user permission to install the Secure Path depot (package). The following procedure describes how to install Secure Path software.

1. Make sure that all users have logged off the server and that all I/O from the server has ceased.

2. Back up the entire system according to normal procedures.

3. Insert the Secure Path for HP-UX CD-ROM into the CD-ROM drive.

4. Verify that the pfs_mountd and pfsd daemons are running by entering the following command:

   # ps -ef | grep pfs

   If these daemons are not listed, start them by entering the following commands:

   # pfs_mountd &

   # pfsd &

5. Mount the CD-ROM by entering the following command:

    # pfs_mount /dev/dsk/cdrom_device_file /mnt_directory

    Example:

    # pfs_mount /dev/dsk/c2t1d0 /cdrom

    Where: cdrom_device_file is c2t1d0 and the mnt_directory is CD-ROM

6. Change to the CD Secure Path install directory by entering the following command:

    # cd /cdrom/swsp_v30_hp

7. Install Secure Path software on the server using the provided shell script by entering the following command:

    # ./CPQswspInstall_v30.sh

    NOTES:
    - At least 7MB of free disk space is required in the /tmp file system.
    - The script checks the server for required drivers and patches before it installs Secure Path.
    - The Secure Path software is interactively installed using the HP Software Distributor (SD) utilities with "ask=true" so that the Secure Path install configurator can be used to set initial configuration parameters.
    - The SD *swinstall* utility is used as part of the installation script. To exit the script without installing Secure Path, wait until the configuration utility scans the bus and the *Welcome to Compaq Secure Path...* message and main menu appear. Enter the following commands at the main menu prompt.

      command [array_number]: **CTRL+C N**

      Are you sure you are finished y|n (n default): **Y**

8. At this point, you can use the Configuration Menu to configure all StorageWorks arrays that can be seen by the server. See "Configuration Menu" on page 3-4 for a description of the Configuration Menu options.

Completing the Secure Path Installation

When the installation is complete the following occurs:

- The Server reboots HP-UX with a new kernel containing Secure Path and the Secure Path Manager (*spmgr*) utilities.

- An ioscan discloses new disk instances for each HSG80/HSG60 LUN configured on the Server.

Secure Path installs the following utilities:

- The Secure Path agent (/sbin/spagent) provides an interface for Secure Path applications to communicate with the Secure Path drivers. *spagent* is started at system boot time and must be running for the *spmgr* utility to operate.

- The *spinit* script (/sbin/init.d/spinit) is used to start and stop the Secure Path agent: /sbin/spagent.

- The Secure Path Management Utility (/opt/CPQswsp/bin/spmgr) is used to display device information, actively manages paths to each device, and sets driver options such as load balancing, path verification, and auto-restore. Refer to Chapter 4, "Managing Secure Path' for more information.

- Man pages are available for *spmgr*, *spagent*, *spinit, hsx*, and *swsp*.

If you are using StorageWorks Command Console, all devices that existed prior to the install are now hidden behind the *hsx* and *swsp* drivers and new names have been presented to the *sdisk* SCSI class driver.

Perform the following procedures to update the new device names:

1. Enter the *ioscan* command to determine the new device names.

2. Refer to the *HSG80 ACS Solution Software for HP-UX Installation and Configuration Guide* and perform the following procedures:

    a. Modify the access device with the new name.

    b. Enable the option to start the agent during system boot.

    c. Restart the Agent.

Configuration Menu

During the installation of Secure Path, a configuration program leads you through configuring all StorageWorks arrays that can be seen by the server. The program enables you to perform the following actions:

- Select and configure arrays and LUNs.

- Set global and array Secure Path parameters.

- Delete arrays and/or LUNs that are not to be configured with your server.

The configurator provides a menu-driven process consisting of five basic menu screens. Each menu screen is appended to the previous screen so that you can review prior actions using the scroll bar.

Prior to the Main Menu, the configurator scans the I/O bus to gather data. During the scan, progress is printed indicating the arrays, devices and paths found by the scan, and a Welcome paragraph displays as follows:

Scanning I/O Bus. (* = array, + = device, . = paths (in order of discovery))

* + . + . + . + . + . + . + .

* + . + . + . + . + . + ...

Welcome to the Compaq Secure Path Installation Process. A default configuration has been prepared based on the arrays and units that can be seen on this server. You may inspect the proposed configuration and modify it by removing arrays or units or by changing parameters. To complete the installation type "c" at this menu.

Main Menu

Notification Level:

Console: Critical,   Log: Warning

Array Parameter Settings: Default

Auto restore: No,   Load balancing: No,   Path verify: Yes, Verify period: 30

Array_Number   WW_Name

    1:             50001FE100105B00

    2:             50001FE1001059F0

s # = Select an array to configure   d # = Delete an array

n   = Do not configure arrays or units   c   = Complete the installation

g   = Change default parameters   r   = Restore default configuration

Enter 'command [array_number]':

The Main Menu shows the state of globally set parameters: Notification Level, Auto restore, Load Balancing, Path Verify and Verify Period. It also shows World Wide Node Names of all of the arrays available to the server.

From the Main Menu you can perform the following actions (Reading the Main Menu right to left.):

- Select an array that you wish to configure using the Array Settings Menu (s #).
- Delete an array that you wish to not configure (d #).
- Choose to exit the configurator without configuring any arrays (n).
- Exit the configurator to complete the installation (c).
- Select the Global Parameter Settings Menu to change global parameters (g).
- Rescan the I/O bus to restore the default configuration (r).

NOTE: Both the n and c options request user confirmation because they exit the configurator and complete the installation.

Global Parameter Settings Menu

```
Notification Level:
Console: Critical,                     Log: Warning
Array Parameter Settings: Default
Auto restore: No,   Load balancing: No,   Path verify: Yes,  Verify period: 30
a y|n  = Auto restore on        b y|n  = Balancing load on
p y|n  = Path verify on         v # (>0)  = Verify period in seconds
c # Console Level               l # Log entry level


      Where #: 0 = Informational (includes Warning and Critical)
               1 = Warning (includes Critical)
               2 = Critical
               3 = Disabled
q  = Return to previous menu
Enter 'command [array_number]':
```

The Global Parameter Settings Menu shows the state of globally set parameters: Notification Level, Auto Restore, Load Balancing, Path Verify and Verify Period.

From this menu you can perform the following actions (Reading the menu right to left.):

- Enable or disable Auto Restore (a y|n).

- Enable or disable Load Balancing (b y|n).

- Enable or disable Path Verification (p y|n).

- Set the Verification period in seconds (v # (>0)).

- Set the Console notification level (c #).

- Set the sysLog notification level (l #).

- Quit this menu to return to the Main Menu (q).

NOTE:
- These settings are global and are therefore applied to all arrays that are configured with the server.
- Messaging sent to the Console and Syslog can be set to disabled, critical messages only, warning and critical messages only or informational, warning and critical messages.

