

# HP OpenView Storage Area Manager Fundamentals

ESG4382SG10311





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HP Training

# Student guide

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## Glossary



## Objectives

After completing this module, you should be able to:

- Identify the key objectives for this training as outlined in this module.
- Describe the general flow of the course.

## Course objectives

After completing this course, you should be able to:

- List the Storage Area Manager applications and the key features they provide.
- Identify key Storage Area Manager terminology.
- Navigate the Storage Area Manager interface to display device, performance, capacity, billing, and LUN allocation information.
- Describe the high-level architecture of Storage Area Manager.
- Integrate new devices into Storage Area Manager after initial installation.
- Manage Storage Area Manager events through sorting, filtering, and creating triggers.
- Identify the requirements for accurate physical mapping.
- Identify the rules Storage Area Manager uses when displaying device maps.
- Use appropriate documentation to verify the environment is properly prepared for installation and perform pre-installation tasks.
- Install Storage Area Manager and perform post-installation configuration tasks.
- View and configure Storage Optimizer performance information.
- View and configure Storage Builder capacity information.
- View and configure Storage Accountant billing information.
- Activate Storage Allocator and assign LUNs.
- Identify tools available for troubleshooting Storage Area Manager.
- Describe how Storage Area Manager integrates with other OpenView enterprise applications.

## Course outline

This course is structured around the Storage Area Manager framework, Core Services, and the five Storage Area Manager applications: Storage Node Manager, Storage Optimizer, Storage Builder, Storage Accountant, and Storage Allocator.

- Module 1: Introduction to Storage Area Manager
- Core Services and Storage Node Manager
  - Module 2: Storage Area Manager Environment
  - Module 3: Core Services and Storage Node Manager Architecture
  - Module 4: Event Management
  - Module 5: Device Maps
  - Module 6: Application Links
  - Module 7: Implementation
  - Module 8: Installation
  - Module 9: Device Plug-ins
- Module 10: Storage Optimizer
- Module 11: Storage Builder
- Module 12: Managed Applications
- Module 13: Storage Accountant
- Module 14: Storage Builder
- Module 15: Manager-of-Managers
- Module 16: Database Management and Basic Troubleshooting
- Module 17: OpenView Integration

Additionally, at the end of many modules, supplemental information has been included such as white papers and application notes. This information is intended to further enhance your knowledge of Storage Area Manager and how it can be used to address customer issues.

## Course prerequisites

Students should meet the following requirements before taking this class:

- Successful completion of:
  - Storage Technologies (WBT)
  - HP Storage Software and Solutions Full-Line Technical Training (WBT)
  - HP StorageWorks Full-Line Technical Training (WBT)
  - SAN Fundamentals (WBT)

Additionally, it is *recommended* that students meet the following requirements before taking this class:

- Hands-on experience with storage and interconnect hardware (disk arrays, tape libraries, and switches).
- Practical experience setting up a small SAN (host with multiple HBAs, minimum two switches, and fibre channel-based disk array).



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# Introduction to Storage Area Manager

## Module 1

### Objectives

After completing this module, you should be able to:

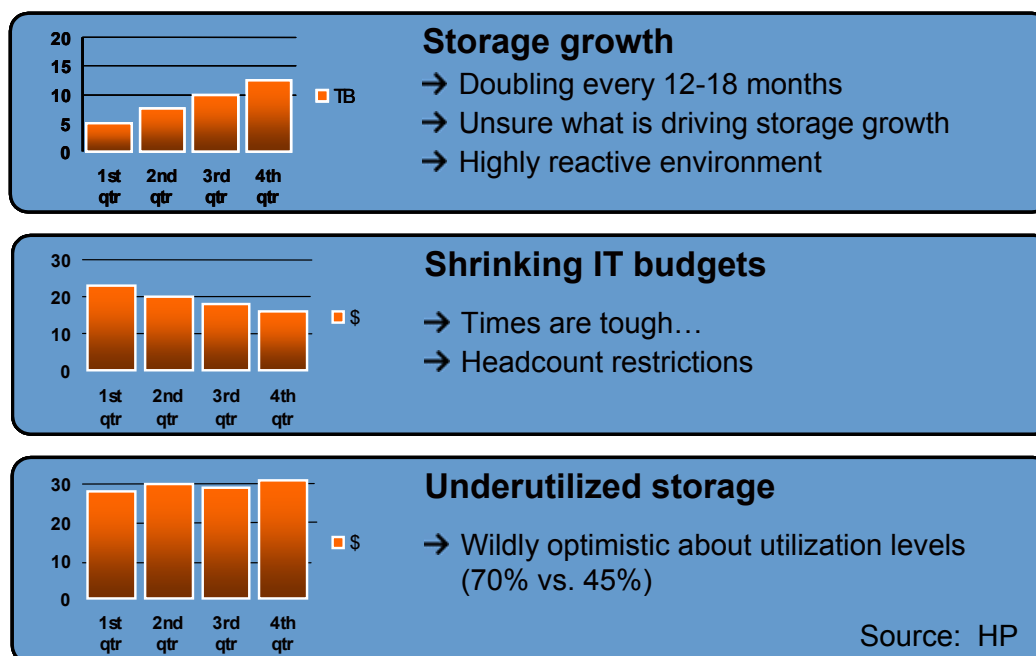
- Identify the key features provided by each of the Storage Area Manager applications.
- Define the key terminology used in Storage Area Manager.
- Identify the operating systems on which Storage Area Manager is supported.
- Recognize Storage Area Manager device support requirements.
- Describe the purpose of the Storage Area Manager implementation service.
- Describe Storage Area Manager licensing, ordering, and support processes.
- Identify sources of information regarding Storage Area Manager supported configurations.

## Shifting perspectives on enterprise storage

As the storage challenges continue to grow, perspectives on enterprise storage management are beginning to shift.

- In the past, storage was viewed from a “point” perspective, typically as an add-on direct-attached storage (DAS) device for individual servers.
- As storage demand is exploding, a comprehensive integrated storage strategy is necessary to efficiently and cost-effectively address growing enterprise needs—a strategy that maximizes the use of existing resources **and** reduces administrative burden so that more storage can be managed by the same number of administrators.

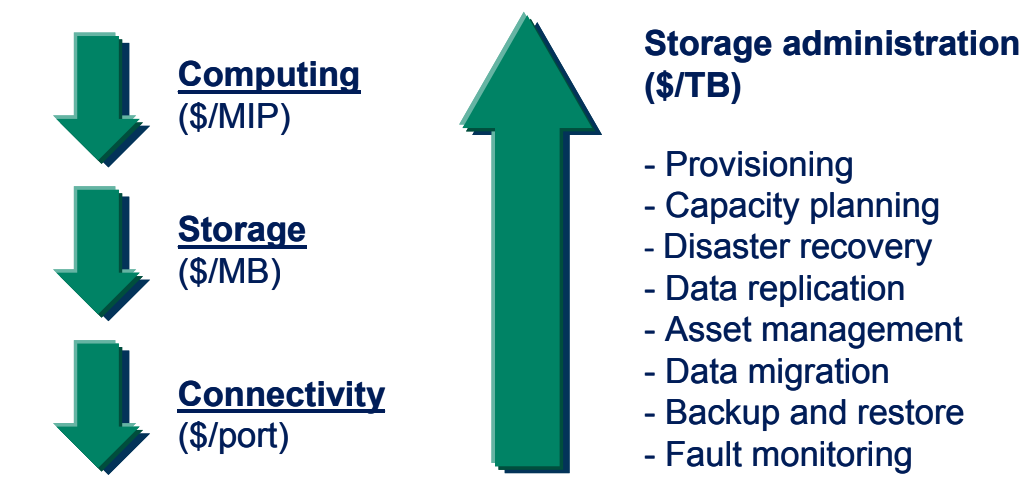
## Customer challenges



Storage challenges are numerous. However, looking at the primary challenges that customers talk about (and the main reasons why customers are looking at rolling out some form of storage management software), those challenges can be distilled down to the following three primary issues:

- Storage growth rates of anywhere from 50–200% per year are not uncommon. These rates are compounded by the fact that for most storage managers, the origin of the growth is unknown, resulting in a highly reactive environment.
- Almost no sector of industry at the moment is able to escape the fact that the economy is declining—this means that infrastructure plans that may have been put in place last year are now being implemented with smaller budgets. Most storage managers need to find a way of doing more with less or having to choose to implement smaller projects or subsections of larger projects.
- Storage managers typically overestimate their utilization rates on arrays by a great percentage. Often, storage managers assume 70% rates when they are actually closer to 40–50%.

## Increasing storage administration costs

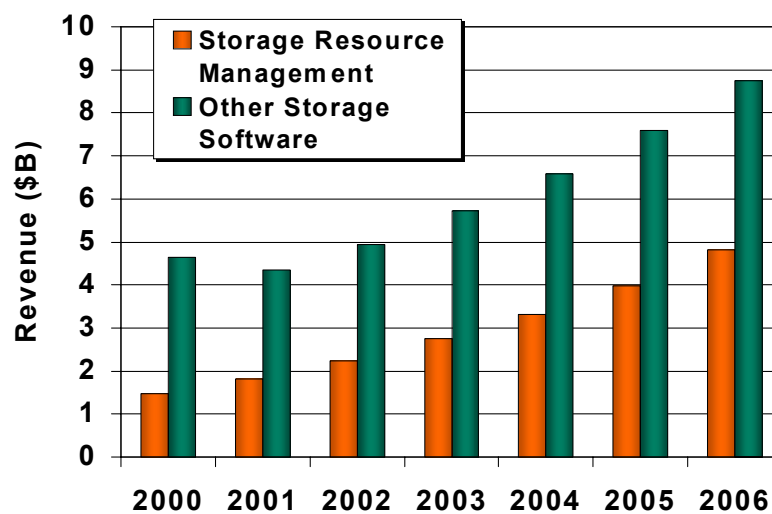


**Managing storage can end up “costing six to seven times the purchase price of the storage.”**

*Aberdeen Group*

While the cost of computing, storage, and connectivity components is decreasing, storage budgets as a whole are an increasingly expensive portion of an IT department's budget.

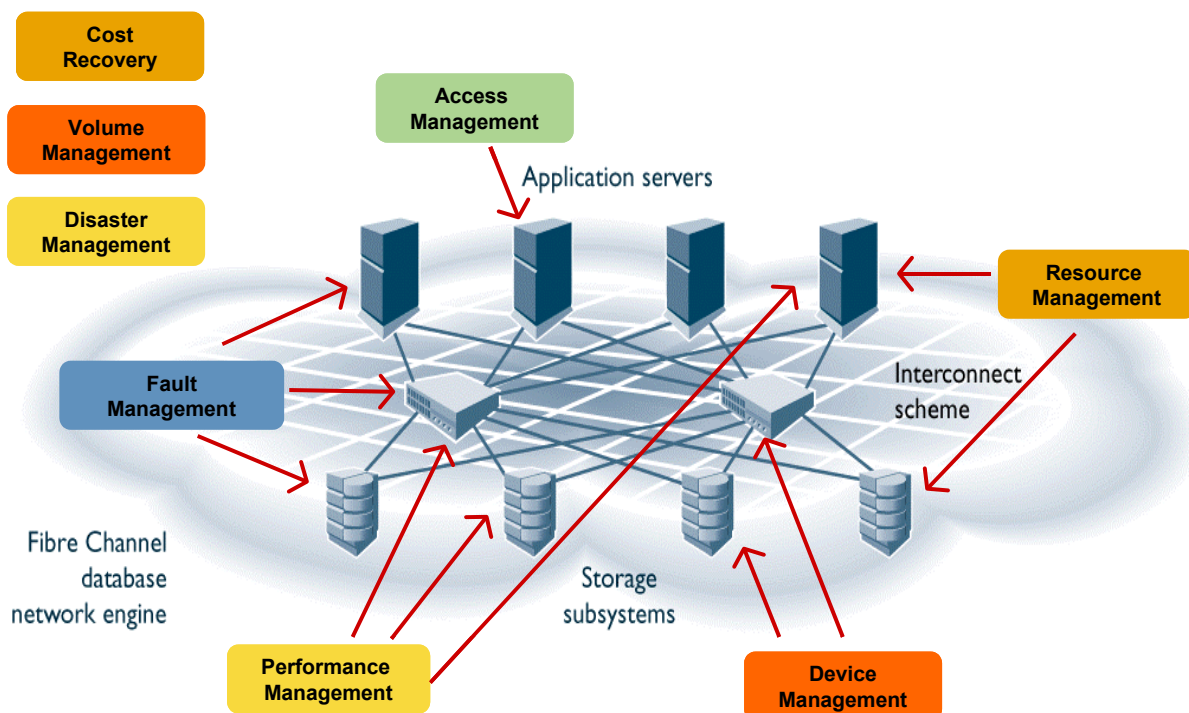
## Storage management software market opportunity



These market trends and customer challenges create the need for storage management tools — a quickly growing market with a large selling potential.

According to IDC's report, *Worldwide Storage Software Forecast and Analysis, 2002-2006*, the storage management software market will grow from \$6.1B USD in 2000 to \$13.6B USD in 2006, which translates to a 14% CAGR. The enterprise storage resource management segment will be the fastest-growing storage software segment with a six-year CAGR of 22%, growing from \$1.47B USD in 2000 to \$4.82B USD in 2006 (source: IDC, June 2002).

## The storage management dilemma



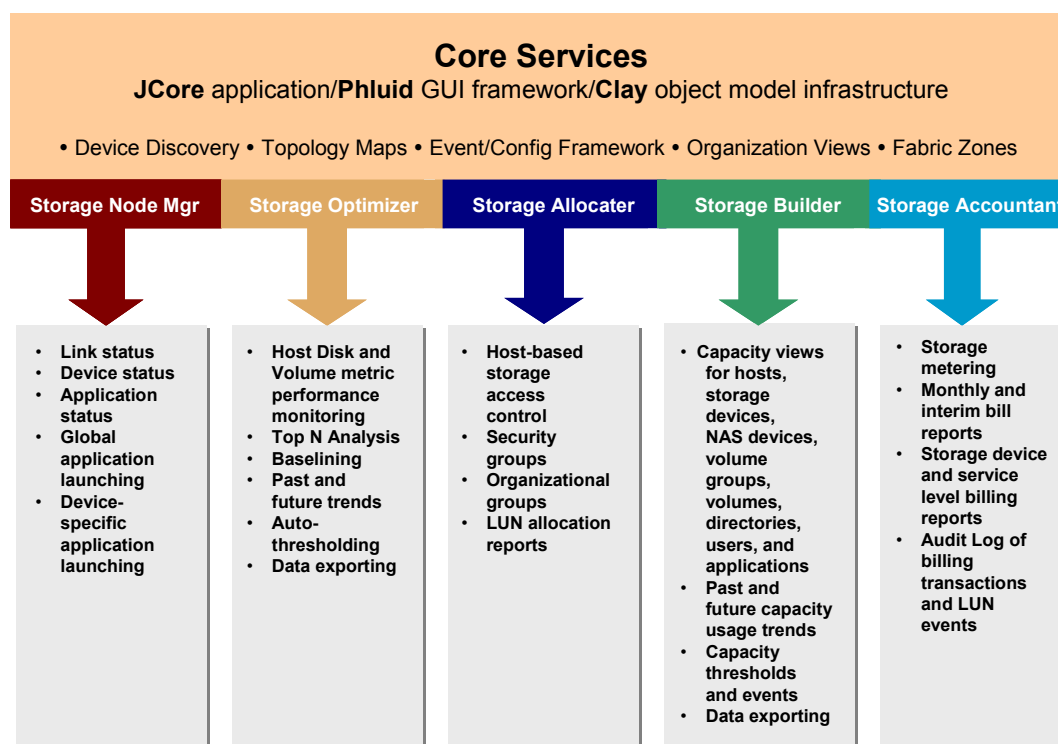
Managing a SAN environment can be a complicated task. For example,

- If a problem exists in the SAN, how do we find it? If the problem is hardware-related, how do we monitor and detect such faults?
- If part or all of the SAN is performing badly, how do we analyze data traffic from the servers, through the fabric, down to the storage devices?
- If the problem has to do with a lack of storage resources, how do we track storage usage to determine where more storage is needed and when it must be made available to host servers?
- What tools can we use to recover from a disaster or prevent one from occurring?

