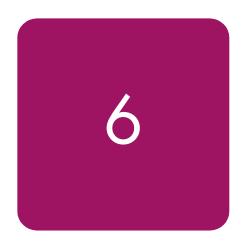# SAN Management

6

With the advent of Storage Area Networks (SANs) and Fibre Channel technology, HP is rapidly transitioning from the traditional server, storage, and component level-based management to a SAN-level application architecture and implementation using the Storage Management Appliance (SMA.)

Just as important as the quality and feature set of the SAN's hardware is the effectiveness of the SAN management applications in tying these devices together and simplifying the complexity of the storage network. Whether using an HP standard topology, or a custom design using the StorageWorks SAN design rules, IT managers need to configure, monitor, and maintain the SAN, as well as plan for, and accommodate, growth.

The HP Open SAN management strategy is to:

■ Simplify storage management using standardized web-based graphical user interfaces (GUIs) residing on easy-to-use, easy-to-implement storage management appliances.

■ Centralize the management of multi-vendor Heterogeneous Open SANs in distributed and consolidated environments.

■ Automate policy-based management.

■ Optimize functionality by exploiting all currently available management levels such as appliances, SAN fabrics, and servers/storage.

Key to the StorageWorks SAN management strategy is the use of the Storage Management Appliance. HP SANs can be designed for local, centralized, or distributed data access. Regardless of the arrangement or location of the storage components and preferred data access method, storage environment management can be centralized using a Storage Management Appliance.

The Storage Management Appliance connects directly to the storage network through a Fibre Channel switch providing full access to all supported devices in the storage environment. Strategically located out of the SAN data path, the appliance allows data transfers to proceed independently between computers and storage devices. The appliance optimizes SAN availability and performance while streamlining manageability.

Note: For more information about using an Storage Management Appliance SAN, see Chapter 3, "Storage Management Appliance Rules and Recommendations".

Storage Management Appliance Features / Functionality

- Simple, unintrusive management of SAN elements
- High SAN performance since the appliance is located out of the data path
- High SAN availability, since data transfers occur independent of the appliance
- Support for multiple management and monitoring applications
- A web-based, centralized user interface
- No console operations for increased SAN management security
- Support for heterogeneous platforms attached to the SAN
- Higher utilization for processing applications on host servers
- Rack mountable, ease of installation and administration

OpenView Storage Management Appliance Software

HP OpenView Storage Management Appliance software is included with and resides on the Storage Management Appliance, giving you access to the storage management appliance functions. Logging into Storage Management Appliance software anywhere over the web provides a single aggregation point to launch a variety of HP's SAN management applications to monitor and manage your storage network.

Zoning the HP Storage Management Appliance in a Heterogeneous Server Environment

Whenever a storage management appliance is placed in a fabric with heterogeneous servers it is recommended that a dedicated storage management zone be created. This zone is specifically for the storage management appliance and the elements it is to monitor and manage.

For example, create a zone called SANAPP_#_ZONE that would contain the appliance host bus adapter port WWN and the port WWNs of all the HSG or HSV controllers managed by this Storage Management Appliance. Because fabric devices can be in multiple zones, this will have no effect on other zones containing the same HSG and HSV controller port WWNs.

Currently, the storage management appliance communicates with HSG or HSV controllers in-band, within the Fibre Channel fabric itself. It is not necessary or recommended to include either the switch WWNs or server HBA port WWNs in this zone. Communications to these devices are done out-of-band; outside the fabric via TCP/IP.

hp OpenView Storage Area Manager Overview

HP OpenView Storage Area Manager provides comprehensive, centralized management of your storage network. The Storage Area Manager product suite includes the following applications:

- Storage Node Manager
- Storage Accountant
- Storage Allocator
- Storage Builder
- Storage Optimizer

You can install all applications from the Storage Area Manager CD-ROM; however, you must purchase and enter operational licenses for each application in order to use them after initial evaluation period.

The software suite's building block architecture allows each of its five software tools to operate and be available separately, so users can add functionality when needed and budgeted. Each tool focuses on a particular aspect of storage management, yet is designed to provide a seamlessly integrated view of the storage environment when used in conjunction with the other tools.

Key Benefits:

- Simple, automated operations
- Intuitive, easy-to-use tools and automated wizards drive staff efficiency and shorten learning curve
- Central console and common reporting structure to manage and monitor storage service availability, performance, usage, cost and growth
- Automated identification of wasted or stale or secondary storage frees capacity
- Usage metering and billing recovers cost and enables charge-back
- Logical, online storage provisioning for storage allocation without impacting operations
- Performance monitoring identifies bottlenecks before they impact business operations
- Automated reporting saves time and increases service quality
- Automated host access notification ensures data is safe from network intruders
- Virtualized storage access control provides highest levels of data integrity
- Continuous health status and event monitoring quickly isolates and solves problems
- Multi-vendor device and system support maximizes storage investments, and provides open choice for future storage acquisitions

Storage Area Manager Architecture

The hp OpenView Storage Area Manager hardware and software architecture is comprised of the bridge, management server, managed hosts, management clients, and the Manager of Managers (optional).

Bridge

The bridge is a Web server application that allows other applications access to Storage Area Manager's functionality, and enables Storage Area Manager's integration with other OpenView enterprise applications. The bridge consolidates information from multiple management servers for use by the application integrating with the bridge.

It is automatically installed on the management server when OpenView Storage Area Manager software is installed from the CD.

Management Server

The management server is a server application that hosts the majority of Storage Area Manager's storage management functionality. Its framework includes the Storage Area Manager database, discovery subsystem, event-handling subsystem, configuration files, and server components for each of the five software tools that comprise the product suite.

The management server software is installed from the Storage Area Manager CD on a dedicated Windows 2000 server or workstation. A single management server manages a single storage domain, which consists of storage resources that are visible to the SAN hosts associated with the management server. Storage Area Manager can manage direct-attached, SAN-attached, or network-attached storage resources.

Managed Host

The managed host contains the host agent software, which includes all components that require access to storage resources visible to the hosts. These components include discovery, status and event inquiry, and performance and capacity data collection.

The host agent software can be installed remotely from the management server or locally from the Storage Area Manager CD onto a Windows, HP-UX, Solaris, Linux, AIX, or Tru64 UNIX (available February 2003) host. Upon successful installation, the host becomes associated with and dedicated to the management server. The host agent runs as a service on Windows hosts and as a daemon on UNIX hosts.

Management Client

The management client is a graphical user interface (GUI) application that uses a common navigation and presentation framework to display the storage information stored by the management server.

The management client software is automatically installed on the management server. It also may be downloaded from the management server to remote client systems running Windows, HP-UX or Solaris.

Manager of Managers

The Manager of Managers (MoM) is a graphical user interface (GUI) application that consolidates storage information from multiple storage domains. This allows administrators to view, from a single location, the high-level status and filtered event information of a large or geographically dispersed storage network. They also can launch the management client for one specific storage domain to view the detailed information displayed by the client.

The MoM software can be downloaded from the management server to remote Windows, HP-UX and Solaris hosts. It is an optional piece of the Storage Area Manager architecture.