Array Settings Menu

```
Array Parameter Settings: 50001FE100105B00
Auto restore: No,  Load balancing: No,  Path verify: Yes,  Verify period: 30
Array:  50001FE100105B00
Unit_number              WW_Name                 Target  LUN
    1:        60001FE100105B0000009105069810017    0      0
    2:        60001FE100105B0000009105069810018    0      1
    3:        60001FE100105B0000009105069810019    0      2
    4:        60001FE100105B0000009105069810013    1      0
    5:        60001FE100105B0000009105069810014    1      1
    6:        60001FE100105B0000009105069810015    1      2
    7:        60001FE100105B0000009105069810016    0      3
Note: Please be certain that you have assigned unique target/LUN numbers
      for each array before completing the configuration.


  s #  = Select a unit to configure          d #  = Delete a unit
  p    = Change parameters for this array  q   = Return to previous menu
  Enter 'command [unit_number]':
```

The Array Settings Menu shows the parameter settings for a particular array. These parameters are the Auto Restore, Load Balancing, Path Verify and Verify Period. It also shows the target LUN assignments for all LUNs on the array.

From this menu you can perform the following actions (Reading the menu right to left.):

- Select a unit to configure using the LUN Settings Menu (s #).

- Delete an array that you wish to not configure (d #).

- Modify parameter settings for the array using the Array Parameter Settings Menu (p)

- Quit this menu and return to the Main Menu (q).

LUN Settings Menu

```
Unit:   60001FE100105B000009105069810017  Target:  0  LUN: 0
Controller      Path            HW_Path           Preferred
========================================================
ZG10505167 c4t0d0      0/2/0/0.1.16.255.0.0.0    YES
ZG10506981 c11t0d0     0/4/0/0.1.17.255.0.0.0    no
t #  = Change Target: #                l #  = Change LUN: #
p #  = Select Preferred path instance  u #  = Unselect Preferred path instance
q  = Return to previous menu
Enter 'command [unit_number]':
```

The LUN Settings menu shows the following information:

- The target LUN assignments for this LUN

- The controllers, path instances and hardware paths for that LUN and controller

- Whether the path is preferred (YES) or not preferred (no).

From the LUN Settings menu you can perform the following actions (Reading the menu right to left.):

- Change this LUN's Target number assignment (t #).

- Change this LUN's LUN number assignment (l #)

- Prefer a path using the path instance number (p path_instance_#)

- Unprefer a path using the path instance number (u path_instance_#).

- Quit the menu to return to the Array Settings Menu (q).

Array Parameter Settings Menu

Array Parameter Settings: 50001FE100105B00

Auto restore: No , Load balancing: No , Path verify: Yes, Verify period: 30

a y|n = Auto restore on   b y|n = Balancing load on

p y|n = Path varify on   v # (>0) = Verify period in seconds

q = Return to previous menu

Enter 'command [parameter]': q

The Array Parameter Settings menu shows the parameter settings for a particular array. Those parameters are the Auto restore, Load balancing, Path verify and Verify period.

From the Array Parameter Settings menu you can perform the following actions:

- Enable or disable Auto Restore (a y|n).

- Enable or disable Load Balancing (b y|n).

- Enable or disable Path Verification (p y|n).

- Set the Verification Period in seconds (v # (>0)).

- Quit this menu to return to the Array Settings Menu (q).

These settings are specific for this array and are not applicable for other arrays.

4

Managing Secure Path

This chapter describes the user interface for the Secure Path V3.0 Management tool: *spmgr*. It includes the following topics:

- Secure Path Manager Overview
- Spmgr Commands
- Spmgr Common Terms
- Displaying Configuration Information
- The alias and unalias Commands
- Setting Storage System Parameters
- Path Management
- The add and delete WWLUNID Commands
- Secure Path Persistence Across Reboots

NOTE: Examples are based on the HSG80 controller, but all actions are identical for the HSG60 controller.

Secure Path Manager Overview

The Secure Path Manager (*spmgr*) utility enables the user to monitor and manage devices, storage systems, and paths to units that are in the Secure Path configuration. It also allows modifications to the configuration for the purpose of repair, replacement, or reconfiguration; *spmgr* relies on the *spagent* to handle calls to the driver (*swsp*).

Spmgr Commands

This section describes the *spmgr* commands. Table 4–1 lists the command options; their format and usage are presented in detail after the table.

Table 4–1: *Spmgr* **Commands**

Command	Options / Argument	Description
spmgr add	WWLUNID [target LUN]	Add a new device to the Secure Path configuration.
spmgr alias	alias_name old_name no argument	Assign an alias to an object.
spmgr delete	WWLUNID device	Removes a device from the Secure Path configuration.
spmgr display	-a[v] [adapter] -c[v] [controller_ser_num] -d[v] [device] -p path-Instance -r[v] [WWNN] -u no argument	Displays information about configured Secure Path devices.
spmgr log	-c 0, 1...3 -l 0, 1...3 -n 0, 3 no argument	Sets logging to the console, system log file, and e-mail notification.
spmgr notify	add severity_level email_address delete email_address no argument	Manage e-mail address and event logging severity to each e-mail recipient.
spmgr prefer	path_instance	Assign a preferred attribute to a path.
spmgr quiesce	-a adapter -c controller_ser_num -p path_instance	Move I/O to an alternative object and temporarily remove selected object from use.
spmgr restart	-a adapter -c controller_ser_num -p path_instance all	Return a previously quiesced object to an active or available state.
spmgr restore	-d device -r WWNN all	Restore one or more devices to their preferred I/O path.

Table 4–1: *Spmgr* **Commands (Continued)**

Command	Options / Argument	Description
spmgr select	-a adapter [-d device] -c controller_ser_num [-d device] -p path_instance	Select a path for I/O.
spmgr set	-a on | off [WWNN] -b on | off [WWNN] -f interval -p on | off [WWNN]	Enable or disable special driver functionality.
spmgr unalias	alias_name old_name	Delete an alias.
spmgr unprefer	path_instance	Remove a preferred path attribute.

NOTE: Commands typed without an argument respond with "usage" if the command is a configuration altering command. The commands: *alias, display, log,* and *notify* respond with current command or configuration information.

Spmgr Common Terms

The following table describes the common terms used with *spmgr*. For a more complete list of Secure Path terms, refer to the Glossary provided at the end of this guide.

Table 4–2: Spmgr Common Terms

Term	Definition
Device	The standard representation for a device or device link on a server. For example: c*x*t*y*d*z*.
Logical Unit	The logical unit or LUN is a device that is managed by Secure Path and identified by it's 32-digit World Wide LUN Identifier (WWLUNID).
Adapter	The operating system ID of the HBA.
Storage System (Array)	The storage system as identified by it's 16-digit World Wide Node Name (WWNN).
Controller	The controller is identified by a unique serial number. The serial number of the HSG80/60 is a 10-character alphanumeric string.

Displaying Configuration Information

Controller States

The following table lists the possible controller states and their descriptions.

Table 4–3: Controller States

Controller State	Description
Critical	Reported for a controller pair bound in multi-bus failover mode when only one of the controllers is available. The Critical state may mean a failed or offline condition, since the server cannot communicate with the controller at this time.
Operational	The controller is available with a good status.
Unknown	The server cannot communicate with this controller.