As you can see, storage management involves many different aspects. In order to understand what is transpiring in the environment and keep the SAN running smoothly, we need management tools. In the past, it was necessary to use a variety of applications, and it was difficult if not impossible, for a tool to take advantage of the information generated by another.

Storage Area Manager provides an answer to these storage management issues by offering a collection of applications, based on a common underlying framework, with a single, integrated graphical user interface (GUI).

# HP OpenView Storage Area Manager 3.1



HP OpenView Storage Area Manager (OV SAM) is a seamlessly integrated software suite that enables you to centrally manage multi-vendor storage as a virtual pool of resources across distributed networked storage environments. Storage Area Manager consists of five separate, though tightly integrated, products: Storage Node Manager, Storage Optimizer, Storage Builder, Storage Allocator and Storage Accountant.

**Core Services** is the underlying framework containing several components that are shared amongst all products. It is the common denominator for all applications in the Storage Area Manager suite. It defines and facilitates the mechanism through which product-specific components co-exist, locate, and communication with one another.

**Storage Node Manager** is a device status monitoring tool for your storage network. It provides ongoing device status, and when a device has a problem or goes down, you can easily launch device-specific applications directly from the Storage Area Manager GUI to further investigate.

**Storage Optimizer** monitors and reports device performance in your storage network. Performance metrics vary by device. However, a set of common metrics is available for all devices supported by Storage Optimizer.

**Storage Allocator** controls storage access and provides security by assigning logical units to specific hosts or groups. Assigned LUNs cannot be accessed by any other hosts. With this application, you can assign, unassign, and reassign storage and related devices from a diverse pool.

**Storage Builder** monitors and reports storage capacity in a storage network. It routinely discovers the physical capacity of storage devices and logical capacity of hosts and NAS devices, and analyzes the information for current usage, past and future usage trends, and threshold violations.

**Storage Accountant** meters storage space in organization accounts and reports the associated cost at the end of each month. Accounts belong to internal and external organizations.



## Customer scenarios

The following three scenarios provide examples of customers that purchased Storage Area Manager, the reasons for their purchase selections, and the value provided by the applications they chose.

### Enterprise headquarters

A national telecom company is slowly rolling out a SAN through a central product excellence center. Currently the customer is running OpenView Operations within all data centers.

#### Storage Area Manager applications purchased

The customer purchased the following Storage Area Manager applications

- Storage Node Manager
- Storage Builder

#### Customer value

Storage Node Manager and Storage Builder addressed the customer's two major pain points

- managing their legacy infrastructure
- enabling them to get much more detail on their capacity growth

The customer liked the OpenView storage area manager building-block approach (as opposed to the whole suite), which enables them to develop their Storage Area Manager environment as needed. In addition, being experienced with other OpenView products the customer is aware of the short learning curve for each application, and the resulting lower training costs.

At this time, Storage Accountant, Storage Allocator, and Storage Optimizer functionality are not required, as they do not address the capacity-growth detail issues.

A company slowly migrating to SANs is very likely to use the Storage Builder product as a tool to identify storage utilization within their existing direct attached pool of servers. Storage Builder is an effective tool for identifying underutilized storage. Candidates for migration to a SAN might be servers that fluctuate in their utilization significantly (up and down) and servers that show significant increases in storage utilization. In either case Storage Builder's trending capabilities can provide data for the planning process.

As servers are added to the fabric, Storage Node Manager will dynamically discover the new devices on the switches and this will be reflected in the map (as stand-alone servers are migrated to the SAN).

Although the customer values centralized performance monitoring capabilities of their storage devices and fabric, they decided that at the present time, this is not the most fundamental concern during the migration to their new SAN infrastructure. As their storage network becomes more fully developed and utilization increases,

the ability to monitor their switch fabric and set thresholds based on this utilization will become a major concern and the Storage Optimizer product will be evaluated at a later date.

## **Enterprise-wide rollout**

A large insurance company looking into managing storage at their corporate headquarters as well as their two data centers. The customer has an installed SAN, but is using device-specific management tools without any centralized storage management product. Presently, they are not using any OpenView products.

### **Storage Area Manager applications purchased**

The customer purchased the following Storage Area Manager applications

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

### **Customer value**

The customer needs to centrally manage a broad range of storage functionality.

Storage Node Manager visualizes their storage environment and monitors the health and availability of their storage and interconnect devices.

Storage Allocator provides the ability to dynamically assign storage without reboots on ALL supported operating systems. Due to the various hosts and storage devices in their enterprise, Allocator is the perfect fit to provide a central console for LUN management across heterogeneous storage devices and on multiple operating system platforms. This was a major selling factor, rather than having to deal with multiple device specific tools. This addresses one of their main pain points: Rapid allocation with heterogeneous storage devices. In addition, Allocator helps the customer to take the first phase in virtualization.

Storage Builder identifies inefficiently used storage and helps the customer plan for future storage demand using the historical trending and extrapolations. The unused storage can then be reassigned using Storage Allocator.

Storage Accountant enables the IT department to charge individual departments for storage utilization. Storage Accountant is an ideal IT tool for managing storage resources and it lowers company cost by effectively tracking usage of highest priority resources through service levels.

Even though the customer did not specifically request Storage Optimizer, they can acquire it at no cost by ordering the Storage Area Manager suite instead of ordering the products individually

## Service provider

A large Internet Service Provider (ISP) is looking to roll out software over all their data centers worldwide (and manage them at a data center level). The customer has one of the most mature SANs in existence. They are currently managing their environment through custom built solutions using best of breed components from multiple sources. In addition, the customer is running multiple OpenView applications such as OpenView Operations, Network Node Manager and Service Desk.

### Storage Area Manager applications purchased

The customer purchased the following Storage Area Manager applications

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

### Customer value

Storage Accountant enables the ISP to charge customers for storage utilization. It is an ideal IT tool for managing storage resources and effectively tracks usage of highest priority resources through service levels.

In addition to device discovery and mapping, Storage Node Manager can feed network monitoring information into a NOC (network operations center) for the purpose of generating trouble tickets for resolving problems, and so on. Storage Node Manager provides the ability to monitor system components across a wide range of storage device and forward these to a centralized point for detailed monitoring, and problem resolution.

Storage Builder provides key functionality that is important to the customer including the ability to easily identify inefficiently used storage and generate reports files that meet user-defined type and age criteria.

Storage Optimizer provides host, interconnect, and storage device performance information that will help the customer monitor their environment and ensure they don't have unexpected events that prevent them from meeting their service-level agreements.

OpenView integration is crucial (need to manage storage at the data center level) The customer is also interested in HP OpenView Storage Provisioner which divides storage pools into services or utilities, based upon attributes, which can then be made available to customers for provisioning.

Storage Allocator is unsuitable for their environment.

## Storage Area Manager “Top 10” values list

These are ten ways a customer can see immediate value from Storage Area Manager.

### Increase in efficiency

#### Centralized device management

1. Print SAN map to learn about topology and device mapping. (Storage Node Manager)
2. Print color zone maps depicting a graphical representation of the fabric zoning. (Storage Node Manager)
3. Print detailed data on list of devices in the environment. (Storage Node Manager)

#### Centralized capacity management

4. Print utilization information on host, host LUN, NAS, storage devices, volumes, directory, user. (Storage Builder)

### Reduce total cost of ownership

#### Improve utilization levels

5. Use Top N Query for Volumes to locate underutilized volumes across the storage domain. This could be used to choose DAS servers to be migrated to a SAN. (Storage Builder)

#### Recover wasted space

6. Configure report filters to search for specific file types, old files, and so on. (Storage Builder)

Use the CLUI to export these file level reports to multiple different file formats. Useful for importing Storage Accountant and Storage Builder data into other accounting software applications.

## Just-in-time purchase

### Capacity and Performance Thresholds

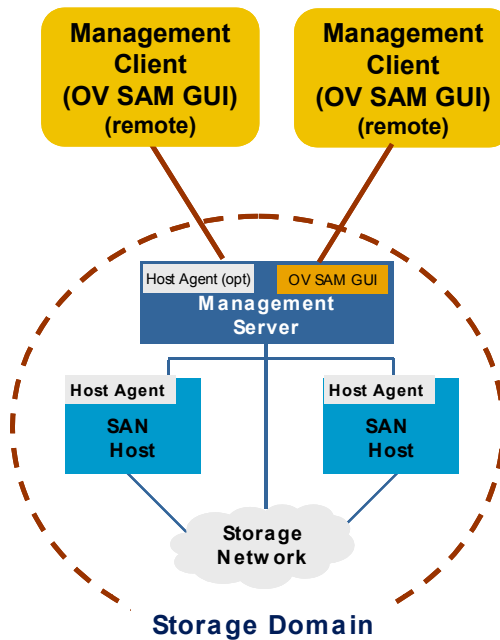
7. Configure and use base lining to send an email alert to an administrator when a switch port exceeds a defined I/O rate. (Storage Optimizer)
8. Configure capacity thresholds to monitor a specific Database directory so that when it reaches a pre-defined size an email notification is sent to an administrator. (Storage Builder)
9. Configure Storage Area Manager for soft quota management of users. When a specific user reaches their pre-defined capacity limit have Storage Area Manager launch a script that searches through the user data for files older than a specific date, back them up to a secondary location (tape, online disk, etc.) and delete the original file. (Storage Builder)

## Storage utility

### Cost of Storage Management

10. Assign average cost of managed storage to all LUNs to get a quick understanding of the cost of storage management. (Storage Accountant)

## Storage Area Manager key terminology

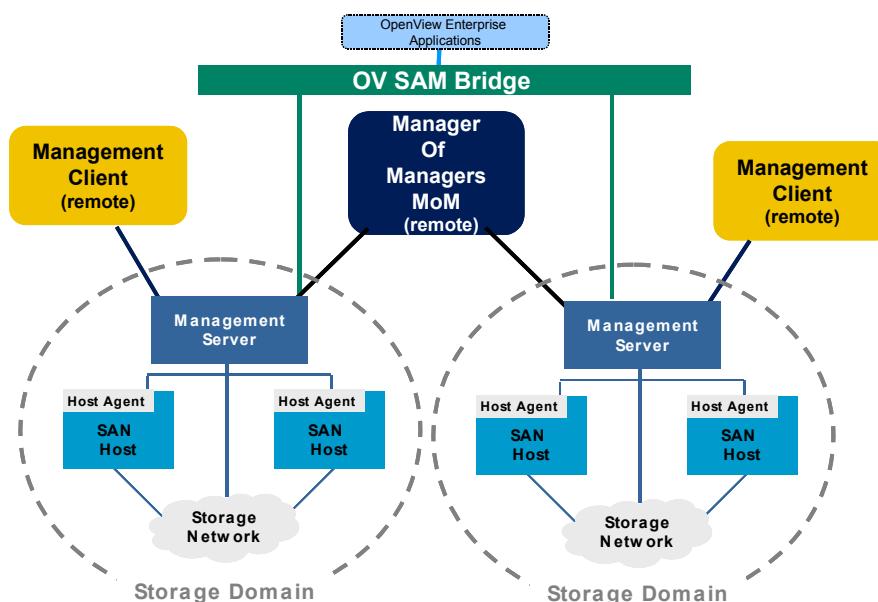


The **management server** is a server application that hosts the majority of Storage Area Manager's functionality. This framework includes Storage Area Manager's database, discovery system, event handling subsystem, configuration files, and server components for each of the five products that comprise the product suite. The management server software is installed from the Storage Area Manager CD on a dedicated Windows 2000 server or workstation. One management server manages a single storage domain. A storage domain consists of storage resources that are visible to the managed hosts associated with the management server. Storage Area Manager is capable of managing direct-attached or network-attached storage resources.

The **managed host** (also referred to as a SAN host) contains Host Agent software, which includes components that enable access to the storage resources visible to the managed 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 2000, HP-UX, Solaris, Linux, AIX, or Tru64 host. The host then 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.

The **storage domain** is defined as the Storage Area Manager management server and its associated managed hosts.

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



The **Manager of Managers (MoM)** is a graphics user interface (GUI) application that consolidates storage information from multiple storage domains. This allows an administrator to view, from a single location, the high-level status and filtered event information of a large, geographically dispersed storage network. The administrators can also launch the management server client for a particular 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.

The Storage Area Manager **Bridge** is a web server application that allows other applications access to Storage Area Manager's functionality. This access enables Storage Area Manager tight integration with other HP OpenView enterprise applications. The bridge is also able to consolidate information from multiple management servers for use by the application integrating with the bridge.

Storage Area Manager 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, Storage Area Manager information and control can be integrated with:

- OpenView Reporter (OVR)
- OpenView Service Information Portal (SIP)
- OpenView Operations for Windows (OVW)
- OpenView Operations for Unix (OVO)
- OpenView Internet Usage Manager (IUM)
- Service Navigator
- Service Activator
- Service Desk

## Supported operating systems

Storage Area Manager is supported on the following operating systems:

### Supported operating systems

Storage Area Manager system	Operating system
Management Server	<ul style="list-style-type: none"><li>■ Windows 2000 (Professional, Server, and Advanced Server with Service Pack 3 or 4)</li><li>■ HP OpenView Storage Management Appliance II with 1 GB memory upgrade or Storage Management Appliance III (Software v2.0 with Service Pack 4 or v2.1)</li></ul>
Management and MoM Clients	<ul style="list-style-type: none"><li>■ Windows 2000</li><li>■ Windows XP</li><li>■ HP-UX 11.0</li><li>■ Solaris 8.0</li><li>■ Linux Redhat 2.1</li></ul>
SAN Host(s)	<ul style="list-style-type: none"><li>■ Windows NT 4.0, Windows 2000, Windows Server 2003 (32-bit)</li><li>■ HP-UX 11.0, 11.11, 11.20</li><li>■ Solaris 7.0, 8.0, 9.0</li><li>■ AIX 4.3.3, 5.1</li><li>■ Linux<ul style="list-style-type: none"><li>■ Red Hat Linux 7.1 (Kernel 2.4.2-2)</li><li>■ Red Hat Enterprise Linux AS 2.1 (Kernel 2.4.9-e.3 and 2.4.9-e.12)</li><li>■ SuSE ES 8.0 (Kernel 2.4.19-64GB)</li></ul></li><li>■ Tru64 4.0f, 5.1a, 5.1b</li><li>■ Netware 6.0</li><li>■ OpenVMS 7.3, 7.3-1</li></ul>

**Important**

Refer to the *hp OpenView storage area manager installation guide* and *hp OpenView Storage Area Manager Supported Components and Configuration Guide* for system requirements and limitations.