OpenView Enterprise Applications

The Storage Area Manager software suite integrates with various OpenView enterprise applications. Through the bridge, the Storage Area Manager Smart Plug-in (SPI), and the integration packages contained on the Storage Area Manager CD, its information and control can be integrated with:

- hp OpenView Reporter
- hp OpenView Operations for Windows
- hp OpenView Operations for UNIX
- hp OpenView Internet Usage Manager
- hp OpenView Service Navigator
- hp OpenView Service Desk

For more information on the integration of Storage Area Manager with these enterprise applications, refer to the Storage Area Manager documentation.

Hierarchical Multi-Domain Architecture

The Storage Area Manager software suite is designed to support hundreds of managed devices and thousands of LUNs spread across both logical and physical (direct, NAS, SAN) domains in the storage infrastructure.

Its optional Manager-of Managers (MoM) capabilities further ease the management of large distributed environments. It enables administrators to see a complete view of the distributed storage infrastructure, and allows individual administrators access to those infrastructure components for which they are responsible.

SAN Management Categories

SAN management is wide ranging, covering many aspects of the day-to-day activities used for monitoring and managing, as well as simplifying, the complexity of the storage network.

This section classifies SAN management into four major categories:

■ Fabric management

■ Storage management

■ Data management

■ SAN usage and monitoring

SAN Fabric Management

SAN fabric management can be thought of as the control of the SAN infrastructure or "traffic flow" within the SAN. This pertains to control and management of device communication or access within the SAN, such as switch zoning, or LUN level Selective Storage Presentation (SSP). This also includes managing SAN interconnect components, individually and collectively, throughout the fabric.

SAN Storage Management

Storage management allows control of the specific storage system configuration such as redundant paths, creation and management of storagesets (LUNS), setting of RAID levels, and the setting of platform specific SAN interface characteristics and parameters.

SAN Data Management

SAN data management applications help ensure that data is available and accessible. The data being stored on the SAN is part of a company's assets. It is imperative to keep this data available to system applications with minimal, if any, downtime. Techniques such as cloning, snapshots, data replication, and backups protect the data from disasters.

SAN/Storage Usage & Monitoring

SAN and storage usage and monitoring applications are necessary to provide SAN event notification and fault/failure information for service before SAN anomalies can adversely impact the enterprise. They may also provide reporting and billing information for determining the amount of storage and quality of service delivered.

SAN Management Application Deployment

Within the different categories of management tools, individual tools are implemented either on the storage management appliance, within fabric interconnect components, or within servers/storage systems. Table 31 lists the management tools by category, and identifies where the specific tools reside.

Note: Some applications may reside in more than one category.

Table 31: SAN Management Tools & Location

SAN Management Application	Appliance Based	Fabric Based	Server Based	Storage Based
SAN Fabric Management				
hp SANworks Network View	Yes	No	No	No
hp OpenView Storage Node Manager	No	No	Yes	No
StorageWorks Fabric Watch	No	Yes	No	No
SAN/Fibre Channel Switch Management	No	Yes	No	No
hp StorageWorks HA-Fabric Manager	No	Yes	Yes	No
SAN Storage Management				
Storage Management Appliance Element Manager for HSG	Yes	No	No	No
Storage Management Appliance Element Manager for HSV	Yes	No	No	No
SANworks Network View	Yes	No	No	No
OpenView Storage Node Manager	No	No	Yes	No
OpenView Storage Allocator	No	No	Yes	No
StorageWorks Command Console	No	No	Yes	No
Storage System Array Controller Software (ACS) Command Line Interface (CLI)	No	No	No	Yes
Storage System Scripting Utility (SSSU)	No	No	Yes	No[1]
RA4000/4100 Array Configuration Utility (ACU)	No	No	Yes	Yes
MSA1000 (ACU, ACU-XE, ACU-XE(Offline)	No	No	Yes	Yes
Secure Path Manager	Yes	No	Yes	No
Storage Provisioner	Yes			
SAN Data Management				
StorageWorks Business Copy (BC)	No	No	Yes	No
OpenView Storage Virtual Replicator	No	No	Yes	No
StorageWorks Data Replication Manager (DRM)	Yes	No	No	Yes[2]
StorageWorks Command Scripter	No	No	Yes	No[3]

Table 31: SAN Management Tools & Location (Continued)

SAN Management Application	Appliance Based	Fabric Based	Server Based	Storage Based
Continuous Access EVA user interface[4]	Yes	no	no	no
SAN/Storage Usage & Monitoring				
OpenView Automation Manager	Yes	No	No	No
SANworks Network View	Yes	No	No	No
OpenView Storage Node Manager	No	No	Yes	No
OpenView Storage Builder	No	No	Yes	No
OpenView Storage Accountant	No	No	Yes	No
OpenView Storage Optimizer	No	No	Yes	No

1.This product is a character cell interface to configure and control an Enterprise Virtual Array

2.DRM requires ACS Version 8.xP Software

3.This product is a front-end to the Storage System CLI

4.Requires Command View EVA, Continuous Access EVA License, VCS V3

SAN Fabric Management Tools

Storage Management Appliance Network View

HP SANworks Network View is a Storage Management Appliance application providing at-a-glance views of SAN configuration and availability. SAN devices, their Fiber Channel interconnects, and associated status are automatically discovered and represented in an intuitive topographical display. SAN device management is made easy by double clicking on a device icon. A Java based design allows remote SAN management from any web-enabled console having Internet Explorer browsing capability. Network View serves as a SAN management consolidation point.

Software Features / Functionality

- Simplified SAN management from one application

- At a glance SAN visualization

- SAN administration from remote locations

- Automated SAN availability monitoring and notification when faults arise

- A consolidation point and launch pad for device specific device and storage management tools

- Fibre link connection mapping for established SANs or for future planning

- Scalable for future SAN growth

- A host independent solution

Storage Management Appliance Network View spans three SAN management categories by providing:

- SAN Fabric Management - Network View can view, monitor and manage FC Switches, Tape Routers as well as Inter Switch Links (ISL) right from the topology map. By either clicking on the device icon or the device folder Network View will automatically launch the device's web GUI.

- SAN Storage Management - HSG elements can also be viewed, monitored and managed from the Network View topology map. By clicking on the element icon or device entry, Network View will call up the respective Element Manager application.

- SAN monitoring - Network View can monitor the condition of the fabric hardware by displaying and reporting the condition of server HBAs, Fabric Interconnects, and HSG elements via E-mail, pager or SNMP traps. Performance can be monitored either in real time or a SAN history may be maintained to playback at anytime.

Network View Setup in a Large SAN

Network View discovers, monitors and manages various FC devices either through in-band or out-of-band communications with that device.

HSG Elements

Network View uses in-band and out-of-band communication to discover the HSG controllers or elements. Network View will automatically populate its database and topology map based on the HSG elements discovered by the appliance. Currently, HSG elements are displayed by the controller serial numbers discovered

It is recommended to change the properties of the HSG Element to a more intuitive name for display and error reporting reasons. Right-click on the element icon or device list to change properties. A suggestion would be: *location-controller type-failover mode- ACS version*

For example: RACK05TOP-G80-T-V8.6F would indicate the element resides in the top of Rack 5, and are HSG80 controllers running in Transparent Failover with ACS code V8.6F.