Path States and Attribute

The following table lists and describes the path states reported by the Secure Path driver.

Table 4–4: Path States and Attribute

Path States/ Attribute	Description
Active	This state indicates that the path is currently used for the I/O stream.
Available	This state indicates that the path is available on the active controller for the I/O stream.
Failed	This state indicates that the path is currently unusable for the I/O stream.
Quiesced	This state indicates that the path is valid, but has been made unavailable for I/O.
Standby	This state indicates that the path is valid on the standby controller.
Preferred	This attribute indicates that the path is preferred for the I/O stream, across reboots.

NOTE: The Preferred path attribute is preferred for the I/O stream, across reboots. It may not be assigned to either a failed or a quiesced path.

Device States

The following table lists and describes device states.

Table 4–5: Device States and Description

Device States	Description
Critical	Only one path remains available to the storage unit.
Degraded	At least one or more paths are failed to the storage unit.
Operational	All paths are available to the storage unit.
Unknown	Unable to communicate with the unit. This may indicate no available path or a failed device.
Failed	Paths are available but an inquiry to the device returns a not-ready state even after retries.

Display Header Information

Due to the possible complexity of the Secure Path configuration and the possibility of shared storage or clustered software across multiple servers, the display information will always have two standard lines of information at the start of the display:

Line 1: Server: Server Name   Report Created: Date and Time

Line 2: Command: Command string

The display Command

This section describes the # spmgr display commands and associated switches. Each switch results in a different type of display.

NOTE: The verbose flag may only be used with some but not all cases of the command.

Syntax:

```
# spmgr display   -a[v] [adapter]
                  -c[v] [controller_ser_num]
                  -d[v] [device]
                  -p path_instance
                  -r[v] [WWNN]
                  -u
                  (no argument)
```

For each of these command switches, this section presents:

- Description

- Syntax

- All forms of the command

- Examples of all forms of the command

- Example displays of all forms of the command.

spmgr display

When you enter # spmgr display, all information for the entire configuration is displayed. The amount of information displayed depends on the number of HBAs, storage systems, and paths to a unit on each storage system.

The full display derives from the component portions described in this section. You can limit the amount of data displayed by combining the # spmgr display command with one of the described switches.

Example:

```
Server: hp.mydomain.com     Report Created: Thu, Sep 13 16:11:50 2001
Command: spmgr display
= = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
Storage: 5000-1FE1-0010-5B00
Load Balance: Off Auto-restore: Off
Path Verify: On    Verify Interval: 30
HBAs: td0 td1

Controller:    ZG10505167, Operational
               ZG10506981, Operational

Devices: c16t0d0 c16t0d1
```

TGT/LUN	Device	WWLUN_ID	H/W_Path	#_Paths
0/ 0	c16t0d0	6000-1FE1-0010-5B00-0009-1050-6981-0013		4
		0/0/255.0.0.0		

Controller	Path_Instance	HBA	Preferred?	Path_Status
ZG10505167			no	
	c4t0d0	td0	no	Standby
	c10t0d0	td1	no	Standby

Controller	Path_Instance	HBA	Preferred?	Path_Status
ZG10506981			no	
	c5t0d0	td0	no	Active
	c11t0d0	td1	no	Available

TGT/LUN	Device	WWLUN_ID	H/W_Path	#_Paths
0/ 1	c16t0d1	6000-1FE1-0010-5B00-0009-1050-6981-0014		4
			0/0/255.0.0.1	

Controller	Path_Instance	HBA	Preferred?	Path_Status
ZG10505167			no	
	c4t0d1	td0	no	Standby
	c10t0d1	td1	no	Standby

Controller	Path_Instance	HBA	Preferred?	Path_Status
ZG10506981			no	
	c5t0d1	td0	no	Active
	c11t0d1	td1	no	Available

spmgr display -a[v] [HBA]

The -a switch lists HBA (adapter) related information. If a parameter is supplied, it must be the `adapter instance number`.

Syntax:

> # spmgr display -a
>
> > –av
> >
> > –a *HBA*
> >
> > –av *HBA*

When the -a switch is used without a parameter, the display contains a complete list of all HBAs in the Secure Path configuration from the server where the command is entered.

Example:

spmgr display -a

Server: hp.mydomain.com   Report Created: Thu, Sep 13 16:11:50 2001
Command: spmgr display
= =
Storage: 5000-1FE1-0010-5B00
Load Balance: Off Auto-restore: Off

When the -a switch is paried with the v switch, the display contains a list of all adapters in the Secure Path configuration. In this case, the "v" acts like a wildcard for the device switch, -a.

Example:

> # spmgr display -av
>
> Server: hp.mydomain.com   Report Created: Wed, Aug 15 14:51:23 2001
> Command: spmgr display -av
> Adapter   Hardware Path Driver   Version
> =
>
> td0   0/2/0/0   N/A
> td1   0/4/0/0   N/A

Syntax:

> # spmgr display -av [HBA]

When invoked with the -a switch, v switch, and HBA, the display shows all paths attached to the HBA as shown in the following example:

Example:

```
# spmgr display -av td0

Server: hp.mydomain.com        Report Created: Wed, Aug 15 14:56:25 2001

Command: spmgr display -av td0

= = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =

Adapter: td0

Hardware Path: 0/2/0/0

Storage: 5000-1FE1-0010-5B00

0   c19t0d0 ZG10505167   td0  0/0/255.0.0.0    c14t0d0
      WWNN: 5000-1FE1-0010-5B00        Path State: Standby
 1   c19t0d0 ZG10506981   td0  0/0/255.0.0.0    c15t0d0
      WWNN: 5000-1FE1-0010-5B00        Path State: Active
 2   c19t0d1 ZG10505167   td0  0/0/255.0.0.1    c14t0d1
      WWNN: 5000-1FE1-0010-5B00        Path State: Standby
 3   c19t0d1 ZG10506981   td0  0/0/255.0.0.1    c15t0d1
      WWNN: 5000-1FE1-0010-5B00        Path State: Active
```

spmgr display -c[v] [controller_serial_number]

The -c switch displays controller related information. If a parameter is supplied, it must be a *controller_serial_number*. The command has four possible forms:

Syntax:

```
# spmgr display -c

              -cv
              -c controller_serial_number
              -cv controller_serial_number
```

Example:

```
# spmgr display –c

Server: hp.mydomain.com    Report Created: Thu, Sep 13 16:30:23 2001
Command: spmgr display -c
Current Controller List

= = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =

ZG10505167, ZG10506981
```

Example:

> # spmgr display –cv

> Server: hp.mydomain.com   Report Created: Thu, Sep 13 16:30:23 2001
> Command: spmgr display -cv
> Controller: ZG10505167 Status: Operational
> Vendor: Compaq
> WWNN: 5000-1FE1-0010-5B00
> HBAs: td0, td1
> Controller: ZG10506981 Status: Operational
> Vendor: Compaq
> WWNN: 5000-1FE1-0010-5B00
> HBAs: td0, td1

Example:

> # spmgr display –c ZG10505167

> Server: hp.mydomain.com   Report Created: Thu, Sep 13 16:39:49 2001
> Command: spmgr display -c ZG10505167
> Controller: ZG10505167 Status: Operational
> Vendor: Compaq
> WWNN: 5000-1FE1-0010-5B00
> HBAs: td0, td1

Example:

```
# spmgr display –cv ZG10505167
```

```
Server: hp.mydomain.com     Report Created: Thu, Sep 13 16:41:17 2001
Command: spmgr display -cv ZG10505167
Controller: ZG10505167 Status: Operational
Vendor: Compaq
WWNN: 5000-1FE1-0010-5B00
HBAs: td0, td1
```

Item	Device	Controller	HBA	Parent	Instance
0	c16t0d0	ZG10505167	td0	0/0/255.0.0.0	c4t0d0
	WWNN: 5000-1FE1-0010-5B00		Path State: Standby		
1	c16t0d0	ZG10505167	td1	0/0/255.0.0.0	c10t0d0
	WWNN: 5000-1FE1-0010-5B00		Path State: Standby		
2	c16t0d1	ZG10505167	td0	0/0/255.0.0.1	c4t0d1
	WWNN: 5000-1FE1-0010-5B00		Path State: Standby		
3	c16t0d1	ZG10505167	td1	0/0/255.0.0.1	c10t0d1
	WWNN: 5000-1FE1-0010-5B00		Path State: Standby		
4	c16t0d2	ZG10505167	td0	0/0/255.0.0.2	c4t0d2
	WWNN: 5000-1FE1-0010-5B00		Path State: Standby		
5	c16t0d2	ZG10505167	td1	0/0/255.0.0.2	c10t0d2
	WWNN: 5000-1FE1-0010-5B00		Path State: Standby		

spmgr display –d[v] [device_instance]

The -d switch displays device related information. If a parameter is supplied, it must
be a *device_instance*.

Syntax:

```
# spmgr display –d
            -dv
            -d device_instance
            -dv device_instance
```

Example:

> # spmgr display –d

> Server: hp.mydomain.com   Report Created: Thu, Sep 13 16:44:25 2001
> Command: spmgr display -d
> Devices by Storage System

> =

> Devices: c16t0d0 c16t0d1

Example:

> # spmgr display –dv

> Server: hp.mydomain.com   Report Created: Thu, Sep 13 16:50:04 2001
> Command: spmgr display -dv
> Device: c16t0d0 Status: Operational [4 paths (2/0/2)]
> Storage: 5000-1FE1-0010-5B00
> LUN ID: 6000-1FE1-0010-5B00-0009-1050-6981-0013
> Preferred Controller: None
> HBAs: td0 td1
> Device: c16t0d1 Status: Operational [4 paths (2/0/2)]
> Storage: 5000-1FE1-0010-5B00
> LUN ID: 6000-1FE1-0010-5B00-0009-1050-6981-0014
> Preferred Controller: None
> HBAs: td0 td1
> etc.

NOTE: When displaying path states the following occurs:

- Path states are displayed using the following convention:

  [total number of paths (active/failed/offline)]
  Where: Actual numerical equivalents replace the text.

- For example, the following attributes:

  Total paths = 10, Active = 8, Failed = 0, Offline = 2
  Are displayed as:
  [10 paths (8/0/2)]

Example:

spmgr display –d c16t0d2

Server: hp.mydomain.com   Report Created: Thu, Sep 13 16:51:43 2001

Command: spmgr display -d c16t0d2

Device: c16t0d2 Status: Operational [4 paths (2/0/2)]

Storage: 5000-1FE1-0010-5B00

LUN ID: 6000-1FE1-0010-5B00-0009-1050-6981-0015

Preferred Controller: None

HBAs: td0 td1

Example:

spmgr display –dv c16t0d2

Server: hp.mydomain.com   Report Created: Thu, Sep 13 16:51:43 2001
Command: spmgr display -d c16t0d2
Device: c16t0d2 Status: Operational [4 paths (2/0/2)]
Storage: 5000-1FE1-0010-5B00
LUN ID: 6000-1FE1-0010-5B00-0009-1050-6981-0015
Preferred Controller: None
HBAs: td0 td1

Item	Device	Controller	HBA	Parent	Instance
0	c16t0d2	ZG10505167	td0	0/0/255.0.0.2	c4t0d2
	WWNN: 5000-1FE1-0010-5B00		Path State: Standby		
1	c16t0d2	ZG10506981	td0	0/0/255.0.0.2	c5t0d2
	WWNN: 5000-1FE1-0010-5B00		Path State: Active		
2	c16t0d2	ZG10505167	td1	0/0/255.0.0.2	c10t0d2
	WWNN: 5000-1FE1-0010-5B00		Path State: Standby		
3	c16t0d2	ZG10506981	td1	0/0/255.0.0.2	c11t0d2
	WWNN: 5000-1FE1-0010-5B00		Path State: Available		

spmgr display –p path_instance

The -p switch displays storage path information. A parameter is required and it must be a *path_instance*.

Syntax:

    #spmgr display -p path_instance

Example:

    # spmgr display –p c6t0d0

    Server: hp.mydomain.com   Report Created: Thu, Sep 13 12:16:14 2001
    Command: spmgr display -p c6t0d0
    Path: c6t0d0   Adapter: td0
    Controller: ZG10506770 Status: Operational
    Device: c17t0d0 Status: Operational

spmgr display –r[v] [WWNN]

The -r switch displays storage system information. If a parameter is supplied, it must be a *WWNN*. The command has four possible forms:

Syntax:

    # spmgr display –r

                    –rv
                    –r *WWNN*
                    –rv *WWNN*

Example:

    # spmgr display –r

    Server: hp.mydomain.com   Report Created: Wed, Aug 15 15:19:38 2001
    Command: spmgr display –r
    Storage Systems List

    =

    Storage: 5000-1FE1-0010-5B00
    Storage: 5000-1FE1-0010-59F0

Example:

spmgr display –rv

Server: hp.mydomain.com   Report Created: Wed, Aug 15 15:21:02 2001
Command: spmgr display –rv

Storage Systems List -Full

= =

Storage: 5000-1FE1-0010-5B00
Load Balance: Off Auto-restore: Off
Path Verify: On   Verify Interval: 30
HBAs: td0 td1
Controller: ZG10505167, Operational
               ZG10506981, Operational

Devices: c19t0d0 c19t0d1 c19t0d2 c19t0d3
Storage: 5000-1FE1-0010-59F0
Load Balance: Off Auto-restore: Off
Path Verify: On   Verify Interval: 30
HBAs: td0 td1

Controller: ZG10504878, Operational

               ZG10505136, Operational

Devices: c21t0d0 c21t0d1 c21t0d2 c21t0d3 c21t0d4

c21t0d5

etc.