**Important**

Support for new SAN host operating systems is added between releases through patches. Refer to the OpenView patch website at [http://support.openview.hp.com/patches/patch\\_index.jsp](http://support.openview.hp.com/patches/patch_index.jsp) for details on all Storage Area Manager patches.

---



## Device support dependencies

To fully take advantage of all Storage Area Manager features, the following is required:

- For fibre channel HBAs: SNIA library
- For storage and interconnect devices:
  - Property file
  - Device plug-in (DPI)

### SNIA libraries

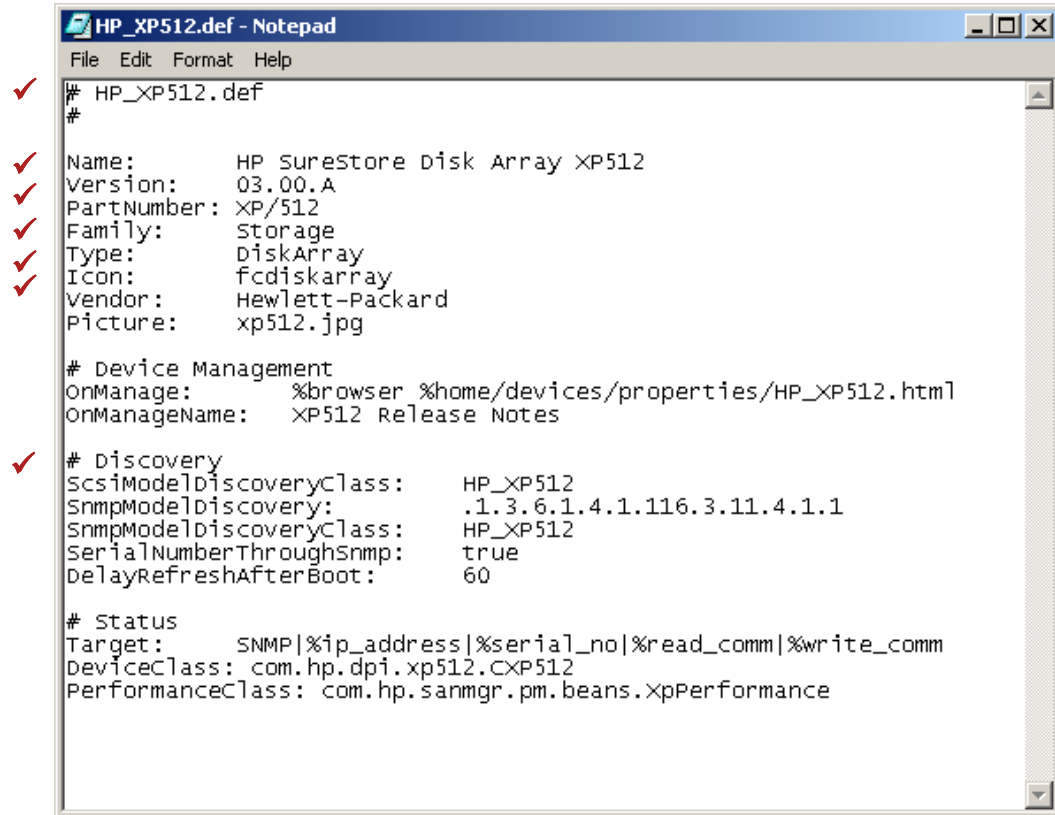
SNIA libraries refer to an industry standard programming interface for accessing management information in fibre channel HBAs. This standard was developed through the Storage Networking Industry Association (SNIA). SNIA libraries allow access to low-level, fibre channel HBA information in a platform and vendor independent way.

**Important**

Refer to the HBA vendor websites for associated SNIA libraries.

---

## Property files



✓ = Required  
values of Property File

A property file, also referred to as a device definition file (.def), is a plain-text Java properties file whose property-value pairs characterize a device model. Examples include, a Brocade 2800 switch, StorageTek 20/700 tape library, or HP FC60 SureStore Disk Array. These device definition files reside on the management server.

Each property file contains four distinct sections:

- Identification
- Device management
- Device discovery
- Device status

Storage Area Manager uses the properties file *Identification* and *Device Discovery* sections to provide the following support:

- Place the device in the proper branch of the directory tree
- Display representative icons
- Map the device (inferred only, unless a DPI is specified and SNIA libraries are present)
- Monitor device status (Good and Unreachable only)

Unless a pointer to a DPI is provided, a property file does **not**:

- Support status conditions other than Good and Unreachable
- Support events in the event panel
- Support capacity planning and reporting
- Support performance information

## Device Plug-Ins

A DPI is internal Storage Area Manager code that is used to retrieve detailed information (required for physical mapping, capacity, and performance metrics) from an interconnect or storage device. DPIs are included with the Storage Area Manager product, or can be downloaded at a later date through the hp OpenView Device Plug-in website asynchronous to product releases.

Devices with DPIs report six levels of device status: Normal, Warning, Minor, Major, Critical, and Unknown/Unreachable. Devices without a full DPI are mapped with inferred links and report only two levels of status: Normal and Unknown/Unreachable.

## Supported devices

The *hp OpenView Storage Area Manager Supported Components and Configuration Guide* is the primary source of information regarding the devices supported by Storage Area Manager. This guide details the operating systems, platforms, interconnect devices, software applications, and storage devices that are supported by Storage Area Manager. Its intent is not to provide end-to-end configuration information, but to show which devices, systems, and applications have been tested in conjunction with Storage Area Manager.

It is available from the following locations:

- Hewlett-Packard internal  
**[http://turbo.rose.hp.com/spock/OV\\_SAM/index.shtml](http://turbo.rose.hp.com/spock/OV_SAM/index.shtml)**
- Americas channel partners  
**[https://www.partner.americas.hp.com/rrc/performance/html\\_src/channel/services/storage\\_delivery.html](https://www.partner.americas.hp.com/rrc/performance/html_src/channel/services/storage_delivery.html)**  
EMEA and AP channel partners  
**<http://www.hp.com/partners/csn>**

Additionally, new and updated DPIs posted on the hp OpenView Device Plug-ins website (**<http://www.openview.hp.com/products/SAM>**) after release of Storage Area Manager provide updated features and new device support.

Customers may also create their own DPIs, by using the Software Developer's Kit (SDK) available at  
**[http://www.openview.hp.com/partners/developers/General\\_HTML-218.asp](http://www.openview.hp.com/partners/developers/General_HTML-218.asp)**.

## Internationalization and localization

Storage Area Manager supports minimal internationalization (I18N).

- Storage Area Manager may be installed on any OS language version (such as Japanese NT) and run under any language mode.
- Data may be entered in the local language.
- Storage Area Manager supports the following different scenarios:
  - All English
  - All multi-byte (single-locale)
  - All single-byte non-English (single-locale)
  - Multi-locale (two locales)
- Storage Area Manager does not support changing language mode through user locale setting (for example, Windows, Control Panel).

Additionally, Storage Area Manager supports the *ability* to be localized.

## Licensing

Storage Area Manager licensing is based on the amount of Raw (TB) storage in the SAN (the exception is EMC disk arrays, where licensing is based on the total size of all LDevs).

Storage Area Manager may be purchased in increments of 1, 5, 10, or 50 TB.

Storage Area Manager comes with a 60-day evaluation license for all components. If permanent licensing has not been configured, a dialog box displays showing the number of days left on the evaluation license.

## Ordering

The customer must purchase:

- 1 Media Kit (includes CD and Installation Guide)
- Appropriate capacity licenses for the suite or specific products
- Desired services
- Purchase includes 1 year 8x5 phone-in support

Product number	Description
<b>T2524AA</b>	<b>Storage Area Manager Media</b>
<b>T2525AA</b>	<b>Storage Area Manager suite with 1 TB license</b>
J5365AA	5 TB license for SAM suite
J5366AA	10 TB license for SAM suite
J5367AA	50 TB license for SAM suite
<b>T2526AA</b>	<b>Storage Node Manager product with 1 TB license</b>
J5369AA	5 TB license for SNM
J5370AA	10 TB license for SNM
J5371AA	50 TB license for SNM
<b>T2527AA</b>	<b>Storage Optimizer product with 1 TB license</b>
J5373AA	5 TB license for Optimizer
J5374AA	10 TB license for Optimizer
J5375AA	50 TB license for Optimizer
<b>T2528AA</b>	<b>Storage Builder product with 1 TB license</b>
J5377AA	5 TB license for Builder
J5378AA	10 TB license for Builder
J5379AA	50 TB license for Builder
<b>T2529AA</b>	<b>Storage Accountant product with 1 TB license</b>
J5381AA	5 TB license for Accountant
J5382AA	10 TB license for Accountant
J5383AA	50 TB license for Accountant
<b>T2530AA</b>	<b>Storage Allocator product with 1 TB license</b>
J5385AA	5 TB license for Allocator
J5386AA	10 TB license for Allocator
J5387AA	50 TB license for Allocator

## Storage Area Manager Solution Service

The Storage Area Manager Solution Service helps customers to install, integrate, and optimize the efficiency and performance of their Storage Area Management solution. It begins with installation and startup of Storage Area Manager applications and then adds defined “bands” of customization to address consulting and integration.

- **Level 1 — Installation and Startup (HA114A1 –5G3)**

Offers basic implementation services for Storage Area Manager. Includes installation, configuration, testing, documentation, and demonstration. Also includes assisting the IT Administrator in setting up the product to meet IT reporting needs

- **Level 2 — Consulting (HA115A1 –5D7)**

Provides additional tailoring and integration of storage management solution to meet business needs. Includes project management, design activities, tailored implementation, testing and knowledge transfer

- **Level 3 — Integration (HA115A1 –5D8)**

Provides integration for the storage management solution into the overall IT management application, such as HP OpenView. Includes an environmental analysis of overall storage needs and current state, a survey of business and process needs relative to storage, and the design of a storage management solution that would meet these needs

### Solution Service Ordering Example

The Level 1 – Implementation and Startup service is structured into specific time increments based on the Storage Area Manager applications being implemented and the number of hosts in the environment. If a customer with 50 hosts wishes to implement Node Manager and Storage Allocator, they would need to purchase 15 HA114A1. This includes:

- 3 x HA114A1 for base installation which includes first 10 hosts
- 1 x HA114A1 for the Node Manager product
- 4 x HA114A1 for the Storage Allocator product
- 8 x HA114A1 for the 40 additional hosts



## Where to get more information

Refer to the following websites for more information.

**General Storage Area Manager information** — includes links to many other Storage Area Manager-related sites

<http://h18006.www1.hp.com/products/storage/software/sam/index.html>

- **Product documentation** — provides access to the Storage Area Manager suite of documentation including *Installation Guide*, *Administrator's Guide*, *CLUI Reference Guide*, on-line help, and OpenView integration guides

[http://ovweb.external.hp.com/lpe/doc\\_serv/](http://ovweb.external.hp.com/lpe/doc_serv/)

- **Storage Area Manager Knowledge Management Tool (KMT)** — a web-based sales training tool. The KMT provides valuable information on the customer benefits provided by Storage Area Manager.

- HP internal: [http://nsscat.corp.hp.com/index\\_cards/sam\\_kmt.htm](http://nsscat.corp.hp.com/index_cards/sam_kmt.htm)
- Americas channel partners:  
[https://partner.americas.hp.com/rrc/performance/html\\_src/train/sam/](https://partner.americas.hp.com/rrc/performance/html_src/train/sam/)
- EMEA and AP channel partners: <http://www.hp.com/partners/csn>

- **Business Value Model for Storage** — examines a customer's current storage approach and growth projections and provides an ROI study to help develop a financial business case to move to a HP storage solution.

The latest Business Value Model (version 3.4), built in cooperation with ITCentrix, provides a breakout of the contributing value of the components of the Storage Area Manager suite.

- HP internal:  
<http://nss.esgonline.hp.com/marketing/wwsalessupport/bvmodel/>
- Channel partners: Contact [Bob.Jefferson@hp.com](mailto:Bob.Jefferson@hp.com)

## Learning check

1. Match the Storage Area Manager application with its key features:
  - a. Core Services ..... Host-based storage access control
  - b. Storage Node Manager ..... Storage metering and billing
  - c. Storage Accountant ..... Host disk and volume metric performance monitoring
  - d. Storage Allocator ..... Underlying framework containing several components that are shared amongst all products
  - e. Storage Builder ..... Device and link status; application launching
  - f. Storage Optimizer ..... Capacity information for hosts, storage devices, NAS devices, volume groups, volumes, directories, and users
  
2. Match the Storage Area Manager term with its definition:
  - a. Management Server ..... Any host in the SAN that has the Storage Area Manager Host Agent software installed
  - b. Management Client ..... A Windows 2000 host with the Storage Area Manager server application software installed
  - c. SAN Host ..... Storage Area Manager client application that consolidates storage information from multiple storage domains
  - d. Storage Domain ..... Web server application that allows other applications access to Storage Area Manager functionality
  - e. MoM ..... Storage Area Manager software component that must be installed on each host in the SAN that is to be managed
  - f. Bridge ..... A management server, its deployed hosts, and any interconnect and storage to which they are connected
  - g. Host Agent ..... Any host that has LAN/dial-up access to the management server with the Storage Area Manager client software installed

- 3. The management server is only supported on Windows 2000.
  - ☐ True
  - ☐ False
  
- 4. With a few exceptions, Storage Area Manager licensing is based on the amount of raw (TB) storage in the SAN.
  - ☐ True
  - ☐ False
  
- 5. Storage Area Manager is available in English, Japanese, or German.
  - ☐ True
  - ☐ False

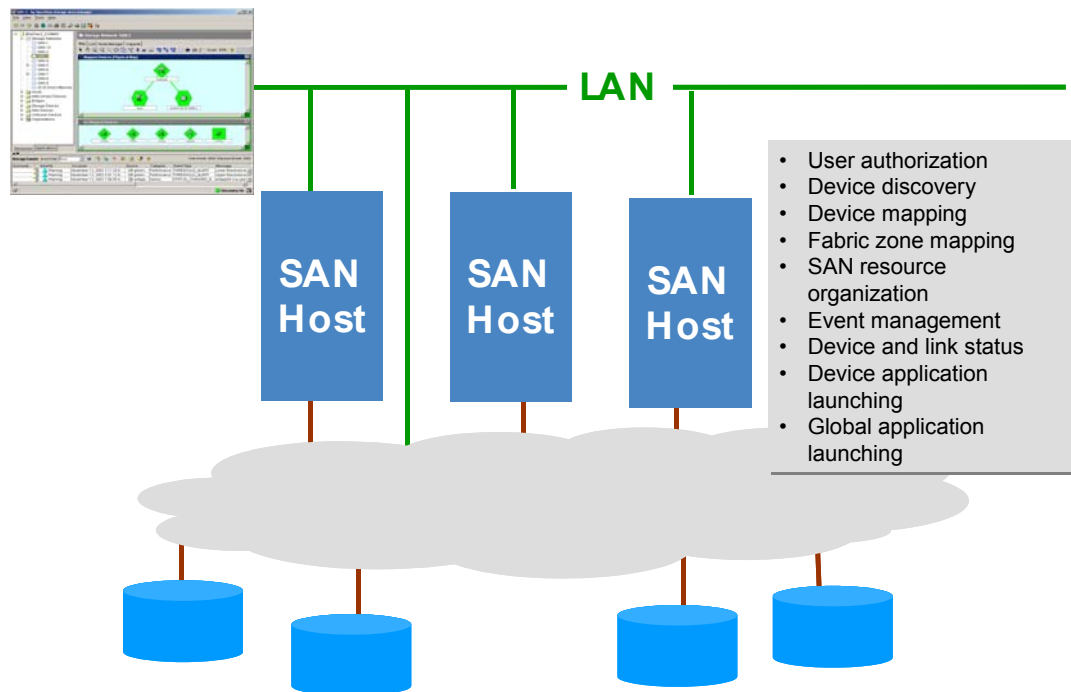


### Objectives

After completing this module, you should be able to:

- Navigate the Storage Area Manager graphical user interface (GUI).
- Describe how Storage Networks and discovered devices are displayed on device maps.
- Recognize the severity of reported device status.
- Display Zoning information.
- Create customer views using organizations. Organize SAN resources using arbitrary folders. Access Storage Area Manager configuration options.