Fibre Channel Switches/ Fibre Channel Routers

Network View uses out-of-band communication (TCP/IP) to discover Fibre Channel Switches and Fibre Channel Routers. When Network View is launched for the first time a Configuration pop-up window will appear indicating the database is empty. You may then add a range of FC Switch/Router IP addresses for Network View to map and monitor.

You may also at any time add additional IP addresses by clicking on the Configure button on the topology map, adding the new IP addresses then Start discovery.

By default, Network View will display the DNS name of the IP address, if any, or the IP address itself. Right-clicking on the device icon or name will allow you to edit the name within the properties box that is displayed in the topology map.

A suggestion would be: *FCtopology-device-xx*

For example: RING-SWITCH-01 would indicate the first FC switch in the RING topology.

Note: Use at least 2 characters for numbers to keep the display sorted properly.

Server Host Bus Adapters

Network View does not initially discover server HBAs until a Device Manager Agent is installed on the server. During the agent install it will prompt you to input the appliance name running Network View. It is this device manager service that "pushes" the HBA information over TCP/IP to the appliance. Currently, server device managers are available on Window NT, Windows 2000, Sun Solaris, Tru64 UNIX, HP-UX, IBM AIX, OpenVMS, and NetWare.

Network View will display the DNS name of the server in the topology map and it cannot be renamed. However it is suggested to append the HBA name located under the Host name for monitoring and error reporting purposes.

A suggestion would be to prefix the existing entry with: *servername-topology*

For Example: SERVER04-RING-Emulex-LP8000-Port0 would indicate this is SERVER04's RING topology adapter.

For further information, including agent O/S versions, please read the Network View QuickSpec and release notes.

hp OpenView Storage Node Manager

HP OpenView Storage Node Manager provides a central management console from which multi-vendor storage and infrastructure resources can be centrally and automatically discovered, mapped, monitored, configured and maintained. In addition, Storage Node Manager serves as a common launch point for device applications. Storage Node Manager is part of the Storage Area Manager suite and is available as an individual product.

Key features and benefits include:

Table 32: Storage Node Manager Features and Benefits

Feature	Benefit
Centralized Management Console	Operators no longer need to run from device to device to troubleshoot problems. Adding, deleting or changing storage configurations and tracking data center environment changes are handled through a single interface.
Status and Event Monitoring	Proactive and quick problem isolation through visible alerts and alarms that display the health of each device (event logs maintained for review at any time).
Auto-Discovery of Devices	Maximized availability as changes in the storage network are immediately identified and mapped through continual automatic discovery.
Device Applications	Reduced configuration and troubleshooting time by launching device applications directly from the management station.
Multi-Vendor Host Support	Choice among market share leaders including Windows NT 4.0, Windows 2000, HP-UX, Linux, Sun, and Tru64 UNIX (available February 2003) servers are all supported.
Graphical Device Maps	Easy to interpret visual status of all aspects of the storage network, including redundant connections between devices.
Device Icons	Efficient management through a standard set of icons.
Asset Management	Customizable location fields allow system administrators to easily identify physical location of devices in large, distributed (e.g., campus) environments.
Fibre Channel Zone Presentation	Easily identify zone members in the maps, facilitating efficient management.

Fabric Watch

Fabric Watch allows the SAN manager to monitor key fabric and switch elements, making it easy to quickly identify and escalate potential problems. It monitors each element for out-of-boundary values or counters and provides notification when any exceed the defined boundaries. The SAN manager can configure which elements, such as error, status, and performance counters within an HP SAN Switch, are monitored.

Fabric Watch can be accessed through a web GUI, a telnet interface, an SNMP-based enterprise manager, or by modifying and uploading the Fabric Watch configuration file to the switch.

Fabric Watch monitors the following elements:

■ Fabric events (such as topology reconfigurations, zone changes)

■ Switch environment (fans, power supplies, and temperature)

■ Ports (state changes, errors, and performance)

■ GBICs

With Fabric Watch, each switch continuously monitors error and performance counters against a set of defined ranges. This and other information specific to each monitored element is made available by Fabric Watch for viewing and, in some cases, modification. This set of information about each element is called a *threshold*, and the upper and lower limits of the defined ranges are called *boundaries*. If conditions break out of acceptable ranges, an *event* is considered to have occurred, and one or more alarms (reporting mechanisms) are generated if configured for the relevant threshold.

Please refer to Table 9 for hardware support.

hp StorageWorks HA-Fabric Manager

As SANs expand and become more complicated, IT administrators need an efficient tool for managing the enterprise. hp StorageWorks HA-Fabric Manager (HAFM) is a comprehensive storage resource management application used to configure and manage HP's M-Series switch product line. HAFM simplifies SAN management, optimizes storage resources, and minimizes storage networking risks.

HAFM features include:

■ complete management of the SAN from a single console

■ integration with leading multi-vendor applications

■ high levels of access and security

■ scaling from department-level SANs to enterprise networks

■ savings in time, money, and personnel resources

■ detailed logging, diagnostics, and proactive alerts that monitor and ensure fabric health

■ streamlined troubleshooting processes

■ ease to use

hp StorageWorks HA-Fabric Manager - New Features:

■ Persistent Fabrics

■ Improved Zoning

■ User Interface Enhancements

■ 2Gb/s Management Support

■ New Product Managers

HAFM can be run locally on the HAFM Server platform or remotely on any network-attached user workstation in the enterprise. The Java-based deployment support gives IT administrators the flexibility to run HAFM from virtually any type or size of client device including Sun, AIX, HP-UX, Linux, Windows NT, Windows 95, Windows 98 and Windows 2000.

Please refer to Table 10 for hardware support.

SAN/Fibre Channel Switch Management

The HP Fibre Channel SAN Switches are high performance, scalable switch fabrics designed for creating large SANs. The management functions let you control and monitor fabric topology, frame throughput, error statistics, fans, cooling, media type, port status, and a variety of other information to aid in system debugging and performance analysis.

The administrative and diagnostic functions of the SAN switch are accessible from IP over the RJ-45 10/100BaseT Ethernet port or any Fibre Channel port. You can use any Simple Network Management Protocol (SNMP)-based management product to access the SNMP agent. You can also use any supported web browser to use the Java Web Management Tools.

Supported management methods include:

■ SNMP

■ Telnet

■ Web-based Management Tools launched via Network View

■ Telnet command subset via switch front panel display (FC SAN Switch/16 only)

SAN Management: C-Series Product Line Switches

The Cisco MDS switches can be managed in several different ways:

■   via the serial port/manager console

■   via telnet over IP

■   with the Cisco Fabric Manager over IP or IP over Fibre Channel.

The Cisco Fabric Manager is a fabric-based, web-loaded application that provides fabric level (Fabric View) and switch (Device View) level management functions from most web-enabled workstations. Fabric Manager also provides a Summary View mode that reports on port statistics.