Example:

spmgr display –r 5000-1FE1-0010-59F0

Server: hp.mydomain.com   Report Created: Wed, Aug 15 15:24:14 2001
Command: spmgr display -r 5000-1FE1-0010-59F0

Storage Systems List -Full

= =

Storage: 5000-1FE1-0010-59F0
Load Balance: Off Auto-restore: Off
Path Verify: On   Verify Interval: 30
HBAs: td0 td1

Controller: ZG10504878, Operational
               ZG10505136, Operational
Devices: c21t0d0 c21t0d1 c21t0d2 c21t0d3 c21t0d4 c21t0d5

Example:

spmgr display –rv 5000-1FE1-0010-59F0

Server: hp.mydomain.com   Report Created: Wed, Aug 15 15:26:49 2001

Command: spmgr display -rv 5000-1FE1-0010-59F0
Storage Systems List -Full

= =

Storage: 5000-1FE1-0010-59F0
Load Balance: Off Auto-restore: Off
Path Verify: On   Verify Interval: 30
HBAs: td0 td1

Controller: ZG10504878, Operational
               ZG10505136, Operational

Devices: c21t0d0 c21t0d1 c21t0d2 c21t0d3 c21t0d4 c21t0d5
Path Information: [P] = Preferred

Item	Device	Controller	HBA	Hardware Path	Instance
0	c21t0d0	ZG10504878	td0	0/0/255.1.0.0	c11t0d0
	WWNN: 5000-1FE1-0010-59F0		Path State: Standby		
1	c21t0d0	ZG10505136	td0	0/0/255.1.0.0	c12t0d0
	WWNN: 5000-1FE1-0010-59F0		Path State: Active		
2	c21t0d0	ZG10504878	td1	0/0/255.1.0.0	c13t0d0
	WWNN: 5000-1FE1-0010-59F0		Path State: Standby		
3	c21t0d1	ZG10505136	td1	0/0/255.1.0.1	c18t0d1
	WWNN: 5000-1FE1-0010-59F0		Path State: Available		
4	c21t0d1	ZG10504878	td0	0/0/255.1.0.1	c11t0d1
	WWNN: 5000-1FE1-0010-59F0		Path State: Standby		
5	c21t0d1	ZG10505136	td0	0/0/255.1.0.1	c12t0d1
	WWNN: 5000-1FE1-0010-59F0		Path State: Active		
6	c21t0d1	ZG10504878	td1	0/0/255.1.0.1	c13t0d1
	WWNN: 5000-1FE1-0010-59F0		Path State: Standby		
7	c21t0d1	ZG10505136	td1	0/0/255.1.0.1	c18t0d1
	WWNN: 5000-1FE1-0010-59F0		Path State: Available		
8	c21t0d2	ZG10504878	td0	0/0/255.1.0.2	c11t0d2
	WWNN: 5000-1FE1-0010-59F0		Path State: Standby		

---

spmgr display -u

This command requires no parameter and returns a display of all unattached units for each storage system. This switch provides the list of units by storage system and reports the WWLUN ID for each. The information gathered by this display, may then be used to add a unit to the Secure Path configuration.

Example:

spmgr display -u

Server: hp.mydomain.com   Report Created: Wed, Aug 15 15:42:37 2001

Command: spmgr display -u
Unattached Units Listing

= =

Storage: (fire) 5000-1FE1-0000-1290

LUN ID: 6000-1FE1-0000-1290-5000-1FE1-0000-4321

       6000-1FE1-0000-1290-5000-1FE1-0000-4334

Storage: (jazzy) 5000-1FE1-0003-4420

LUN ID: 6000-1FE1-0000-9320-5000-1FE1-9321-5733

The alias and unalias Commands

The Secure Path application supports the use of aliases. Aliases replace or substitute longer strings for shorter strings.

Example:

The World Wide Node Name (WWNN) of a storage system is *5000-1FE1-0005-3480*. You can assign the alias *Bird* to replace the longer, less easy-to-remember WWNN *5000-1FE1-0005-3480*.

When an alias is used in an spmgr display, it is shown in parenthesis before the term that it substitutes for.

Example:

Storage: (fire) 5000-1FE1- 0001-3420

Where*:* fire is the alias.

Alias commands:

- Define an alias and store it for future use.

- Remove an alias from the alias table.

- Display the alias table.

spmgr alias alias_name old_name

To add an alias to the alias table use the following alias command.

Syntax:

spmgr *alias_name old_name*

In the following example, the alias of *Birdtop* is created for the controller serial number: *ZG66654211*.

spmgr alias Birdtop ZG66654211

spmgr unalias

To remove an alias from the alias table invoke the spmgr unalias command and enter either the *alias_name* or the *old_name*.

Syntax:

spmgr unalias old_name

alias_name

In the following example, the alias, *Birdtop*, is removed from the alias table.

spmgr unalias Birdtop

spmgr alias

Use the alias display command to display the alias table.

Syntax:

spmgr alias

Example:

> # spmgr alias
>
> Server: hp.mydomain.com   Report Created: Wed, Aug 15 15:42:37 2001
>
> Alias:old_string
>
> = = = = = = = = = = = = =
> bob:5000-1fe1-0000-1231
> jim: 5000-1fe1-0000-1233
> fredt:ZG111298235442
> fredb:ZG238817633215
> = = = = = = = = = = == ==

NOTE:
- When the spmgr display is invoked, the screen output will use both the alias, if any, and the standard Storage system WWNN, controller serial number, etc. The alias will be enclosed in parentheses (alias_name).
- For the command set that requires a parameter, it is assumed that the parameter or its alias may be input. Commands may not be aliased.

Setting Storage System Parameters

The Secure Path 3.0 driver has options a user can enable or disable on a storage system or global basis. These options may be turned off and on dynamically. Under normal conditions, these changes occur within 45 seconds.

- The spmgr set command allows the user to enable storage system specific settings for the Secure Path driver.

  — **Load Balancing**–Version 3.0 of Secure Path implements a round-robin usage of all available paths to a unit for its I/O. The default for Load Balancing is disabled.

  — **Path Verification**–The driver checks the state of all possible paths to all units at a settable period or frequency. The default for Path Verification is enabled with a period of 30 seconds.

  — **Auto-restore**–The auto-restore command enables the driver to automatically restore paths to their preferred path after a failure and subsequent reinstatement of that path. The default for Auto-restore is disabled.

- The spmgr log command allows the user to enable logging from Secure Path driver to the syslog, console and e-mail notification.

- The spmgr notify command enables the user to manage the distribution of the three classes of event reports (critical, warning and informational) via an e-mail address list.

NOTE: The results of these commands are stored in configuration files and the files persist across reboots. However, because these commands make dynamic changes to the driver in kernel space, the kernel must be rebuilt for the new configuration to persist across reboots. It is recommended that all changes be done in a session and that the kernel be rebuilt following the session. Reboot could then be done at a later time. See "Secure Path Persistence Across Reboots" on page 4–36.