## Core Services and Storage Node Manager features



Core Services provides the following features. They are available regardless of which application(s) you install and license.

- **User authentication and authorization** — When starting Storage Area Manager, a user must login with their unique user name and password. Storage Area Manager user accounts can be configured with different levels of privilege.
- **Device discovery and mapping** — Storage Area Manager automatically discovers hosts, interconnect devices, bridges, and storage devices in direct attached (Fibre channel or SCSI) and networked storage (SAN and NAS) environments. Discovered devices are placed in the Resources tree and a device map. Storage Area Manager illustrates the relationship of these devices by displaying their links within each device map. If the storage network is using interconnect hardware to support fabric zoning, Storage Area Manager identifies the pre-configured zones and lists them under the Storage Networks node in the Resources tree. Storage Area Manager also creates a corresponding device map of each zone.

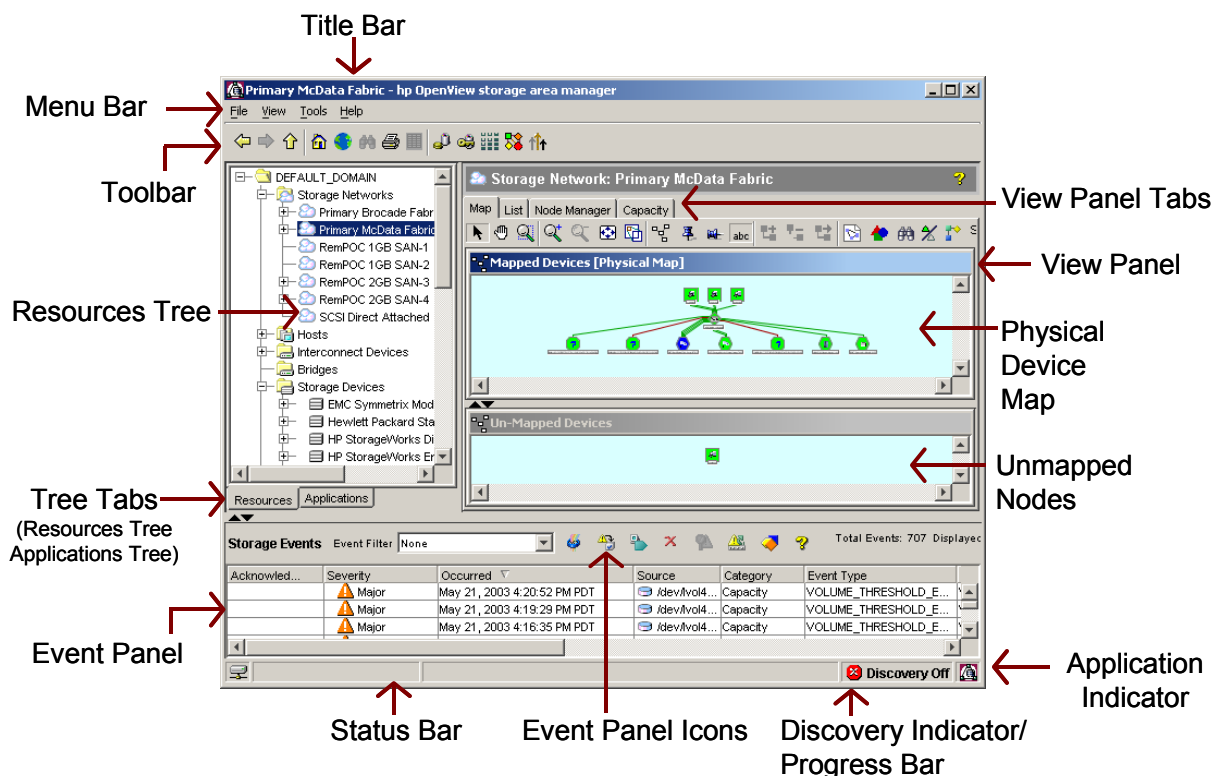
- **Event management** — Based on its status inquiries of the storage network and its own processes, Storage Area Manager generates and displays events in the event panel. Framework and discovery-related events are displayed regardless of which applications are installed and licensed. Device status, LUN security, performance, capacity, and billing related events only appear if the applicable application is installed and licensed. Storage Area Manager is able to receive SNMP traps from devices that support trap forwarding. You can also configure event triggers to perform certain actions based on event criteria.
- **SAN Resource Organization** — Storage Area Manager provides two features for organizing SAN resources: organizations and arbitrary folders. Organizations allow you to create “customer views” of your environment. Arbitrary folders act as a simple file cabinet for your SAN resources.

Storage Node Manager is a device status monitoring tool for your storage network. You must install and license Storage Node Manager in order to use these features.

Storage Node Manager adds the following features to Storage Area Manager:

- **Application linking** — You can link device-specific applications to Storage Area Manager and then start them from the user interface. An application may be linked to a specific device or device model. Many default device-specific application links are provided with Storage Node Manager.
- **Device status monitoring** — Storage Node Manager monitors and graphically displays the status of each discovered device in your storage network. Device status is displayed wherever the device is referenced in the user interface, including the Resources tree, device map, and event panel. Based on its status inquiries of the storage network, Storage Area Manager generates and displays status-related events as they occur in your storage network.

## Storage Area Manager GUI



Storage Area Manager's user interface allows you to monitor the status of your storage network, view event information, and easily perform administrative tasks.

The *title bar* indicates the node or subnode currently selected in the tree panel and the product name. For example, DOMAIN\_NAME – hp OpenView Storage Area Manager.

The *menu bar* and *toolbar* provide access to commonly performed tasks. Application icons are included on the toolbar, which provide direct navigation to each application's home page.

The *tree panel* includes two views, Resources and Applications, which are controlled by the Tree Panel tabs on the bottom of the tree panel. Each tree panel will be discussed later in this module.

The *event view panel* lists events received and reported by Storage Area Manager as it monitors the storage network.

The *view panel* displays detailed content for the node or subnode that is currently selected in the tree panel.

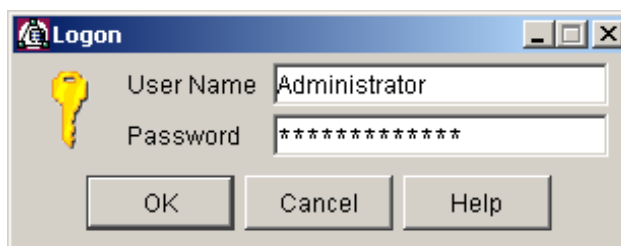
The *application indicator* reflects which application's information is currently displayed in the view panel.

The *discovery indicator* reflects if Storage Area Manager's ongoing device discovery process is on or off.



## Starting Storage Area Manager

Starting Storage Area Manager involves starting the management client and logging on with a unique username and password. You can perform the same activities from a remote client as you can from the user interface on the management server.



### Starting the management client (Windows)

To connect to the management client's default management server select *Start Storage Area Manager* from the *Windows Start* menu. The default management server is the server to which you were previously connected.

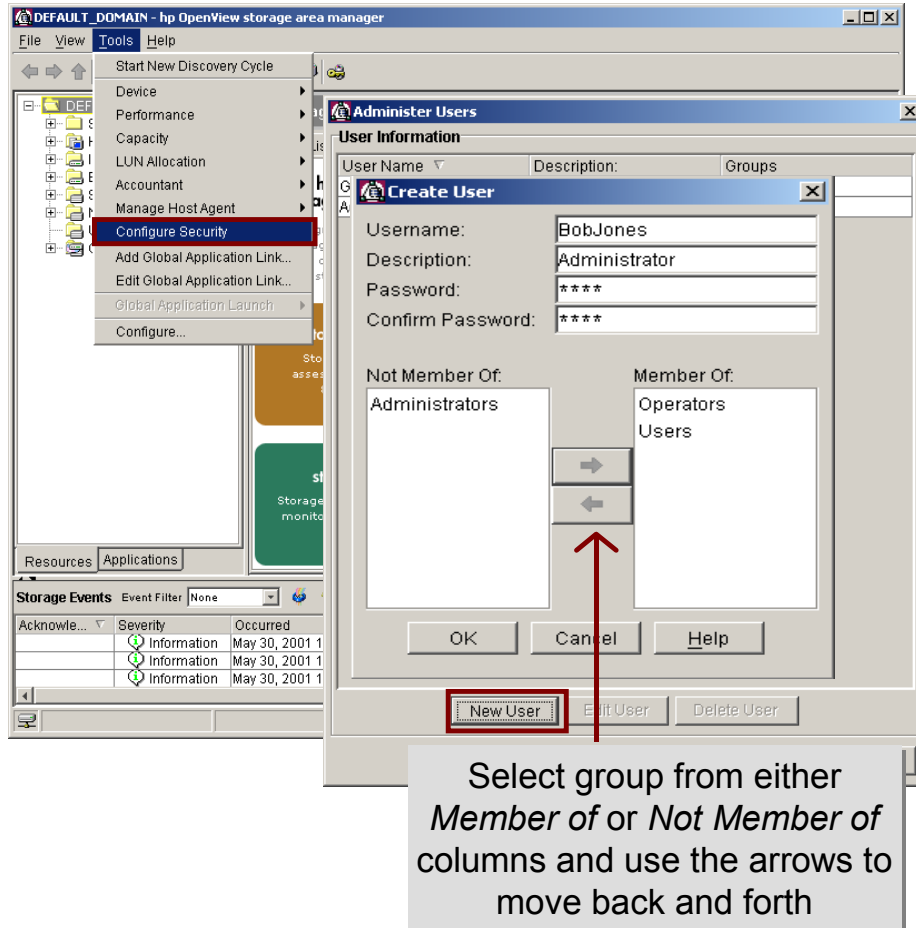
To connect to a management server other than the default management server, use the *Select Management Server* command.

### Starting the management client (HP-UX and Solaris)

1. Change to the `\opt\sanmgr\client\bin` directory.
2. Start Storage Area Manager by entering:  
`SanManager -h <management server IP address>`
3. When the Logon window displays, enter a Storage Area Manager user name and password, and click the *OK* button.

The management server to which you connected, becomes the default server for this management client.

## User accounts



The authentication and authorization feature enables creation of users specific to Storage Area Manager. Each user is assigned to a *user group*, which determines the tasks that the user is able to perform within Storage Area Manager.

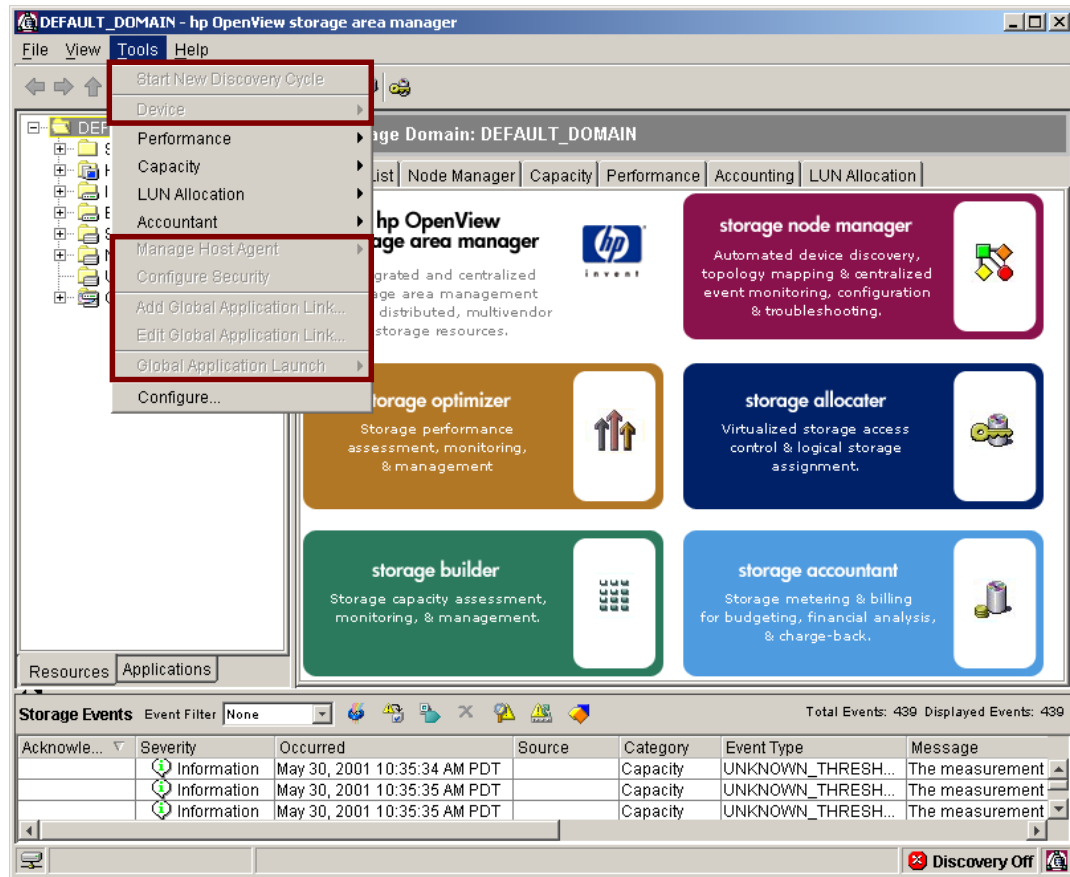
Each time Storage Area Manager is started a login window displays. The user name entered in the login window determines which tasks can be performed based on the user group to which the user belongs.