OVSAM

There is an HP OpenView Device Plug-In (DPI) for Cisco MDS Switches. This DPI extends Storage Node Manager and Storage Optimizer support to discover, map, and monitor the health and performance of the Cisco MDS 9509 and MDS 9216 switches. This DPI can be obtained through this URL:

http://www.openview.hp.com/products/dpi/dpi_0049.html

SAN Storage Management Tools

Element Manager for HSV

Element Manager for HSV is a SAN management application to configure and monitor HSV controllers. For each controller pair, Element Manager for HSV enables you to:

■   Initialize an Enterprise Virtual Array and create a pool of disk drives

■   View, configure, and upload code to the controllers and disk drives

■   View and configure virtual disks, and host properties

■   Dynamically expand volumes for operating systems that support dynamic volume expansion

■   Make temporary snapshots of volumes for backup purposes (with supported firmware, requires license)

■   Make snapclones to create an exact copy of another Virtual Disk at a particular point in time (with supported firmware, uses same license as snapshots)

■   View Enterprise Virtual Array event logs

VCS Features and Functionality

■   Support for up to 240 disk drives per controller pair

■   Management of up to 512 virtual disks per disk pool ranging in size from 1GB to 2TB per virtual disk

■   Dynamic capacity expansion and virtual disk data load leveling

■   Distributed sparing of disk capacity

■   Virtually Capacity-Free Snapshot (Vsnap)

■   Virtually Instantaneous Snapclone

■   Dual redundant controller operation for increased fault tolerance

■   Multiple Bus Failover Support

■   Battery Back-up

■   Asynchronous Disk Swap (Hot Swap)

■   Clustered Server Support

■   Mirrored Write-Back Cache Support

■   Read-Ahead and Adaptive Read Caching Support

■   Virtual RAID Arrays (Vraid0, Vraid1, Vraid5)

■   Non-disruptive software upgrade capability

■   Initially supports connection of up to 256 hosts

■   Multi-Vendor Platform Support

■   Controller Password Protection for Configuration Control

■   Selective Storage Presentation and SAN-based data zoning

■   GUI Interface for management and monitoring

Supported management methods include:

■   SSSU

■   Storage Management Appliance

VCS works in a heterogeneous environment that includes Tru64 UNIX, OpenVMS, Microsoft Windows NT and Windows 2000, and Sun Solaris. This application is at the storage system level.

Command View EVA Restrictions

Current restrictions of the Command View EVA must be enforced:

■   A maximum of 16 Enterprise Storage Systems can be managed by one Storage Management Appliance

■   An Enterprise Storage System must not be visible to more than one Storage Management Appliance

General HSV Storage System Configuration Process

The following steps highlight the configuration process for storage systems. Refer to your storage system user guide for more information.

1.   Set up the storage system according to the product user guide.

2.   Ensure that you have connected the Fibre Channel from HSV controller ports to optical interfaces found on the Fabric Switch.

3.   Ensure that appliance and the HSV controller port WWNs are in a Storage Management Appliance zone.

Initially, Enterprise Storage Systems are display as "UNINITIALIZED" on the Command View EVA browser window. It is recommended that, when the storage system is initialized, a intuitive name is used for display and monitoring convenience.

1.   In the navigation pane, click on a controller icon.

2.   In the Content Pane, click the INITIALIZE button.

A pop-up message confirms that you are initializing the storage system. It also states that any data associated with the selected system will be lost, and then asks if you wish to proceed with the initialization procedure.

If you have not previously entered the license key for the storage system, you will be prompted to do so.

3.   Enter a name for the storage system.

A suggestion would be:

location-controller type- VCS version -

For example: RACK05-V110-V2002 would indicate the element resides in Rack 5, and contains HSV110 controllers running VCS code V2002.

4.   Specify the number of disks in the default group. Enter from 8 up to the total number of drives in the subsystem.

5.   Click on the **Advanced Options** button and set the date and time option. It is recommended that you synchronize the time with the Storage Management Appliance time. If this practice is used with all controllers, then you will have synchronized times on all event log entries.

Leave the Console LUN ID set to "**0**"

Element Manager for HSG

Element Manager for HSG is a Storage Management Appliance application to configure and monitor HSG80/60 controllers. For each controller pair, Element Manager for HSG enables you to:

■ View existing virtual disk, controller, physical disk, and host properties

■ Make changes to these properties for different configurations

■ Configure Remote Copy sets and add associations (with supported firmware)

■ Dynamically expand volumes for operating systems that support dynamic volume expansion

■ Make temporary snapshots of volumes for backup purposes (with supported firmware)

HSG Element Manager Restrictions

Current restrictions of the HSG Element Manager must be enforced:

■ Maximum of 25 HSG Storage Systems can be managed by one Storage Management Appliance

■ An HSG Storage System must not be visible to more than one Storage Management Appliance

Note: The HSG Element Manager is not a supported management tool for DRM environments. Contact HP consulting services for information about managing DRM.

Storage Management Appliance and HSG storage system Communication

When configuring an HSG controller in a Storage Management Appliance storage environment, you will need to enable CCL (i.e. setting the controllers to SCSI-3 or SCSI-2 with CCL Enabled) or provide a dedicated LUN (i.e. setting the controllers to SCSI-2 CCL Disabled) for the Storage Management Appliance. If you are using a dedicated LUN instead of CCL, verify that the LUN is presented to the Storage Management Appliance through each controller host port connection for the Storage Management Appliance (there are two host ports per controller). The LUN may be a partition. For more information, see your HSG controller user guide.

General HSG Storage System Configuration Process

The following steps highlight the configuration process for storage systems. Refer to your storage system user guide for more information.

1. Set up the storage system according to the product user guide.

2. Ensure that you have connected the Fibre Channel from HSG controller ports to optical interfaces found on the Fabric Switch.

3. Ensure that the appliance and the HSG controllers port WWNs are in a Storage Management Appliance zone.

> **Note:** The following steps are only necessary if the HSG controller is configured for SCSI-2 CCL Disabled.

   a.   Connect to the HSG controller via the serial interface. Refer to your HSG controller manual for further information on the serial connection.

   b.   Start terminal session. Refer to your HSG controller manual.

   c.   At the prompt in the terminal session, enter the Command Line Interface (CLI) command SHOW CONNECTION.

   d.   Verify, via HSG connection table, that the Fibre Channel HBA of the Storage Management Appliance is online. Use CLI command SHOW CONNECTION.

   e.   Create Logical Unit Number (LUN) and enable access from the LUN to the Storage Management Appliance.

4.   Verify that the HSG controllers are discovered. To verify HSG status, you will need to configure and launch Element Manager for HSG and click on OPTIONS. Enable controllers that are discovered.

Currently, HSG elements are displayed by the controller serial numbers discovered. It is recommended to change the properties of the HSG Element to a more intuitive name for display and error reporting reasons.