The set Command

Syntax:

```
# spmgr set   -a  (on | off) [WWNN]
                -b (on | off) [WWNN]
                -p (on | off ) [WWNN]
                -f verify_period
```

spmgr set -a on | off [WWNN]

This command enables or disables the Auto-Restore feature of driver. When Auto-Restore is enabled it directs the driver to monitor the state of the paths. If the preferred path should fail and then later return to service, the driver will automatically reroute all I/O to the restored path. When Auto-Restore is disabled, there is no Auto-Restore by the Secure Path driver. The I/O will continue along the current path(s) until another event changes the active path. The default is disabled.

spmgr set -b on | off [WWNN]

This command enables or disables the Load Balancing option of the driver. When Load Balancing is enabled, it allows I/O to be sent to the unit along all available paths. When load balancing is disabled, the I/O will be sent along the Preferred Path (if one is selected) or will use the first available path for I/O. The default is disabled.

spmgr set -p on | off [WWNN]

This command enables or disables the path verification of the driver. When enabled, this command verifies the state of all possible paths to all units. On large configurations with active I/O to many units this commands may reduce performance. The default is enabled.

spmgr set -f (1…65535 seconds)

This command sets the path verification interval. This interval can be set between 1 to 65535 seconds. The use of the -f switch does not change the current state of the path verification, it will only change the value for the interval. Therefore, if path verification is disabled, it remains disabled with the new interval. The default is 30 seconds.

The log Command

Syntax:

```
# spmgr log -l  (level  0, 1..3)
            -c (level  0, 1..3)
            -n (level  0, 3 )
```

The numerical level indicates the message severity. The levels of severity are:

1: Critical, 2: Warning, 3: Informational

When you select a numerical level, messages of that severity and higher are delivered to the appropriate output.

- If 3 is selected, then 3,2,1 are logged

- If 2 is selected, then 2,1 are logged

- If 1 is selected, then 1 is logged

- If 0 is selected then logging is disabled for that item.

spmgr log -l [0, 1..3]

This command sets the level of logging to the syslog of the server. When you select level 1…3, the messages of that severity and higher are written to the syslog file. The default is 2.

spmgr log -c [0,1..3]

This command sets the level of logging to the console. When you select level 1..3 the messages of that severity and higher are displayed on the console. The default is 1.

spmgr log -n [0, 3]

This command enables or disables logging to the notify function. This option has two values 0, and 3. The default is 3. Level 0 is provided for disabling all notification messages.

spmgr log

The #spmgr log command displays the current logging settings.

Example:

```
#spmgr log

Server:  hp.mydomain.com    Report Created: Wed, Aug 15 15:42:37 2001
Current    Log             Options
= = = = = = = = = = = = = = = = = =
Syslog,    enabled,        level 2
Console,   disabled,       level 0
Notify,    enabled,        level 3
= = = = = = = = = = = = = = = = = =
```

The notify Command

The notification function enables the user to manage the distribution of the three classes of event reports: critical, warning and informational. In Secure Path V3.0, notification is through e-mail.

Syntax:

```
#spmgr  notify add
                delete
                (no argument)
```

Severity Levels

Messages from the Secure Path drivers are one of three severity levels:

- Critical messages are severity level 1.

- Warning messages are severity level 2.

- Informational messages are severity level 3.

The implementation for notify is to send event notices to the user from the highest to the lowest level of the severity marking as follows:

- A user with severity level 3, receives level 3, 2 and 1 severity messages.

- A user with severity level 2, receives level 2 and 1 severity messages.

- A user with severity level 1, receives severity level 1 messages only.

spmgr notify add

This command adds an e-mail address to the notification list.

Syntax:

spmgr notify add severity_level email_address

Example:

spmgr notify add 3 john.doe@oscar.edu.it

Where: severity_level is 3 and email_address is john.doe@oscar.edu.it

NOTE: A user is defined by a unique email_address. A user with more than one email_address may have multiple records, one for each unique address.

spmgr notify delete

This command deletes an e-mail address from the notification list,

Syntax:

spmgr notify delete email_address

Example:

spmgr delete julie.smith@hollywood.edu

Where: julie.smith@hollywood.edu is the email_address.

spmgr notify

This command displays the list of users to be notified that have been saved in configuration files.

Example:

spmgr notify

Server: hp.mydomain.com   Report Created: Wed, Aug 15 15:42:37 2001
Command: spmgr notify

  Current Log Options

Severity   Mode   email_address
= =
1   M   bob.proliant@compaq.com
3   M   evil.knevil@jump.into.the.net
2   M   harry.houdini@magic.org

= =

Path Management

Secure Path Version 3.0 supports up to 32 paths to a unit on a storage system. Given the very large number of paths that can be configured for a single system, spmgr provides the user the ability to monitor and manage paths.

The path management actions include:

- Selecting paths
- Preferring and unpreferring paths
- Restoring preferred paths
- Quiescing and restarting objects and paths.

The select Command

A path is a combination of all the components from server to the unit on the storage system. When you describe the entire path you must identify the HBA and the controller port.

Selecting paths means to identify a path to be used for I/O. Path information, including *selected* paths, can be viewed with one or more options of the spmgr display command.

- When paths are selected for I/O and are intended to remain selected during a server reboot or power cycle, they are referred to as *preferred paths*.
- If the path is selected for the duration of the server's current processing time, they are referred to as *selected paths* and are not preserved during a reboot or power cycle of the server.

Syntax:

```
spmgr select  -a HBA [-d device]
              -c controller_ser_num [-d device]
              -p path_instance
```

spmgr select *-a HBA*

This command selects the path with the indicated HBA conditions and makes that path Active.

Example:

> # spmgr select –a td0

Result: The Secure Path driver locates all paths from td0 to all Units on all storage systems and marks them *selected*.

spmgr select -a *HBA –d device*

This command selects the path with the indicated HBA and device and makes that path Active.

Example:

> # spmgr select –a td0 –d c21t0d2

Result: The Secure Path driver locates one path from td0 to unit c21t0d2 and marks it *selected*.

spmgr select -c controller_serial_number

This command selects the path with the indicated controller serial number and makes that path Active. For example, if there are three HBAs with paths through one controller, the Secure Path driver marks one path for each device from one HBA, not necessarily the same HBA. The result is to have identified selected paths for multiple units with this command.

Example:

> # spmgr select –c ZG10505167

Result: The Secure Path driver marks each path through the controller, ZG10505167, to each unit as the selected path for I/O.

spmgr select -c controller_serial_number –*d* device

This command selects the path with the indicated controller and device and makes that path Active. This command selects one controller. Therefore, the driver is able to mark one path for each device on that controller as *selected*. This command indicates which controller to begin selecting and which unit to end marking. Thus if there are three HBAs with paths through that controller, the Secure Path driver will mark one path for the device from one HBA. The overall result is to have identified selected paths for a single unit with this command.

Example:

```
# spmgr select –c ZG10505167 –d c21t0d2
```

Result: The Secure Path driver marks each path through the controller, ZG10505167 to unit c21t0d2 as the selected path for I/O.

spmgr select -p path_instance

This command selects the indicated path and makes that path Active. This parameter, path_instance, satisfies the path equation because it contains the necessary components of HBA, controller-port and device. Thus, no other switches or parameters are required to identify the path.

Example:

```
# spmgr select –p c18t0d1
```

Result: The Secure Path driver marks path c18t0d1 as the selected path for I/O.