Storage Area Manager users are independent of operating system users and users displayed within Storage Builder. The users displayed within Storage Builder represent users of a particular host that Storage Builder encountered as part of its host data-gathering activity.

Consider the following when adding, deleting, or modifying users:

- When adding a new user, by default the user will be a member of the *Users* group.
- You cannot delete the currently logged-in user.
- If you modify the currently logged-in user, the changes do not take effect until the next time the user logs in to Storage Area Manager.

## User group privileges

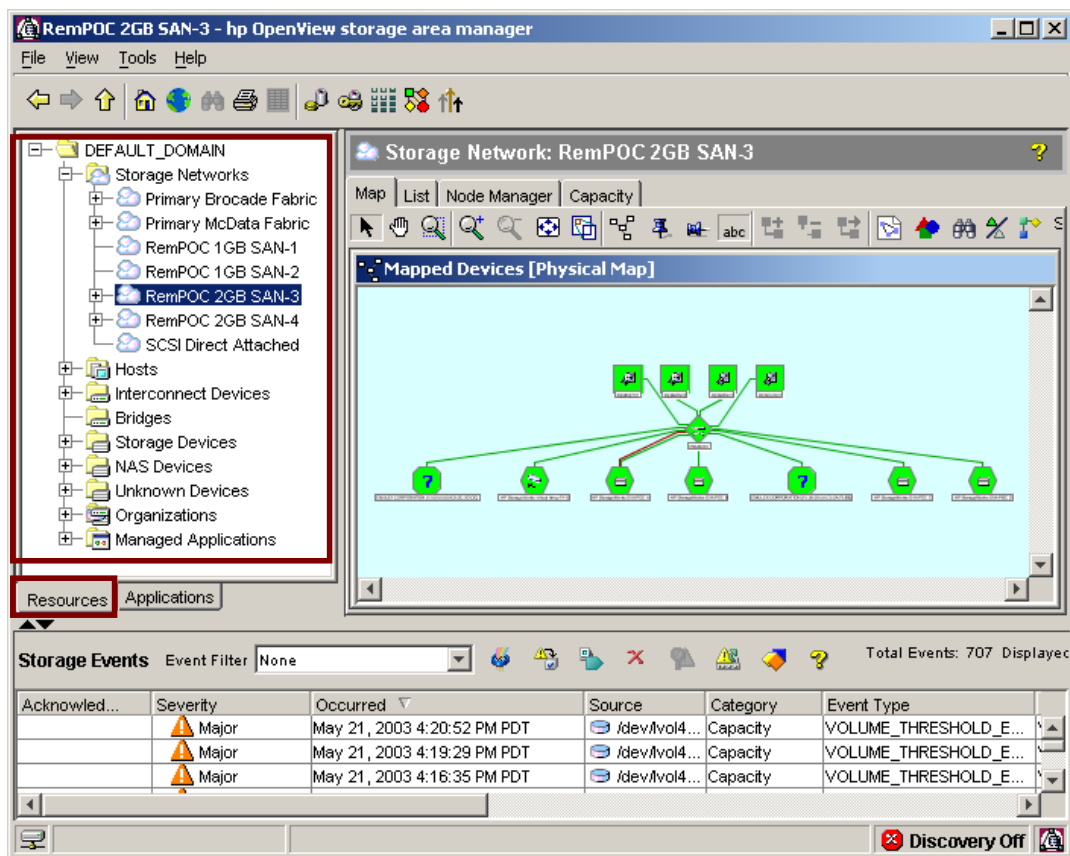


Storage Area Manager provides three groups: *Administrators*, *Operators*, and *Users*.

- **Administrators** — Members of this group are able to perform all Storage Area Manager tasks, including making changes that are saved in the database. Administrators can add, modify, or delete Storage Area Manager users.
- **Operators** — Members of this group are able to perform all Storage Area Manager tasks, including making changes that are saved in the database, but they cannot add, modify, or delete Storage Area Manager users.
- **Users** — Members of this group are able to view all information presented within Storage Area Manager, but cannot make changes that are saved in the database or configure Storage Area Manager users.

User account privileges apply to tasks conducted through both the graphical user interface (GUI) and command line user interface (CLUI).

## Resources tree

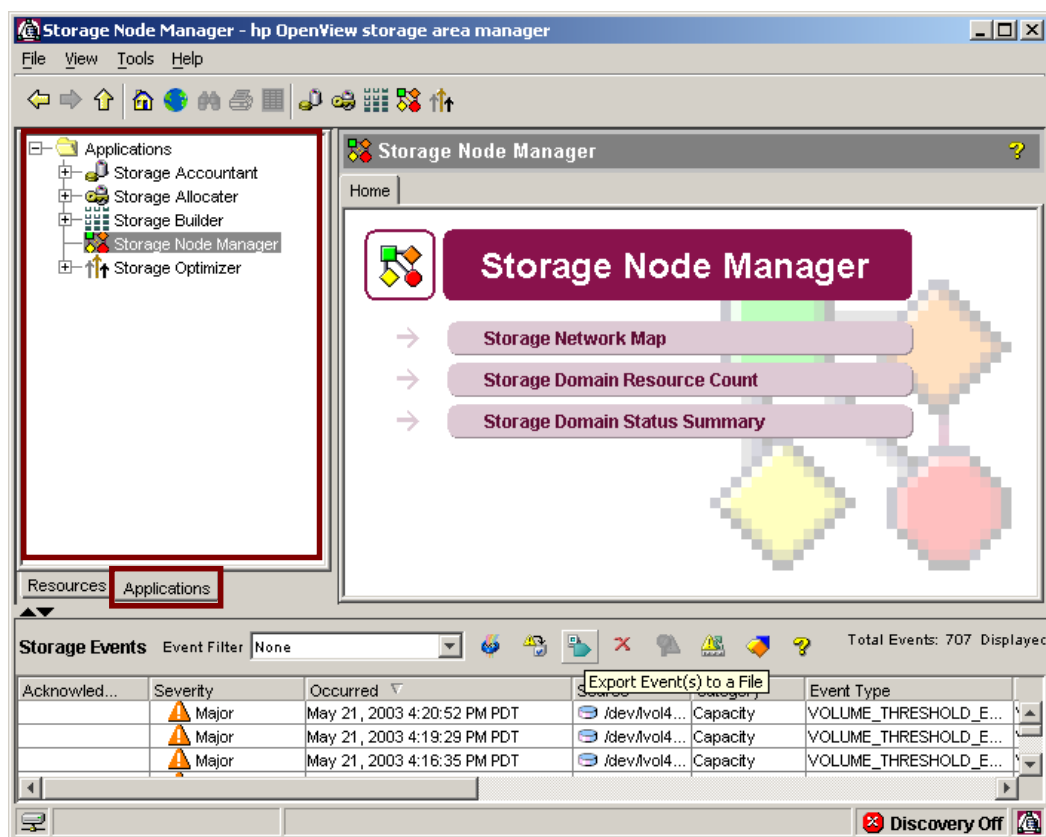


The *Resources tree* lists resources managed by the storage domain including storage networks, devices, and organizations.

Expand nodes to view individual storage networks, hosts, storage devices, NAS devices, volumes, volume manager groups, users, and organizations within the tree.

Select nodes or sub items to view corresponding maps and related information in the View panel.

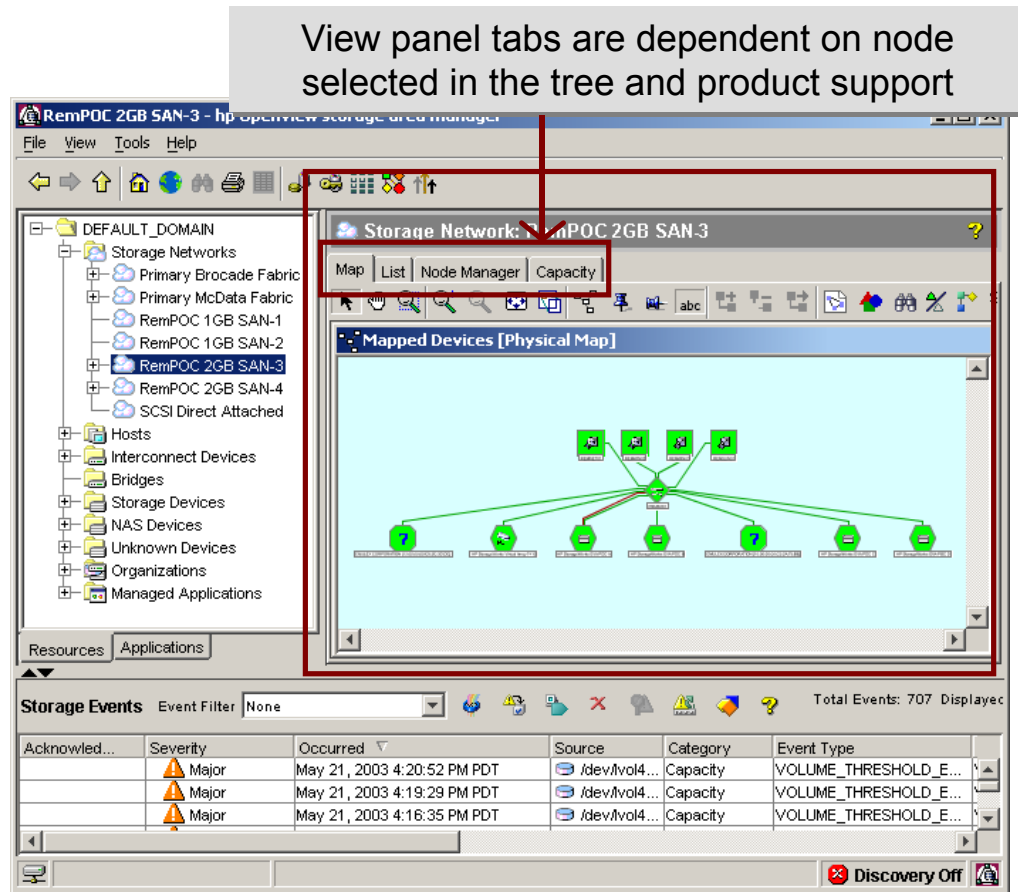
## Applications tree



The *Applications tree* includes a node for each of the five applications that make up the Storage Area Manager product suite. Each application node includes shortcut navigation to that application's primary tasks.

Only licensed Storage Area Manager applications display in the tree.

## View panel

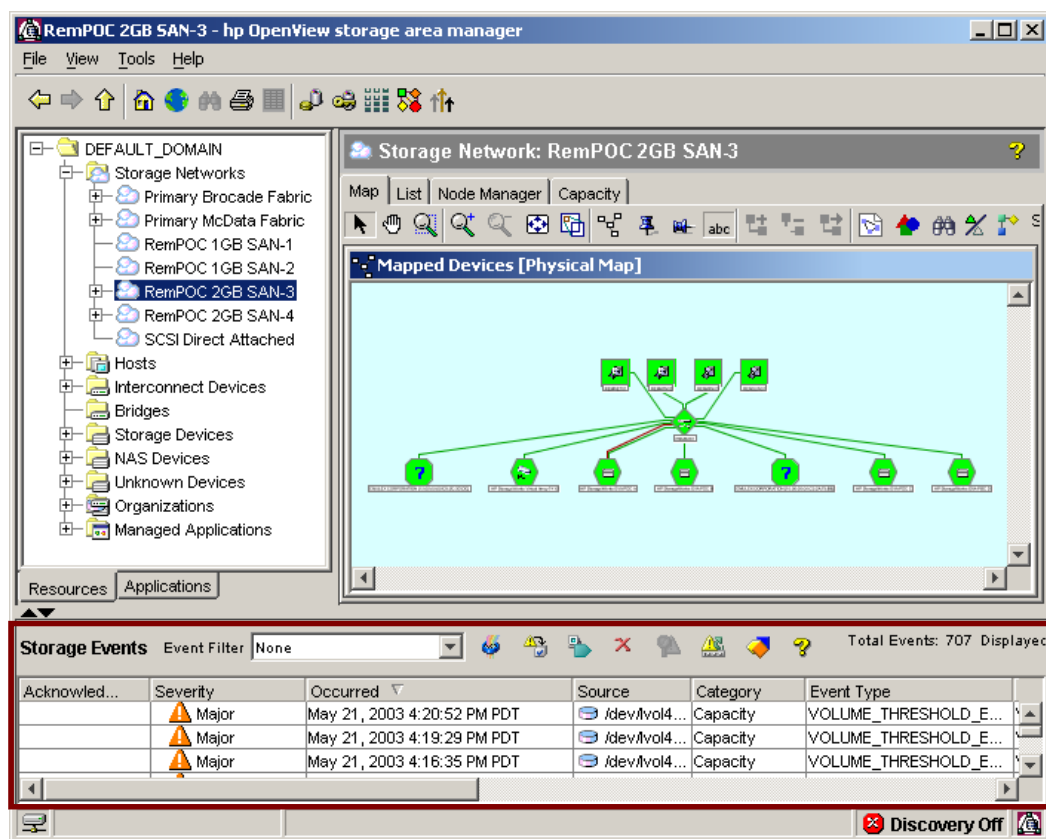


The view panel displays detailed content for the node or subnode that is currently selected in the tree. This could include report listings, device identification information, device capacity or performance data, or device maps that illustrate the storage network.

The information available is dependent on which Storage Area Manager applications are installed.

Tabs near the top of the View Panel provide navigation to additional information for the selected nodes.