1.   In the navigation pane click on a controller serial number displayed.

2.   In the Content Pane edit the ALIAS field and save changes.

A suggestion would be: *location-controller type-failover mode- ACS version*

For example: RACK05TOP-G80-T-V8.6F would indicate the element resides in the top of Rack 5, and are HSG80 controllers running in Transparent Failover with ACS code V8.6F.

HSG Storage System Array Controller Software/Command Line Interpreter

HSG Array Controller Software (ACS) for Fibre Channel Arbitrated Loop and Switched Fabrics provides storage controller software capability for the StorageWorks HSG60 and HSG80 Array Controllers in Fibre Channel arbitrated loop and switched fabric environments. HSG Array Controller Software is designed to be common across multiple operating system platforms. However, there may be operational differences between platforms, and there may also be features that are not supported on every platform.

Management of storage systems based on the HSG60 or HSG80 is provided directly through the controller serial port using a terminal or a terminal emulator (such as Microsoft Windows NT HyperTerminal) using the CLI interface. The CLI provides all the commands necessary to configure controller failover modes and parameter settings, controller and host connections to the SAN, storageset creation, SAN LUN access (SSP), RAID levels, and cache settings. The CLI also provides access to the array controller utilities. The utilities are used to monitor controller functions and statistics, and to allow storage system component replacement procedures be conducted while the storage system is active.

Selective Storage Presentation

Selective Storage Presentation (SSP) provides a way to control SAN access at the storageset or LUN level. SSP allows each server or HBA's storagesets (LUNs) to be presented exclusively to those that are allowed access. Additionally, SSP allows the setting of host modes and LUN offsets for each HBA connected to the storage system. The host mode is specially tailored to the storage communication techniques of the operating system type. The LUN offset feature of SSP allows higher numbered LUNs in a storage array to be presented in a range required by specific operating systems. The SSP feature also provides a way to track the numerous Fibre Channel HBAs within servers attached to a SAN by identifying each by name and WWN.

ACS Features / Functionality

- Host Interconnect and Protocol Services
- Microsoft Cluster Server (MSCS) Support
- Dual Redundant Controller Operation
- Testing and diagnosis of the HSG array controller
- SCSI device control
- Transparent Controller Failover Support
- Multiple-Bus Failover Support
- Asynchronous Disk Swap (Hot Swap)
- ACS system management services
- Local program support
- Mirrored Write-Back Cache support
- Read Ahead Cache support
- Disk Mirroring capability (RAID 1)
- Disk Striping capability (RAID 0, 0+1)
- RAID capability (RAID 3/5)

- Storageset Expansion
- Disk Partitioning capability

Supported management methods include:

- Terminal emulation through the HSG's serial port using the CLI
- Command Console
- Command Scripter

ACS works in a heterogeneous environment that includes Tru64 UNIX, OpenVMS, Microsoft Windows NT and Windows 2000, Novell NetWare, Sun Solaris, HP-UX, SGI IRIX, IBM AIX, Linux x86, and Linux Alpha. This application is at the storage system level.

hp OpenView Storage Allocator

The hp OpenView Storage Allocator software delivers a central, unified method for virtualized storage access control and LUN-level storage assignment, enabling you to build and manage complex Storage Area Networks (SANs) with heterogeneous servers and storage devices.

Storage Allocator is part of the Storage Area Manager suite and is also available as an individual product.

Key features and benefits include:

Table 33: Storage Allocator Features and Benefits

Feature	Benefit
Centralized, unified method for dynamically assigning RAID, JBOD and tape devices in SAN environments	Protects against data loss and unauthorized access by controlling host access to storage devices
LUN level storage assignment: dynamically add, remove and assign storage	Optimizes storage utilization by enabling any LUN to be assigned to any host quickly and easily with no downtime rebooting
Storage access control: control which hosts can access specific storage devices	Storage security, prevents data loss and unauthorized access
Highly scalable	Simplifies administration since one software solution may be used in a wide range of configurations
Add/remove/assign storage without host reboots	Allows administrators to assign storage whenever it is needed without interrupting host operation, increasing overall system availability
Mirrored SAN configuration	High system availability provided by a NSPOF configuration.
Automated storage network discovery	Automatically populates configuration database with host and storage device information, dramatically reduces configuration time and eliminates a major source of errors
Intuitive graphical user interface (GUI)	Using familiar techniques and powerful controls like view filters maximizes productivity and minimizes training time
Share groups for cluster configurations	Clear visualization of storage accessible to multiple hosts prevents errors when setting up cluster server and shared tape device environments
Fibre Channel topology independence	Compatibility with FC Arbitrated Loop and Switched Fabric provides SAN configuration flexibility
Open system, heterogeneous environments	A single tool can be used to provide storage security in data centers with a mixture of Windows NT servers, UNIX servers, and storage from multiple vendors
Native file system and raw disk support	Greatly simplifies process for moving existing storage to SANs, no need to copy data or reformat disks
Automated rogue host detection and notification	Enhanced data and information security. Eliminates component/driver tampering.

StorageWorks Command Console

StorageWorks Command Console (SWCC) is a feature-rich, graphical user interface providing local and remote management of StorageWorks HSG60 and HSG80 array controllers. It is a user-friendly tool for monitoring, configuring, and troubleshooting HP storage arrays and controllers.

SWCC can be connected to your StorageWorks controller in several ways. Once connected, the program issues commands and interprets the responses sent by the controller. The user interface displays the logical and physical layout and status of a selected subsystem in graphical form. Command Console consists of two major components: the Client and the Agent. The Client, which includes the user interface and some additional services, provides a window into your storage subsystems. The Agent is a host-resident program that is an interface between the Client and the host's storage controller to interpret and transfer information.

The Agent acts as the Client's assistant in controlling your storage subsystem. The Agent continuously monitors the subsystem and notifies the Client of changes. Commands sent from the Client are received by the Agent and are routed to the storage subsystem via the subsystem's Fibre Channel bus. Subsystem status is transmitted back to the Client from the Agent via the network connection.

Software Features / Functionality

- Easy, graphical configuration of the storage subsystem using an interface similar to Windows Explorer.

- Graphical view of the controller and its physical and logical storage elements.

- Status monitoring of the storage subsystem using intuitive icons.

- Fault notification by pager, electronic mail, and event log entries.

- Management of multiple host systems through a TCP/IP network connection.

- Direct serial port connection.

- Direct SCSI port connection (Windows NT and Windows 2000 Only).

- Robust security that prevents unauthorized access to configuration capabilities.

- The Client supports Microsoft Windows NT 4.0 and Windows 2000.

- The Agent supports HP-UX, Tru64 UNIX, OpenVMS, AIX, and multi-vendor platforms.

- This application is at the server level for both the Client and the Agent.

Array Configuration Utility for RA4000/4100/MSA1000

The HP Array Configuration Utility (ACU) software (for Smart Array products, StorageWorks RAID Array 4100/4000 systems, and MSA1000 systems) makes it easy to configure and expand your disk drive arrays. This graphical tool is very intuitive: by using its Configuration Wizards, you have the ability to configure your array controller, add additional disk drives to an existing configuration, or completely reconfigure your disk drive array.