The prefer and unprefer Commands

On an array, each LUN may be assigned to a particular controller and be available for selection at startup. This feature is enabled by using the HSG80 ADD or SET commands and the Preferred_path attribute for a unit. For example, a unit can be assigned to be preferred to "this" controller by entering the following command:

```
HSG80> SET D6 PREFERRED_PATH = THIS_CONTROLLER
```

Since Secure Path can have more than one path to each controller, a user can further specify a "preferred path." To differentiate between the controller unit attribute of *Preferred_path* and the Secure Path "preferred path" this document refers to the controller-based Preferred_path attribute as the *preferred controller*.

The preferred path assignment allows the user fine control in setting static load balancing because the path chosen determines which adapter and controller port are designated as the default path at system startup. One preferred path can be assigned to each controller for each LUN.

At any time the user can select a different path to be used for I/O. The selected path is not preserved for a server power cycle or operating system restart. To preserve an active path through power cycles as well as restarts, the user should identify it as a *preferred path*. Preferred path identifications are marked by the Secure Path driver in the running system and the identifications are stored in the configuration files for that driver. Thus, the path may be maintained permanently until removed or another preferred path is selected.

To support the preferring and removal of preferred paths, spmgr provides two commands, # spmgr prefer and #spmgr unprefer. These two commands each require a single parameter: the path_instance.

NOTE: The results of these commands are stored in configuration files and the files persist across reboots. Because these commands make dynamic changes to the driver in kernel space, the kernel must be rebuilt for the new configuration to persist across reboots. It is recommended that all changes be done in one session and that the kernel be rebuilt following the session. Rebooting may then be done at a later time. See "Secure Path Persistence Across Reboots" on page 4–36.

spmgr prefer path_instance

This command instructs the Secure Path driver to mark a selected path as *preferred*. If load balance is disabled, this path becomes the active I/O path. Additionally, *spmgr* adds this path_instance to the Secure Path driver's configuration file and upon reboot of the server, the preferred path(s) will be restored.

Syntax:

> # spmgr prefer path_instance

This command requires that the *path_instance* be supplied on the command line. The *path_instance* is provided in the spmgr display listings.

Example:

> # spmgr prefer c21t0d5

spmgr unprefer path_instance

This command instructs the Secure Path driver to unmark the path as a preferred path. Additionally, the configuration file for the Secure Path driver is modified by removing the preferred path markings.

Syntax:

spmgr unprefer path_instance

Example:

spmgr unprefer c21t0d5

Impact of Load Balancing and Active Paths (Preferred or Selected)

Preferred path and *Selected path* are meaningless designations when the user has enabled load balancing. Load balancing treats all paths equally and directs I/O to all available paths. In other words, load balancing is a higher priority than *preferred* or *selected* paths.

When load balancing is enabled, the Secure Path driver will attempt to use all the available paths to a LUN in a round-robin fashion.

If load balancing is enabled and the user *prefers* a path, the system will perform the following actions:

- The driver will mark the path as preferred but the path will not be used as preferred until the load balancing is turned off.

- The configuration file for paths will have this path marked as preferred and upon reboot, this path will be marked as preferred and deployed as preferred if and when load balancing is disabled.

If load balancing is enabled and the user selects a path, the system will perform the following actions:

- If the path is on the Standby controller, I/O will be moved to the Standby controller and the selected path will be one of the Active paths.

- If the path is on the Active controller the path will continue to be used as one of the set of active paths.

This selection and marking is not preserved across reboots or power cycling.

The restore Command

Once a path has failed or has been taken off line by one or more events, the *spmgr restore* command enables the user to restore one or more LUNS to their preferred I/O path. This command enables the user to manually restore all or part of a configuration when the auto-restore feature has been disabled.

A path to a device consists of an adapter (HBA) and a port on a controller (WWNN). A unit on a storage system may be seen through several paths, for example, more than one HBA and controller. The default for spmgr restore is to return all LUNs to their preferred path. It will transition all LUNs to their preferred controller and their adapter if one has been specified and if load balancing is disabled.

By using one or more of the switches for this command, the user will have full control of restoring preferred paths to the Secure Path configuration.

The use of this command assumes two important conditions:

- Paths were preferred previously. If paths to some LUNs have not been preferred, no action will be performed on those units.

- Load Balancing is currently disabled. If Load Balancing is currently enabled, no action will be performed on any path.

Syntax:

```
spmgr restore all
              -d device
              -r WWNN
```

spmgr restore all

Restores all LUNs to their preferred paths and/or preferred controller. If there is no preferred controller, the default will be the current controller. If there is no preferred path, the default will be the current path.

Syntax:

```
# spmgr restore all
```

Example:

```
# spmgr restore all
```

spmgr restore -d *device*

Restores a preferred path to the indicated device.

Syntax:

    # spmgr restore -d device

Example:

    # spmgr restore –d c21t0d2

spmgr restore -r *WWNN*

Restores a preferred path to the indicated storage system.

Syntax:

    #spmgr restore -r WWNN

Example:

    # spmgr restore –r 5000-1FE1-0010-5B00

The quiesce Command

Quiescing an object means to

- Move all active I/O from an object to an alternate path.
- Mark all paths to the object as 'quiesced' to temporarily remove the object from use.

The objects that are supported for V3.0 of Secure Path are adapters and controllers. Also, quiescing individual paths is supported to allow other fabric infrastructure such as switches to be removed and replaced.

Syntax:

    # spmgr quiesce -a HBA
                    -c controller_serial_number
                    -p path_instance

spmgr quiesce -a HBA

When this command is invoked, *spmgr* will move all active I/O using this HBA to paths available on other HBAs. The paths of the specified HBA will then be marked as *quiesced* and no further I/O will be sent along that path until the HBA is returned to service with the corresponding restart command.

These actions may be verified by issuing the # spmgr display –a HBA to view the current path state.

This feature may be used to move I/O to another adapter as the first step to replacing an HBA.

Example:

> # spmgr quiesce -a td0

spmgr quiesce -c controller_serial_number

When this command is invoked, *spmgr* will move all active I/O using this controller to paths on the other controller of the storage system. The paths of the specified controller will then be marked as *quiesced* and no further I/O will be sent along that path until the controller is returned to service with the restart command.

These actions may be verified by issuing the # spmgr display –c controller command to view the current path states.

This feature may be used to move I/O to the other controller as the first step to upgrading or replacing a controller.

Example:

> # spmgr quiesce -c ZG11233409

spmgr quiesce -p path_instance

When this command is invoked, *spmgr* will move all active I/O using this path to another path on the same controller if possible or to a path on the *other* controller. The specified path will then be marked as *quiesced* and no further I/O will be sent along that path until the path is returned to service with the restart command.

These actions may be verified by issuing the # spmgr display command to view the current path states.

Example:

> # spmgr quiesce –p c12t0d5

The restart Command

Object restarting is the means of changing a quiesced adapter or controller to an Available or Standby state. When restarted, the HBA or controller is available as an I/O entity for a path.