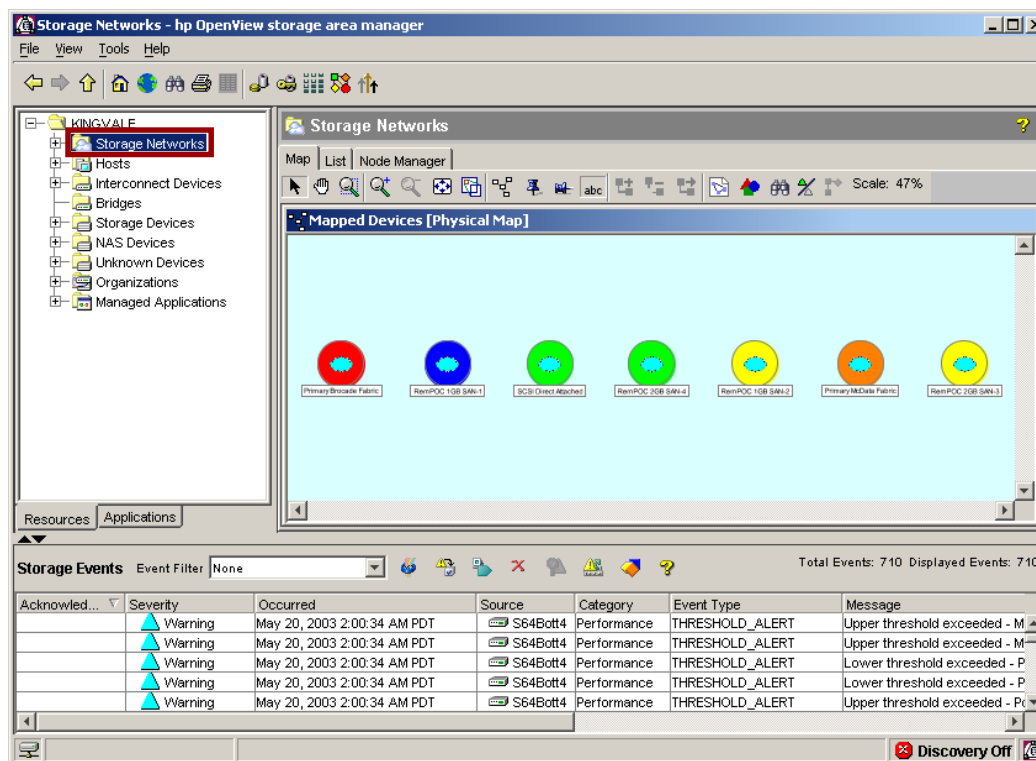
## Event View panel



The Event view panel lists events received and reported by Storage Area Manager as it monitors the storage network. Each event listed in the Event view panel includes its severity level, the date and time it occurred, the source of the event, the event's category and type, and the message provided by the event itself.

Storage Area Manager's event management subsystem enables several features to help you manage the events displayed in the event view panel. These features are accessed through the toolbar icons near the top of the event panel.

## Storage domains

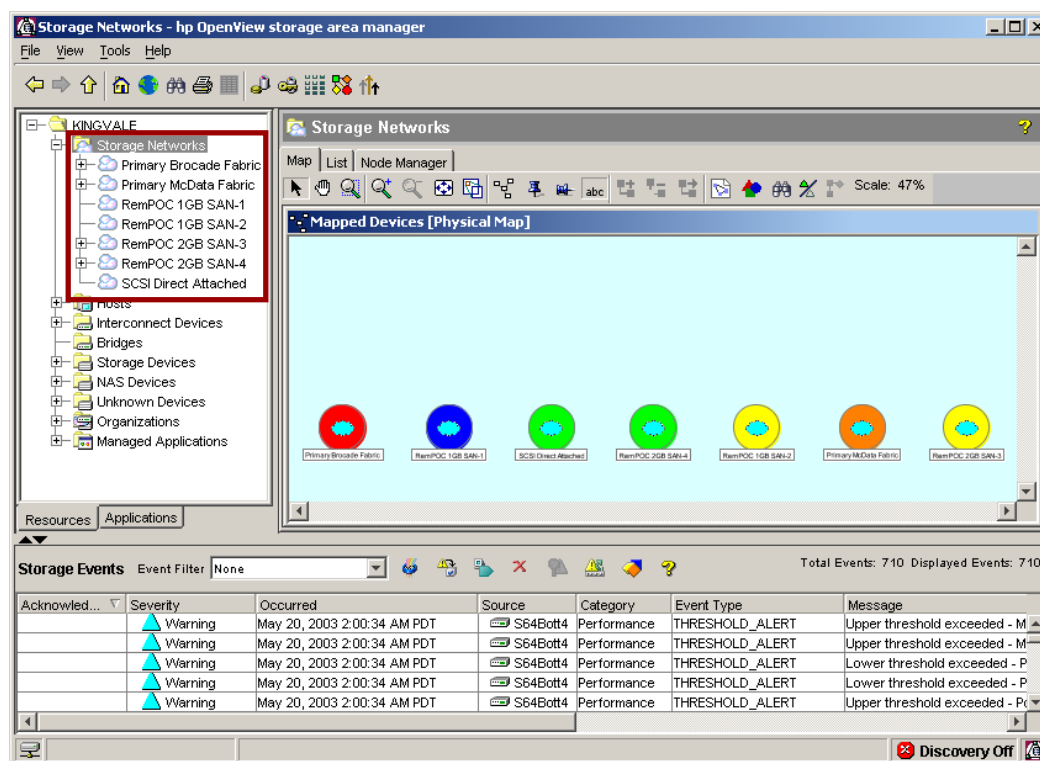


A Storage Domain uniquely identifies a management server and its deployed SAN hosts. A SAN host can be managed by only one management server at a time.

Within the Storage Area Manager GUI, only one management server can be monitored at a time. Using MoM, multiple domains can be monitored simultaneously.



## Storage networks



As Storage Area Manager discovers and maps devices in your environment, it places them in the Resources tree and organizes them as storage networks. They are labeled as SAN-1, SAN-2, and so on. Each storage network is illustrated on a corresponding device map.

Each storage network is an island of Fibre channel connectivity. Each device in a storage network map is able to send Fibre channel commands to all other devices in the map.

The FC Direct Attached storage network represents a Fibre channel connection between one host and one storage device in which Storage Area Manager does not discover or infer an interconnect device between the two devices. This map might contain multiple pairs of these types of connections.

Similarly, the SCSI Direct Attached storage network represents a SCSI connection between one host and one storage device.

## Storage network requirements for Storage Area Manager

For Storage Area Manager to accurately map and monitor a storage network, the following is required:

For each SAN Host:

- Supported operating system
- Host Agent software
- HBA supporting the SNIA API

For each SAN device:

- Property file—Discovery, mapping, and limited device status support
- Device Plug-in (DPI)—Full Storage Area Manager support

## SAN host requirements

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**INTRA**NET

For a complete list of supported Host Agent operating systems and storage network configurations, refer to the hp OpenView Storage Area Manager Supported Components and Configuration Guide at [http://hpso.rose.hp.com/spock#OV\\_SAM/](http://hpso.rose.hp.com/spock#OV_SAM/).

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The Host Agent software contains components that enable in-band communication between the management server and devices using the fibre channel protocol, and includes discovery and status monitoring activities.

As part of the installation process, Host Agent software is deployed to each SAN host to which a storage or interconnect device is connected.

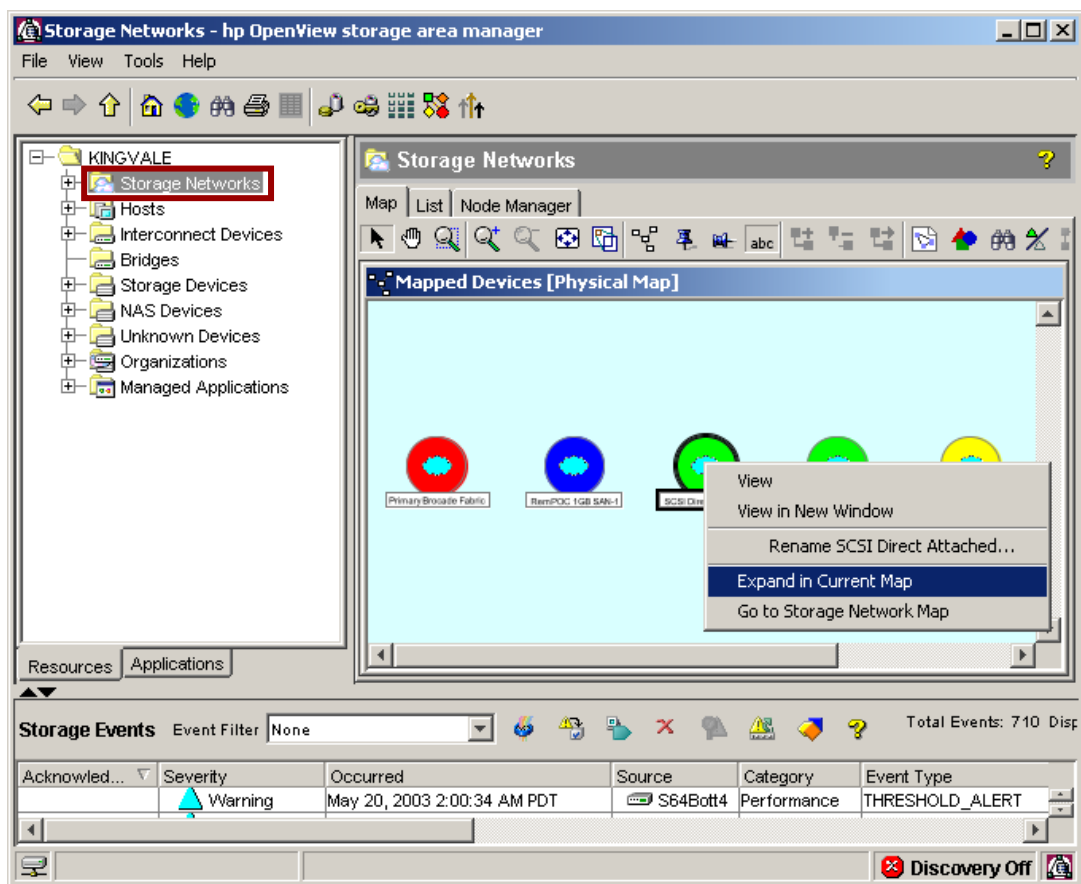
With the exception of HP-UX, a SNIA library is needed for each HBA in order for Storage Area Manager to accurately discovery and map host identification information.

## SAN device requirements

DPIs reside on the management server and are central to Storage Area Manager device support. A DPI is a Java archive file (.jar) that comprised of three parts:

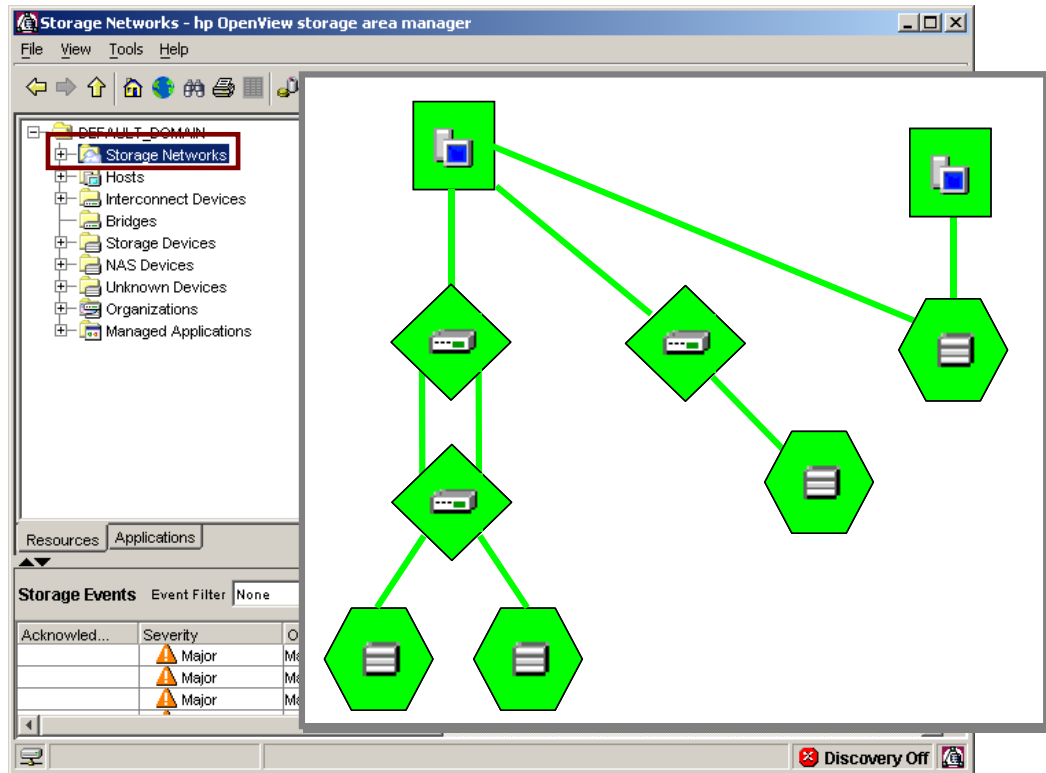
- Device discovery code
- A device property file
- Custom device object file

## Viewing Storage Network maps



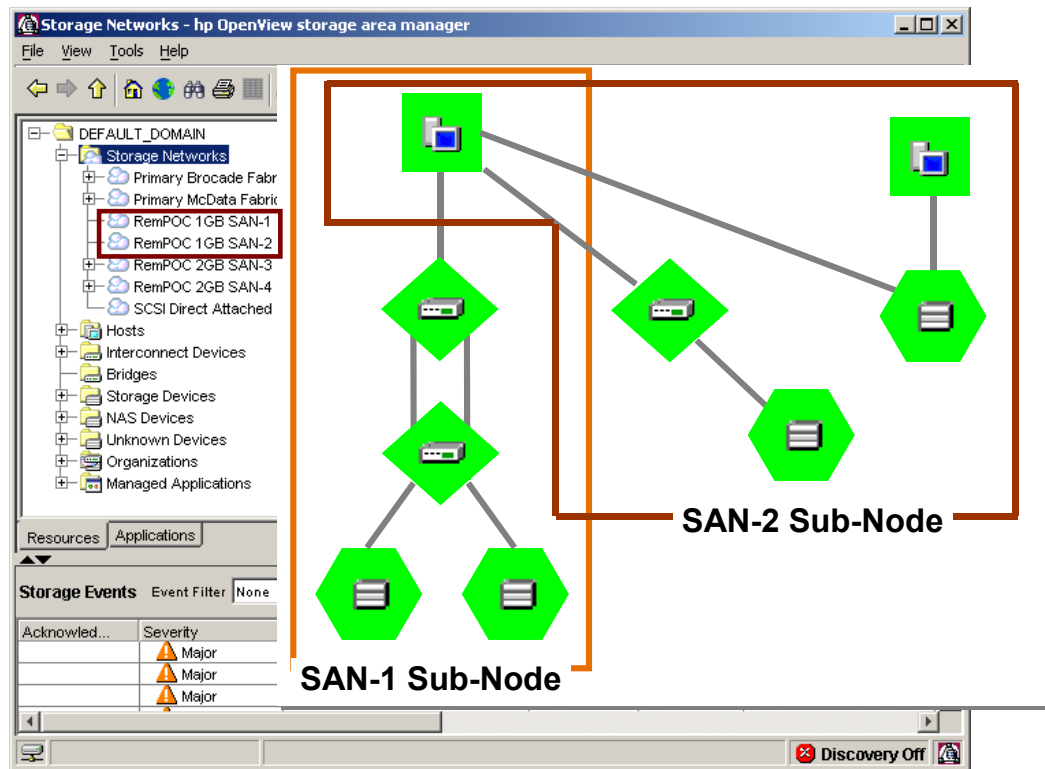
Select the *Storage Networks* node to view all the storage networks in the domain. Storage networks can be expanded or collapsed by the user. The color of the collapsed SAN represents the worst status of any device in the SAN.