Software Features/ Functionality

■ Selective Storage Presentation: allows RA4100 and MSA1000 array sets to be partitioned to multiple servers for SAN access

■ Online RAID Level Migration: allows for online post-configuration change to RAID level without destroying data or volume information.

■ Online Capacity Expansion: lets you add storage to an operational RA4100 or MSA1000, reducing expensive server downtime.

■ Online Volume Extension: allows for the capacity growth of existing logical volumes.

■ Global Online Spare: reduces the risk of data loss by facilitating automatic rebuilds after a drive failure.

■ Logical Drive Capacity Extension: allows the user to increase the size of existing logical drives online under Windows NT and offline for other operating systems.

■ Pre-Failure Warranty: Drives installed in an RA410 or an MSA1000 and monitored under HP Insight Manager are supported by a Pre-Failure (replacement) Warranty.

Note: Pre-Failure Warranty allows for the replacement of designated drives in an RA4100 before they actually fail when using HP Insight Manger on HP servers.

Note: Some operating systems may not support all of these features.

Secure Path Multi-Path Software

Depending on the platform or operating system, high availability functionality may or may not be embedded in the operating system I/O drivers. Tru64 UNIX V5.0A/V5.1 and OpenVMS operating systems have the ability to create and maintain multiple paths over the SAN to the same LUN, with support for these functions embedded. For those operating systems that do not support multi-pathing, HP provides this capability using HP Secure Path.

The HP Secure Path provides continuous data access for RAID storage systems accessed by operating systems that are not HP-based. When combined with the inherent fault-tolerant features of the RAID Array, this configuration effectively eliminates single points of failure in the storage system.

When a host bus adapter, cable, or controller in a path fails, the failure is detected and I/O is automatically re-routed to the functioning, alternate path. This process, called failover, requires no resource downtime and ensures high availability of data. Storage units that have experienced failover may be configured to failback automatically after a path is restored. Failback can also be done manually through the use of the Secure Path GUI.

Software Features / Functionality

- Switched fabric and loop support

- Automatic path failover

- I/O load distribution

- User-selectable failback

- Supported on the Storage Management Appliance

Secure Path works in a heterogeneous environment. See Chapter 4, "Heterogeneous SAN Platform and Storage System Rules".

Secure Path Element Manager on the Storage Management Appliance

Managing Windows NT and Windows 2000 Secure Path servers throughout the enterprise is now available using the Storage Management Appliance. Secure Path Element Manager uses the easy-to-use Storage Management Appliance Web GUI interface to manage and monitor hosts and HSG60/80 storage subsystems and integrates with the Storage Management Appliance's notification utility.

The notification utility provides centralized functionality. The web-based Notification console is used to provide a single, modular, networked software unit that has the ability to handle Event Logging, SMTP, SNMP and command line launching operations.

Secure Path Element Manager uses TCP/IP to communicate with Secure Path servers. Adding the Storage Management Appliance server name to the Client list on the Secure Path Server will allow Secure Path Element Manager to discover the Secure Path server and add it to a profile.

SAN Data Management Tools

Business Copy

Business Copy (BC) is web-based application software that manages controller-based clone and snapshot operations. Cloning is a mirroring copy function that allows you to create an exact copy of a LUN; snapshot provides an instantaneous point-in-time copy function. BC can be used to meet business continuance requirements by minimizing application downtime required for system backups and data migration activities. BC automates the creation of command files that control the cloning or snapshot operation. BC also allows you to mount the clone or snapshot on a second host on the same controller.

BC is a host-based tool that can be accessed by the user directly via a GUI or remotely via a browser. The tool then interacts with the requested application(s) to stop new I/O and flush pending I/O to disk. Once the I/O is stable, BC instructs the storage via the in-band CLI to perform a snap or clone operation. Finally, on completion of that operation, BC restarts the application.

BC automates the creation of command files that control the cloning or snapshot operations. BC also allows users to mount the clone or snapshot to a new host. The new host can then act as a dedicated backup server or data warehouse server. All operations are performed on the clone or snapshot, minimizing performance impact on the production system.

Software Features / Functionality

- Web-based application
- Supported on the Storage Management Appliance
- Easy management of complex cloning and snapshot operations
- Supports LAN-less backup
- Simplified, centralized storage management

Business Copy works in a heterogeneous host environment that includes Tru64 UNIX, Microsoft Windows NT, Windows 2000, and Sun Solaris. This application is at the server level.

Business Copy on the Storage Management Appliance

Managing Windows NT and Windows 2000 Business Copy (BC) servers throughout the enterprise is now available using the Storage Management Appliance.

Business Copy uses TCP/IP to communicate with BC servers. Adding the Storage Management Appliance server name during the BC server agent setup will allow the BC application on the Storage Management Appliance to discover the BC server.

Virtual Replicator

The hp OpenView Storage Virtual Replicator (VR) combines a rich set of innovative capabilities that enhances and simplifies storage management for Microsoft Windows NT and Windows 2000 environments. Through virtualization, online volume growth, snapshot and management features, the software complements the standard capabilities within the operating system.

Virtual Replicator utilizes industry-standard server, storage, and network-interconnect components, protecting an organization's current and future storage investments.

Storage Virtual Replicator provides the ability to create instant, virtual snapshots of production data without having to physically copy it. A snapshot, which looks exactly like the original disk from which it was copied, takes seconds to create and allows customers to back up and restore data with minimal impact to users and applications. Customers can schedule automated snapshot backups using the integrated policy-based scheduling and scripting features.

Software Features / Functionality

- Virtualization:

  Allows companies to respond quickly to rapidly changing storage capacity requirements. With storage virtualization, multiple storage arrays can be grouped into a pool of disk space for individual or clustered systems to use. Multiple high-capacity virtual disks, up to 2 terabyte in size, can be created from a pool for users and their applications. System administrators can tailor disk space to specific requirements for maximum utilization of storage resources.

- Online volume growth:

  Enables easy, non-disruptive growth for Windows 2000 with zero downtime. Online Volume Growth allows a system administrator to grow an existing volume on a Virtual Replicator virtual disk and also on a Windows 2000 basic disk. The system will remain online, and the data on the volume will remain intact.

- Snapshots:

  Enable the instant creation of multipurpose virtual replicas of production data without the requirement of a physical copy. Snapshots function identically to ordinary physical disks with both read and write capability. Whenever a quick copy of production data is needed, snapshots can be used with minimal disruption to running applications. For example, the snapshot can be the source for backup using standard backup tools. Snapshots can remain online for restore operations, testing, and data mining.

- Management:

  Simplification through easy-to-use interfaces using Microsoft Management Console or a command line. Interactive wizards are available to guide the administrator through all management tasks and create automatic schedules of operations.

Virtual Replicator provides server-based virtualization and is supported on Microsoft Windows NT and Windows 2000 (Server and Advanced Server.) VR is cluster-aware to ensure business continuance.

Continuous Access EVA

Continuous Access EVA is a Fibre Channel storage controller-based data replication (remote mirroring) solution to support disaster tolerance requirements. Continuous Access EVA works with the HP StorageWorks Enterprise Virtual Array storage system, which contains the HSV virtualized RAID controller. The HSV controller and the Virtual Controller Software (VCS) Version 3.0 enhance the virtualization with remote replication technology.