Syntax:

```
# spmgr restart  all
                 -a HBA
                 -c controller
                 -p path_instance
```

spmgr restart all

When this command is invoked, *spmgr* will verify the existence of all components on quiesced paths and change those paths to Available or Standby as appropriate. If the Auto-restore feature is enabled and one or more of those paths are Preferred paths, those paths will be made the Active path.

spmgr restart -a HBA

When this command is invoked, *spmgr* will verify the existence of the HBA and then change the state of the paths using the HBA to Available or Standby. If the Auto-restore feature is enabled and a path using that HBA is the preferred path, the path will be made the Active path.

Example:

```
# spmgr restart -a td0
```

spmgr restart -c controller

When invoked, spmgr will verify the existence of the controller and then change the state of the paths using the controller to Standby. If the Auto-restore feature is enabled and a path using that controller is the preferred path, then the path will be made the Active path.

Example:

```
# spmgr restart -c fire-top
```

spmgr restart -p path_instance

When invoked, spmgr will verify the existence of the path and then change the state of the path to Available or Standby. If the Auto-restore feature is enabled and the path is the preferred path, the path will be made Active.

Example:

spmgr restart –p c12t0d5

The add and delete WWLUNID Commands

Version 3.0 of Secure Path supports the dynamic addition and removal of LUNS on a storage system. There are several steps required to add and delete LUNs:

1. If adding a unit, the unit must be physically added to the storage system and *ioscan* must be run for the system to see the new unit.

2. Enter spmgr display –u or spmgr display –dv to obtain the WWLUNID of the unit(s).

3. Enter the spmgr add or spmgr delete command to add or delete the unit(s).

4. Run ioscan to allow the system to claim or unclaim the unit(s).

NOTE: The results of these commands are stored in configuration files and <u>the files persist across reboots</u>. However, because these commands make dynamic changes to the driver in kernel space, <u>the kernel must be rebuilt for the new configuration to persist across reboots</u>. It is recommended that all changes be done in a session and that the kernel be rebuilt following the session. Reboot may then be done at a later time. See "Secure Path Persistence Across Reboots" on page 4–36.

The spmgr add command probes for the new LUN on the storage system with the WWLUN ID provided on the command line.

spmgr add WWLUNID [target LUN]

Syntax:

spmgr add WWLUNID [target LUN]

Where:

WWLUNID is the World Wide LUN ID of the new Unit to add on the storage system.

target LUN (optional) is the target and LUN values to assign for the server

This command will verify the indicated unit and add that unit to the system.

Example: #spmgr add 6000-1FE1-0005-B480-0009-9341-4111-00FB

When invoked, the Secure Path driver will probe for the unit and if available, add it to the data. At the same time, the configuration files will be updated.

This command requires administrative commands before and after use. Prior to using spmgr add, new Array units must be found by the system and after the add, units must be claimed by the system. This command sequence must be done at least once for adding single or multiple units.

Example:

```
# ioscan –fn  (for the Server to find and map new arrays and units)

# spmgr display –u  (to identify unmapped WWLUNIDs)
# spmgr add WWLUNID1 [target LUN]
# spmgr add WWLUNID2 [target LUN]
# spmgr add WWLUNIDn [target LUN]
# ioscan –fnCdisk  (for the Server to claim newly added units)
# insf -e (to install and assign device files)
```

spmgr delete WWLUNID | device

Syntax:

```
# spmgr delete  WW LUNID | device
```

Example: # spmgr delete fireD12   (<= alias used for the WWLUNID)

This command verifies the device and if correct, will delete the device from the configuration.

These actions occur only on the server where the command was issued. For shared storage, the unit must be deleted on each server that has access to it.

After the delete, the following command sequence must be issued at least once to delete single or multiple units from the system.

Example:

```
# spmgr display (to identify WWLUNIDs)

# spmgr delete WWLUNID1
# spmgr delete WWLUNID2
# spmgr delete WWLUNIDn
# ioscan –fnCdisk  (for the Server to unclaim newly deleted units)
```

Secure Path Persistence Across Reboots

Certain Secure Path commands require changes to the kernel. Configuration changes to add and delete LUNs, prefer and unprefer paths, change logging preferences and set parameters (auto-restore, load balancing, path verification and verification period) are stored permanently in configuration files. A reboot of the Server would not alter these files but would reset the state of the configuration to the latest kernel build state. In order for any or all of your changes to persist across reboots, the kernel must be rebuilt.

Although *spmgr* reminds you that the kernel must be rebuilt after each "add", "delete", "prefer", "unprefer", "log" and "set", it must only be rebuilt after you have finished making all the changes you wish to make. The following series of commands is provided as one example of a procedure for rebuilding the kernel.

```
# cd /stand/build
# /usr/lbin/sysadm/system_prep -v -s system
# mk_kernel -s system
# mv ../vmunix ../vmunix.prev
# mv vmunix_test ../vmunix
# reboot (at a convenient time)
```

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Removing Secure Path Software

Secure Path can be removed using HP's SD utilities. When you remove Secure Path, all files, including configuration files, will be removed. You can use SAM or enter:

```
# swremove –x autoreboot=CPQswsp
```

NOTE: After SecurePath is removed, you must reconfigure the array. Consult your HSG80 ACS Solution Software for HP-UX Installation and Configuration Guide for details.

Glossary

This glossary defines terms used in this guide or related to this product and is not a comprehensive glossary of computer terms.

Controller

A controller is a hardware device that facilitates communication between a host and one or more LUNs organized as an array. The HSG80 and HSG60 array controllers are supported for use with Secure Path.

Controller States

- **Critical**–Reported for a controller pair bound in multi-bus failover mode when only one of the controllers is available. This state may mean a failed or offline condition, since the server cannot communicate with the other controller at this time.

- **Operational**–The controller is available with a good status

- **Unknown**–The server cannot communicate with this controller.

Device States

Attributes that describe the current operational condition of a device. A device may exist in the following states:

- **Critical**–Only one path remains available to the storage unit.

- **Degraded**–At least one or more paths are failed to the storage unit.

- **Operational**–The Secure Path device can be accessed on at least one path.

- **Unknown**–Unable to communicate with the unit. This may indicate no available path or a failed device.

- **Dead**-All paths used by this Secure Path device have failed.

Fabric

A network comprised of high-speed fiber connections resulting from the interconnection of switches and devices. A fabric is an active and intelligent non-shared interconnect scheme for nodes.

HBA

A Host Bus Adapter is an I/O device that serves as the interface connecting a host system to the SAN (Storage Area Network).

LUN

A Logical Unit Number is the actual unit number assigned to a device at the RAID system controller.

Path

A virtual communication route that enables data and commands to pass between a host server and a storage device.

Path States and Attribute

- **Active**–Currently used for the I/O stream.
- **Available**–Available on the active controller for the I/O stream.
- **Failed**–Currently unusable for the I/O stream.
- **Quiesced**–Path is valid but the user has moved all I/O from it.
- **Standby**–The path is valid on the standby controller.
- **Preferred**–A path that is preferred for the I/O stream, across reboots.

SAN

Storage Area Network. A configuration of networked devices for storage.

State

State is an attribute that describes the current operational condition of an object. See Path, Path States and Attribute, Controller States, and Device States.

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