## Viewing the entire storage network



Select the *Storage Networks* node to display the entire storage network

## Viewing the storage network subnodes

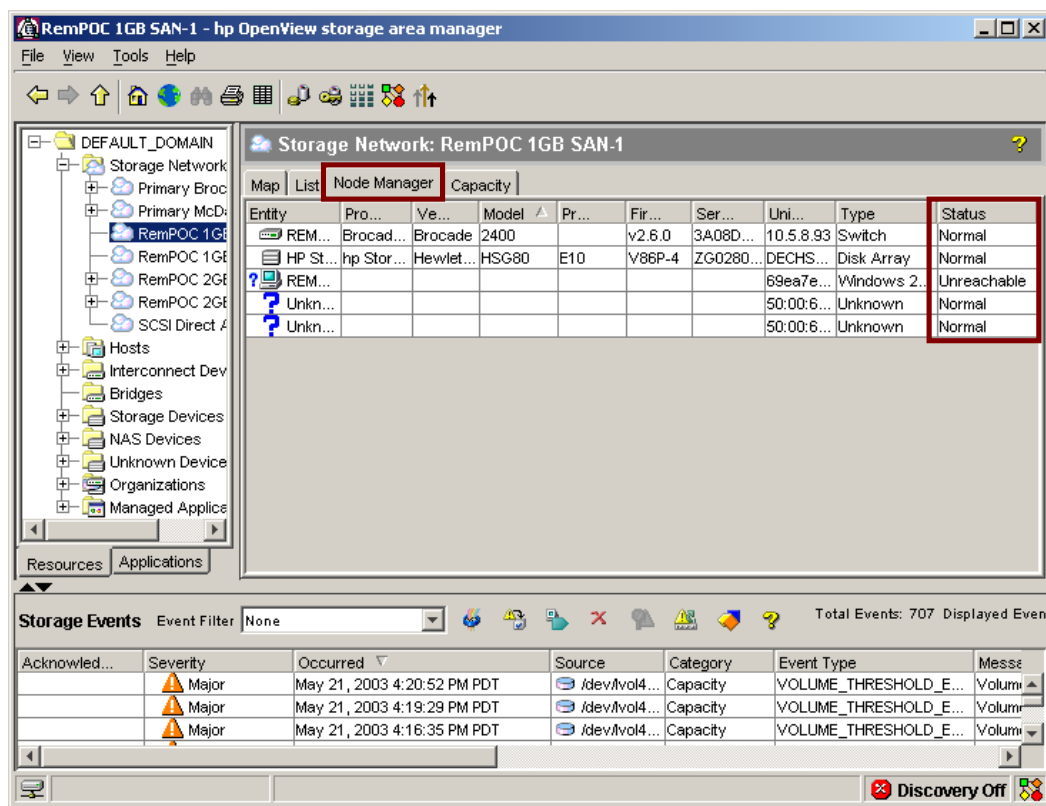


Select the *SAN-1* node to display one island of fibre channel connectivity.

Select *SAN-2* to display another collection of fibre channel devices. Note that the same host appears in both SAN-1 and SAN-2.

Select the *Fibre channel Direct Attached* node to display fibre channel devices that are directly attached, in other words, attached without an interconnect device.

## Viewing storage network information



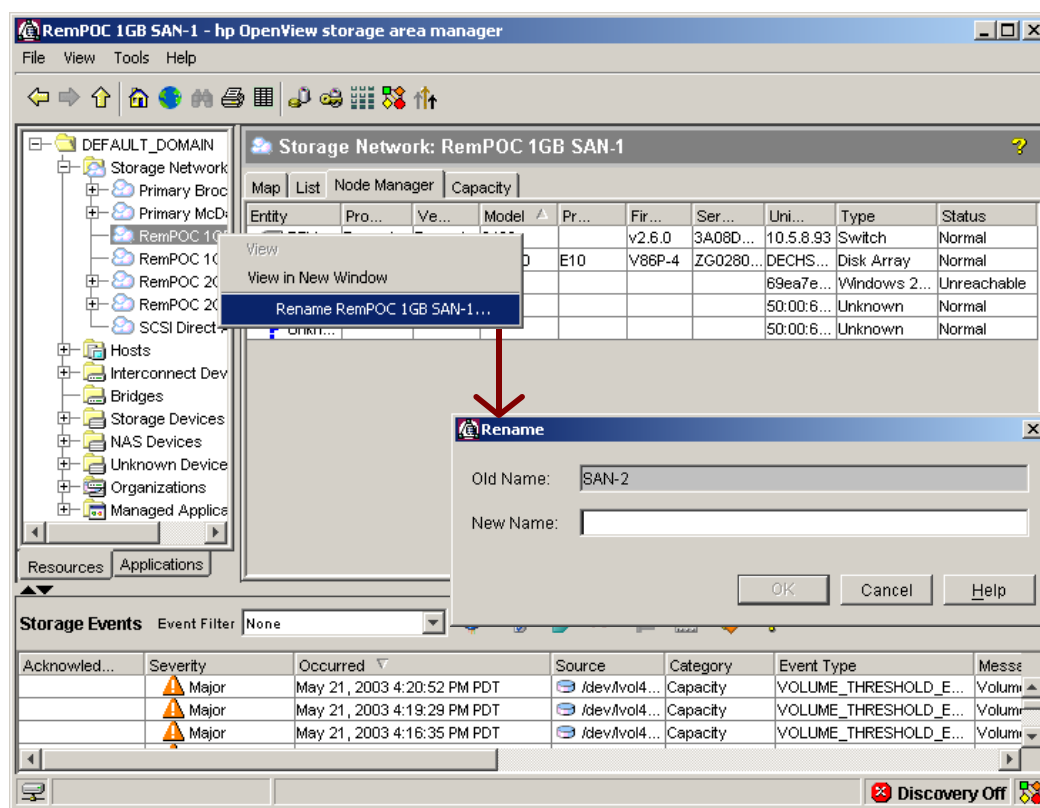
The *List* and *Node Manager* tabs provide storage network identification information for all devices residing in the selected Storage Network

Device identification includes:

- **Entity:** Resource name
- **Inquiry Information:** Product name, vendor, model, product revision, firmware revision, serial number
- **Type:** Disk array, switch, Hub, host operating system

The Node Manger tab provides an additional column showing current device status.

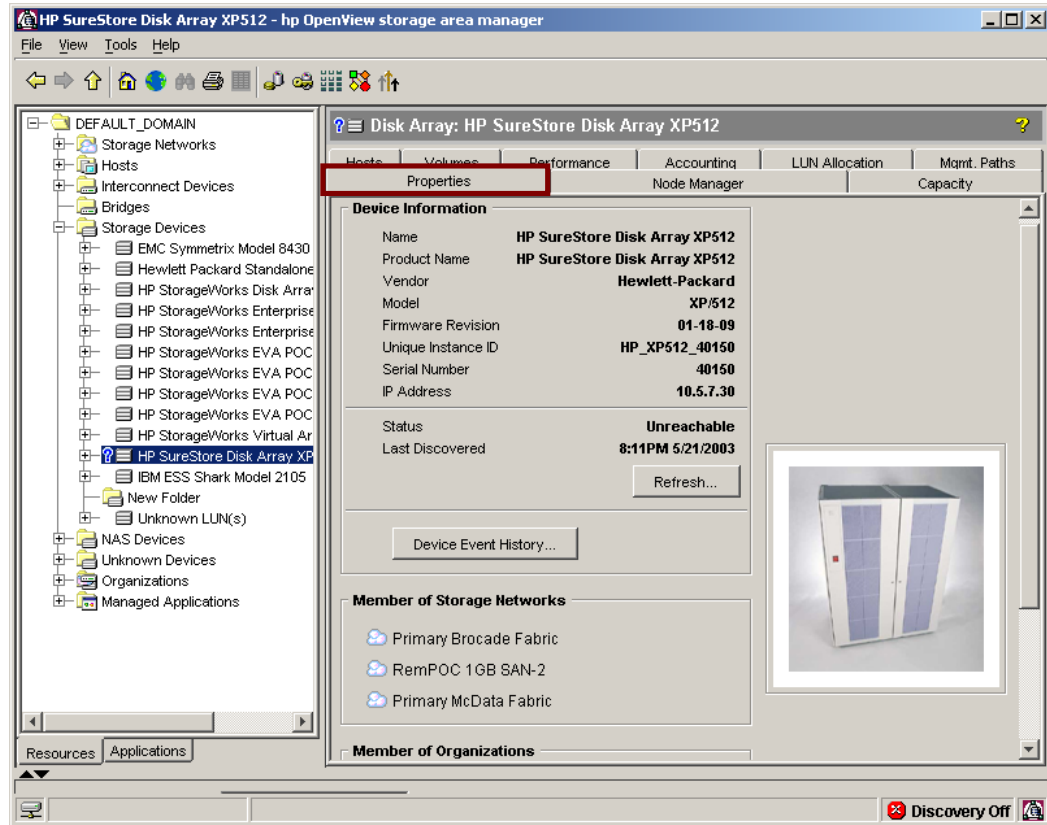
## Renaming storage networks



To rename a storage network, right-click the node and select *Rename* from the shortcut menu.

Likewise, you can rename hosts, interconnect devices, bridges, storage devices, NAS devices, unknown devices, share groups, associated LUN groups, host groups, and LUN groups.

## Displaying device information



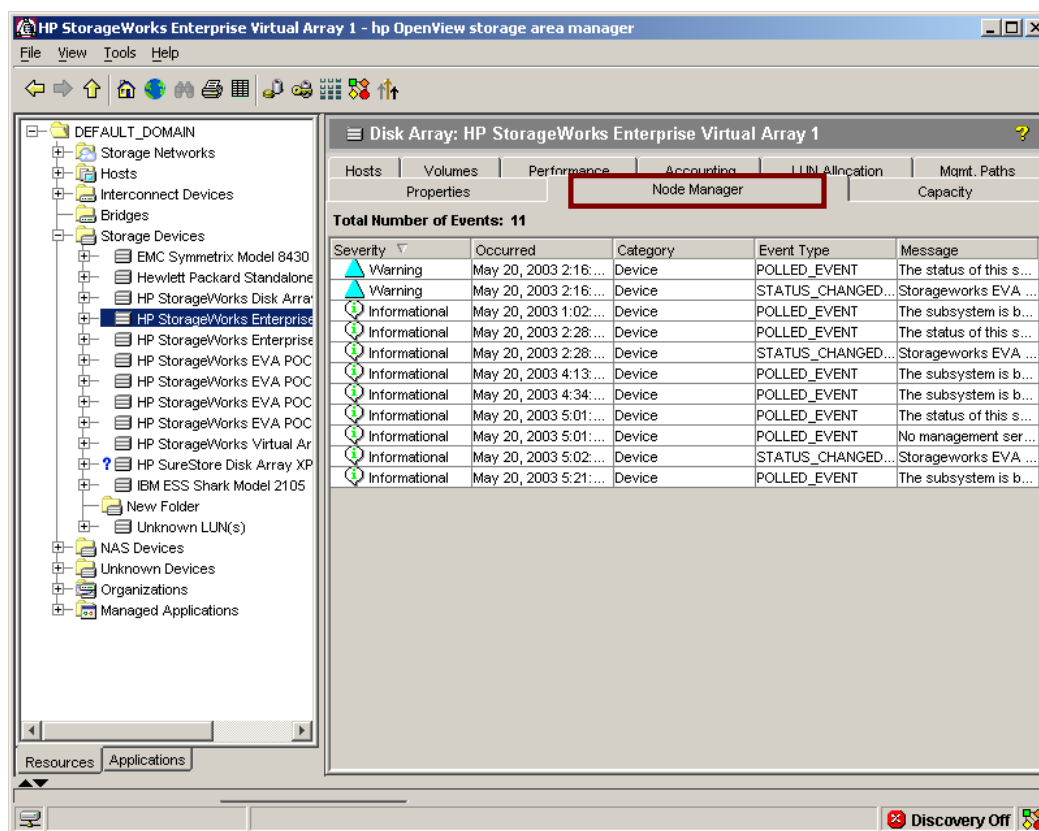
To display detailed information about a specific device (host, storage device or NAS device), select the device in the Resources tree.

The Properties view panel displays

- Device identification information
- Device status
- Storage network membership details

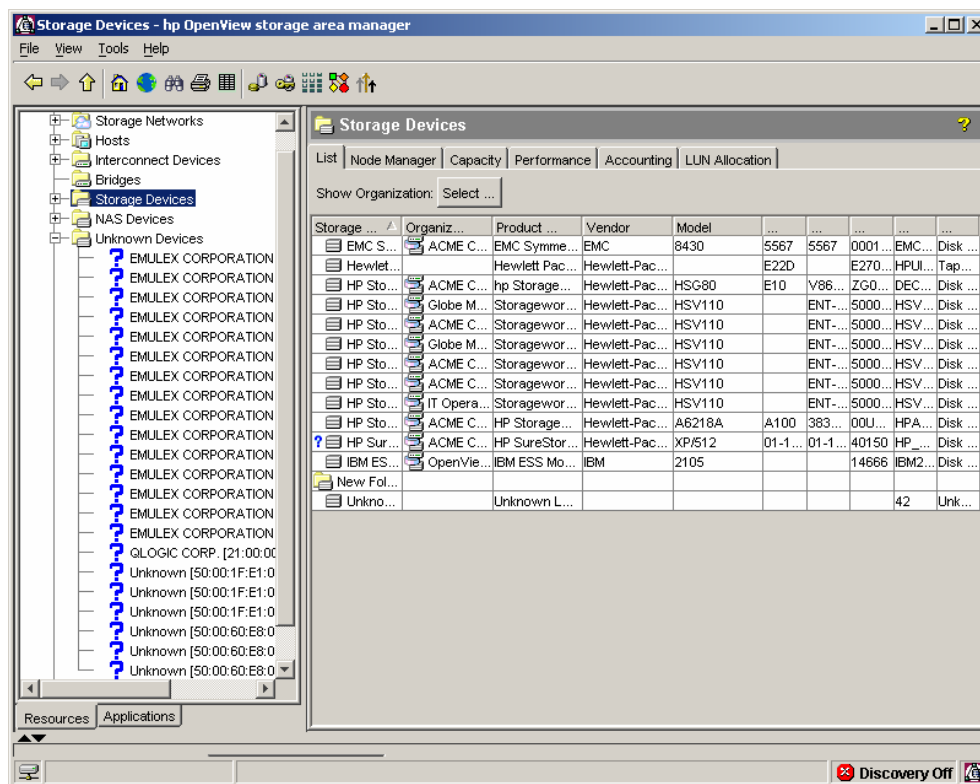


## Displaying device event history



The Node Manager view panel displays device-specific event history. It lists all events relating to the selected device currently stored in the database.

## About unknown devices



The Unknown Devices node represents devices that Storage Area Manager can determine from a switch, but cannot be identified.