Continuous Access EVA copies data online and in real time via synchronous replication to a remote EVA through a local or extended storage area network (SAN). Additionally, data replication can be bidirectional, meaning that a storage array can be both a source and a destination. A particular LUN can be replicated in only one direction between the two storage arrays. Write I/O is sent to the source and then replicated by Continuous Access to the destination. Properly configured, Continuous Access EVA can be a complete disaster-tolerant storage solution that guarantees data integrity in the event of a storage system or site failure.

A basic Continuous Access EVA configuration is shown in Figure 1.

While Continuous Access EVA may be used to satisfy data distribution or data migration requirements, this version of the Design Guide does not provide design recommendations for those solutions.
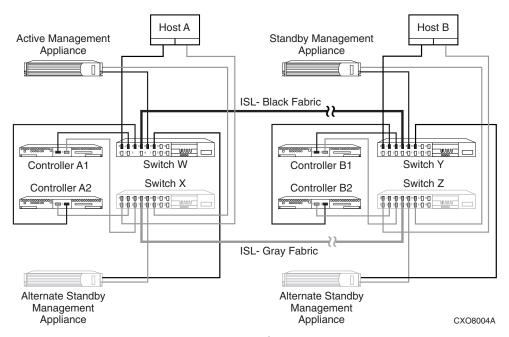

Figure 48: Continuous Access EVA basic configuration

Features

The following are prominent features of the Continuous Access EVA solution:

- In-order synchronous remote replication (remote mirroring)
- Automated failover support
- Support for the following disk drives:
    — 36 GB 10K and 15K RPM
    — 72 GB 10K and 15K RPM
    — 146 GB 10K RPM
- Normal and fail-safe data protection modes of operation
- Dual redundant controller operation for increased fault tolerance
    — No single point of failure
    — Pairs of arrays share replication relationship
    — Replicated write-back cache support
    — Read-ahead and adaptive read caching support
    — I/O continuation during normalization and merging
- Intersite link suspend and resume operations
- Multi-vendor platform support
- Dynamic capacity expansion, if supported by OS
- Merge of write history log in write order
- Failover scripting

- Multiple bus failover support
- Continuous Access user interface
- Asynchronous disk swap (hot swap)
- Controller password protection for configuration control
- GUI interface for management and monitoring
- Selective storage presentation for SAN-based data zoning
- B-Series and M-Series switch support
- Virtual RAID arrays (Vraid0, Vraid1, and Vraid5)
- Virtual RAID (Vraid) techniques that:
  — improve performance
  — increase disk utilization efficiency
  — dynamically expand storage capacity
- Virtual disk data load leveling
- Clustered server support
- Distributed sparing of disk capacity
- Non-disruptive software upgrade capability
- LiteTouch Management
- Battery back-up
- Bi-directional replication
- Copy set size of 1 GB to 2 TB in 1 GB increments
- Up to 64 remote copy sets
- Up to 64 DR groups
- Up to eight copy sets per DR group
- Management of up to 512 virtual disks per EVA ranging in size from 1 GB to
- 2 TB per virtual disk
- Maximum of 240 FC-AL drives (with expansion cabinet) per storage system
- Maximum of 8 storage systems on the SAN management zone
- Maximum of 60 Fibre Channel adapter (FCA) connections per fabric, 120 per dual fabric
- Maximum of 256 LUN presentations from an EVA to a single FCA.
- Up to 10 B-Series switches per fabric; seven hops are allowed (three per site and one as the intersite link)
- Up to 10 M-Series switches per fabric; three hops are allowed (one per site and one as the intersite link)
- Dark Fibre to 35 km at 2 Gbps or 100 km at 1 Gbps
- 2 Gbps end-to-end Fibre Channel solution
- 36 ms latency with wide area network gateways
- Virtually capacity-free snapshot (Vsnap)
- Virtually instantaneous snapclone
- Snapclone across physical disk groups
- Multiple snaps of the same data (both source and destination)
- Maximum of 8 snapshots or snapclones per DR group at the local or remote site

■ The option of selectable World Wide Names (WWNs) for Vsnaps, snapshots, and snapclones

Data Replication Manager

The HSG80 Data Replication Manager (DRM) Software is the software component of the HSG80 array controller used in switched fabric environments for remote data replication. Data Replication Manager Software is a storage-based disaster tolerance and workload migration solution that provides the ability to copy data, in real time, to a remote location, up to 100 km away using direct Fibre Channel or further using ATM links. This is done without any host involvement. The HSG80's dual host port design, when used in DRM configurations, allows for long distance mirroring in a switched No Single Point of Failure (NSPOF) Fibre Channel topology.

The DRM software executes in the HSG80 array controller and processes I/O requests from the hosts, performing the local and remote device-level operations required to satisfy the requests. This is done through the use of a pair of initiator and target controllers sharing a switched NSPOF Fibre Channel fabric. Host generated Reads are performed on the local copy of the data. Host generated Writes to the local storage are copied by DRM from the local controller directly to the remote controller automatically. This capability provides the ability to maintain the same data at both locations, providing disaster tolerance protection.

Software Features / Functionality

- Online, real-time data replication to a local or remote site

- Data replication over a Fibre Channel SAN

- Cloning at Initiator and Target sites

- Snapshot support at Target site

- Cascaded switches support

- Full Fibre Channel-to-ATM connectivity with line speeds of T1 through OC3

- Replicate up to 100 km(~63 miles) with Very Long Distance GBIC

- Asynchronous and synchronous transfer modes

- Write History Logging and "Mini-Merge" reconstruction

- Stretched Clusters capabilities for Microsoft Windows NT and OpenVMS

- Association sets

- Non-RCS LUN support

- Switch Zoning support

- Wavelength Division Multiplexing

Data Replication Manager works in a heterogeneous host environment that includes HP OpenVMS, HP Tru64 UNIX, HP-UX, IBM AIX, Microsoft Windows NT, Windows 2000, Novell NetWare, and Sun Solaris. The application is at the storage system level.

Command Scripter

Command Scripter is application software that provides command-level control of HP StorageWorks systems equipped with HSG60, HSG80, HSZ70, and HSZ80 Array Controllers. With Command Scripter, you can create, edit, and run script files that contain StorageWorks Command Line Interpreter (CLI) commands. This allows automation of frequently performed StorageWorks operations.

Two interfaces are included in Command Scripter: a command line interface for local, direct connection to StorageWorks controllers and a web-based interface, which requires StorageWorks Command Console (SWCC)) for centralized, remote connection via browser.

Software Features / Functionality

- Web-based interface for centralized, remote connection to StorageWorks array controllers
- Command line interface for local, direct connection to array controllers
- Select agent host and StorageWorks subsystem
- Create and edit CLI script files
- Run saved CLI script files
- Execute a single CLI command
- Display CLI command history

Command Scripter works in a heterogeneous host environment that includes Tru64 UNIX and OpenVMS, Microsoft Windows NT, Windows 2000, and Sun Solaris. This application is at the server level.

Storage System Scripting Utility

The Storage System Scripting Utility (SSSU) is the character cell interface for a user. Host based application that needs to access the Command View EVA should use the EMClientAPI. That API will transport SOAP/XML requests over the wire to the element manager, handling security and communication. The EMClientAPI provides an efficient machine interface to the Command View EVA, specifically designed for host-based applications.

SAN Storage Usage & Monitoring Tools

Automation Manager

Automation Manager provides a tool with which a storage administrator can automate the management of a storage area network. Automation Manager runs, controls, and manages predefined policies that storage administrators can configure for their environment. Predefined policies are provided with the product as Perl scripts. In addition, you can create and import your own management scripts.

Automation Manager also provides the following utilities to assist in managing storage operations:

Reports – View and print status reports about storage operations.

Agents – View and download an agent to hosts on which scripts resides. Agents enable Automation Manager to communicate with and run batch jobs on hosts systems.

Notification – Set up different notification types for Automation Manager events. The notification utility provides centralized functionality. The web-based Notification console is used to provide a single, modular, networked software unit that has the ability to handle Event Logging, SMTP, SNMP and command line launching operations.

hp OpenView Storage Builder

The hp OpenView Storage Builder is a storage inventory and resource planning tool for direct attached, SAN attached and network attached storage, and enables you to monitor, manage storage capacity and plan for future storage demands.

Storage Builder is part of the Storage Area Manager suite and is available as a separate product.

Key features and benefits include:

Table 34: Storage Builder Features and Benefits

Feature	Benefit
Centralized, common view (through screens and reports) of allocated vs. unallocated storage by host, storage device, LUN, partition, volume, directory and user.	Gain an understanding of how much of their storage resources are assigned and how much storage is available for deployment. As a result, storage resources will be better utilized, lowering total cost of ownership.
Centralized, common view (through screens and reports) of used vs. unused storage by host, partition, volume, directory, and user.	Gain an understanding of how much allocated storage capacity has been used. Helps to balance the load can be balanced across systems and optimize the addition of new users, applications and data.
	Gain an understanding what hosts, LUNs, partitions, volumes, or directories are at critical free space levels and need resizing. As a result, storage resource will be better utilized, lowering total cost of ownership.
Threshold-based warning and notification systems for hosts, partitions, volumes, directories, and users.	Early warning of a capacity short falls that could cause system outages or user inconvenience. Capacity quotas on a per-user basis can be established and monitored to ensure that storage growth is in line with company goals.
Grouping of partitions, volumes, directory, or users to reflect lines of business, departments, or physical locations. Screens, reports, and thresholds can be created for these storage groups.	Gain an understanding who your major users are, and establish consumption norms and quotas.
Identification of junk or stale files that waste valuable storage space. In addition, storage manager can use Storage Builder to identify low accessed files for possible deletions or routing to secondary storage freeing up even more primary storage space.	Locate wasted storage. Identify files for deletion and low accessed files to be sent to secondary storage. Free up valuable storage capacity to optimize utilization rates and costs.
Screens and reports that rank hosts by the amount of storage accessed each day.	The hosts with the most storage accessed over time would be ideal candidates for nodes on a storage area network resulting in better asset utilization, higher availability, and centralized management.
Historical trending of storage capacity data through screens and reports, and extrapolation of storage capacity data into the future.	Make storage demand and growth more predictable. Gain an understanding of potential shortfalls and plan for just-in-time purchases of additional storage capacity. Use historical and extrapolated data to justify decisions and gain support of upper management.
Tabular and graphic reports showing allocated vs. unallocated storage as well as consumed vs. free storage. Almost all reports are available on a host, storage device, LUN, volume, directory and user (file) level.	Facts, trends, and analysis concerning an organization's storage resources can be communicated effectively to staff and upper management.
Volume management	Provide better visibility into the host-to-LUN utilization mapping.
Capacity information can be seamlessly integrated into OpenView Internet Usage Manager (IUM)	Allow for centralized usage analysis, billing, and charge-back.

hp OpenView Storage Accountant

The hp OpenView Storage Accountant provides a toolset to measure, or meter, storage assigned to users (customers/organizations) for financial analysis, budgeting and charge-back.

Storage Accountant is part of the Storage Area Manager suite and is available as an individual product.

Key features and benefits include:

Table 35: Storage Accountant Features and Benefits

Feature	Benefit
Create and manage customer accounts and their underlying organizations	Provide additional level of granularity within the customer account
Create and manage service levels and price tiers	Classify and differentiate storage offering based on attributes of storage and services associated with it, such as economy, standard, premium, and calculate the cost associated with the service-tier.
Assign LUNs to service levels and to customers entities or their organizations	Associate storage with a service-tier and price and map the LUN classified into different service level according to customers' or their organizations' demands
Meter and monitor storage usage and consumption	Utilize usage information to calculate charges
Calculate charges based on service level price, size of LUNs assigned and duration of storage consumption	Utilize charges information for financial analysis, budgeting and charge back.
Generate bills	View charges associated with each customer. Print bills and recover cost associated with providing and assuring storage services.
Generate CSV, HTML & XML output	Integrate usage and charges related information with reporting, billing and financial applications.
Usage & billing views	Utilize data to manage the customer relationship, keep record of usage and answer billing related questions. Modify or create new storage services based on customer usage trends, and perform financial analysis, budgeting or charge back
Maintain audit log	Keep track of customer, service level and storage consumption related events.
Seamless integration with OpenView Internet Usage Manager (IUM)	Centralize usage analysis and billing/charge-back.

hp OpenView Storage Optimizer

The hp OpenView Storage Optimizer provides performance monitoring of all components of the Storage Area Network (SAN), including hosts, storage devices, and infrastructure.

Storage Optimizer is part of the Storage Area Manager suite and is available as an individual product.

Key features and benefits include:

Table 36: Storage Optimizer Features and Benefits

Feature	Benefit
Monitors key metrics of SAN performance with the ability to drill down to an individual node level such as host, switch, or storage array.	Act proactively to ensure service levels based on SAN performance. In this way, business processes associated with the SAN will always be available.
Centralized performance management across all components of the SAN and across multi vendor platforms. Support for HP-UX, Sun Solaris, Windows NT 4.0, Windows 2000, and Linux	Increase operational and staff efficiency and reduce cost.
Offers several types of access to collected data. For example, a GUI that allows graphing of metrics over time, a CLUI that can manipulate raw or summarized measurements and a set of reports focused on reporting data summed over different intervals.	Storage managers will have the information they need to optimize their SAN operation in the form they prefer. Communication of key storage resource trends to upper management will be facilitated through the use of defined reports.
Simple thresholds to be set on performance metric, e.g., IO's per switch port.	Early notification of potential SAN service slowdowns. Proactively assure SAN service level expectations are met.
Historical performance metrics of SAN components.	Proactively identify trends and anomalies in the SAN infrastructure, and plan for upgrades. Evaluate the impact of system, storage, and infrastructure upgrades to improve efficiency.