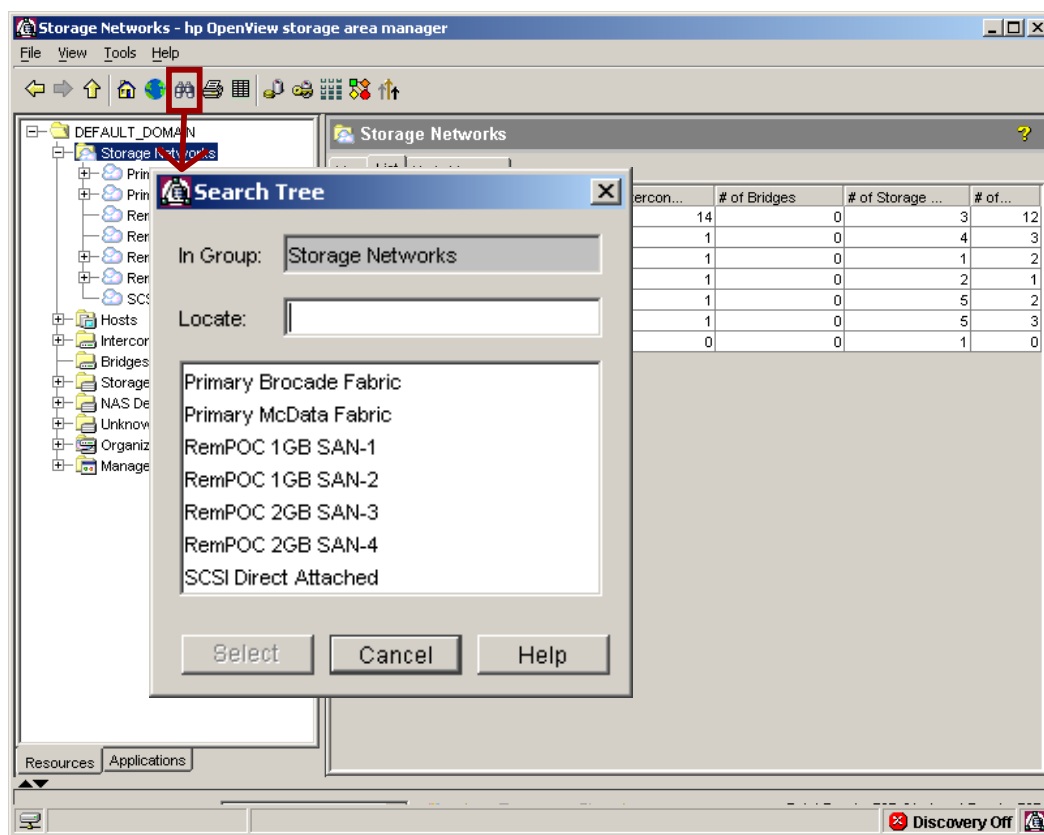
In addition to the Unknown Devices Node, an Unknown LUNs sub-node displays under the Storage Devices Node.

These are LUNs Storage Area Manager cannot identify, either because there is no Discovery Class and Property File for the device the LUNs belong to, or because the paths were down during discovery.

Examples include:

- Fibre channel disks that have not been associated with an FC10 JBOD
- HBAs on hosts that do not have SNIA libraries
- HBAs on a host that do not have the Host Agent software installed
- WWN of a device is detected from a switch, though does not have a corresponding device file
- Host internal disk drives

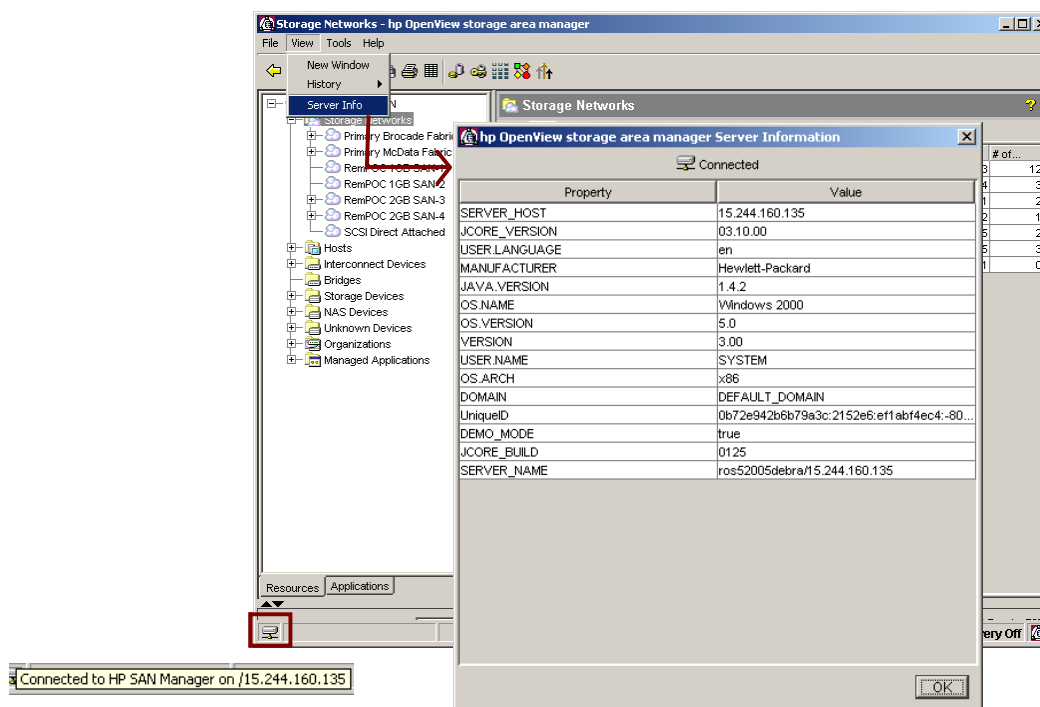
## Searching the tree



The Search Tree feature is helpful when dealing with large numbers of objects in the Resources tree because it allows you to quickly search for a particular node.

Click the *Find* icon or right-click any node in the Resources tree and select *Search Tree*.

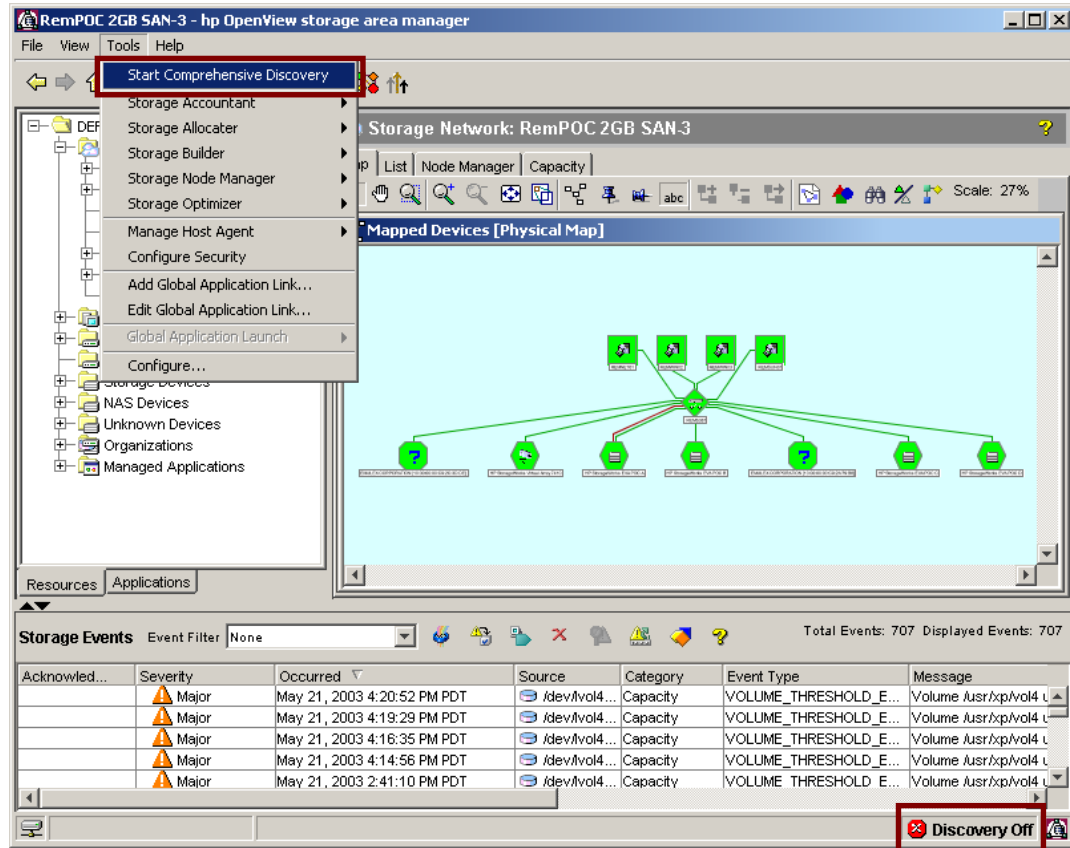
## Viewing management server information



You can display information such as the storage domain name, management server name, and IP address.

For example, if you are running Storage Area Manager from a management client, you can use this window to determine which management server you are connected to.

## Device discovery



Storage Area Manager automatically discovers hosts, interconnect devices, and storage devices in direct-attached (Fibre channel or SCSI) and networked storage (SAN and NAS) environments.

In Storage Area Manager 3.0, this discovery process automatically runs on an ongoing basis. To manually override the ongoing discovery process and request a comprehensive discovery of the entire environment, select *Tools* → *Start Comprehensive Discovery*.

## Discovery components

Storage Area Manager discovery has three primary components:

- **Multicast discovery of managed hosts.** This is a simple process in which the management server sends a multicast request for managed hosts to reply, informing the management server that they are available.
- **SNMP-based (out-of-band) discovery of IP-based storage elements** such as storage devices and infrastructure devices. For this process, a user specifies an IP address range of addresses during installation. For each address, an attempt is made to connect, and if the connection is successful, the address is added to a list of “alive” devices. Additional information (in essence the sysobjectid) is gathered from each “alive” device to enable a more detailed identification of the device.
- **Storage device discovery of storage devices through managed hosts (in-band).** Managed hosts use the DIAL discovery engine that generates an XML encoded stream of device information that can be requested during the management server’s ongoing discovery cycle.

## Setting the discovery interval on SAN hosts

There is an additional, configurable component for discovery, which sets how often the Host Agents check for changes (for example, execute an `ioscan -k` on HP-UX SAN hosts). If anything changes, the hosts will asynchronously notify the management server to process the updated information. This discovery cycle is set under *Tools* → *Configure* → *Discovery*. The default is set to every 15 minutes.

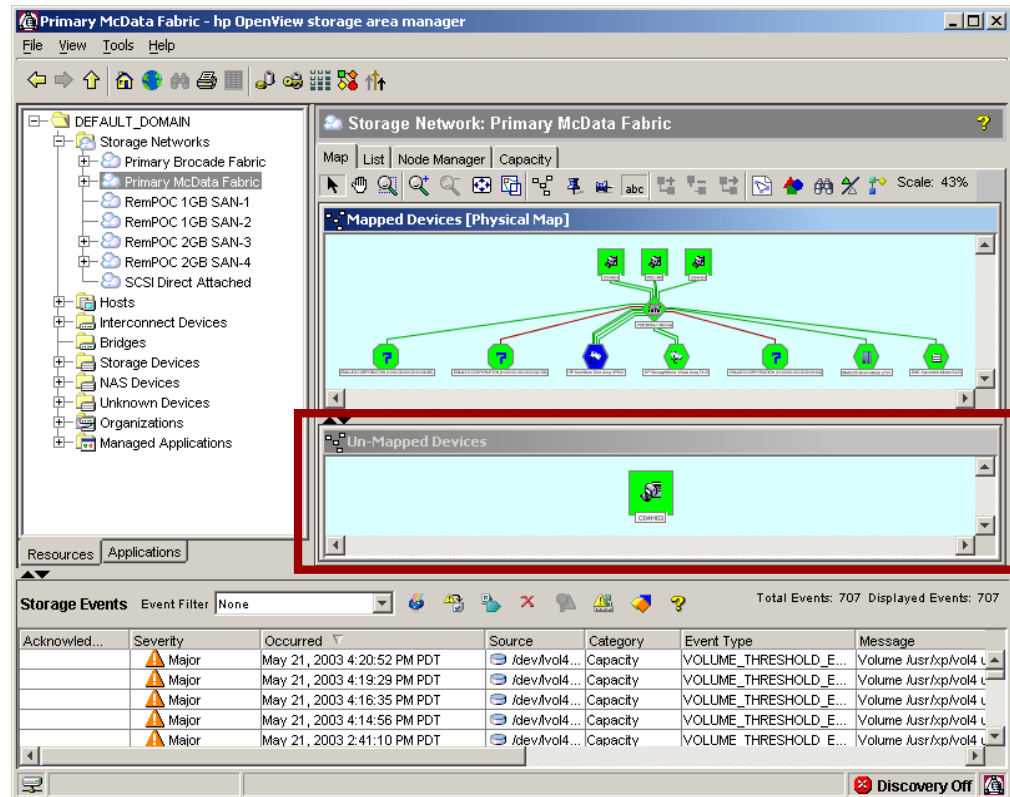
## Device maps

As Storage Area Manager discovers your storage network, it places devices in device maps. Because of device limitations, Storage Area Manager must assume the existence of some devices, such as hubs.

While placing devices in the map, Storage Area Manager also links them using information offered by the devices. Links can be physical or logical and are graphically identified as such in the device maps.

Storage Area Manager provides two *map modes*: physical and inferred.

### Physical mode



Devices that appear on physical maps provide enough information that Storage Area Manager is able to establish their identity and connectivity properties.

## Node bank

Some devices do not provide sufficient information for Storage Area Manager to accurately identify them; however, Storage Area Manager is able to obtain enough connectivity information concerning the devices to physically map them.

In these cases, when the device map is in physical map mode, a placeholder device is placed in the device map with a physical link and an unmapped device is placed in the *Un-Mapped Devices* node bank. The placeholder device is typically identified by the device vendor.

The placeholder device also appears in the *Unknown Devices* node of the Resources tree, and the unmapped device appears under the appropriate node for its device type. This placement in the Resources tree is independent of the map's mode.

## Associating unknown devices with their placeholders

Storage Area Manager provides two methods for associating unknown devices with their placeholder icons depending on whether the unknown device and placeholder device are shown in the same storage network map.

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### Note

When in inferred map mode, Storage Area Manager estimates the connectivity of logical devices by applying its own map rules to the limited information provided by the devices. This map mode can be helpful in determining which unknown devices should be associated with particular placeholder icons

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If in same storage network map

1. Select the unknown device in the Un-Mapped Device node bank.
2. Drag the unknown device and drop it on the placeholder icon in the device map.

If the association is successful, the unmapped device is removed from the Un-Mapped Devices node bank, and the placeholder device in the map assumes the appropriate characteristics of the device. The placeholder device is also removed from the Unknown Devices node in the Resources tree.

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### Note

In some configurations, multiple placeholder devices might be associated with the same unmapped device. The above result completes when the final placeholder device is associated with the unmapped device.

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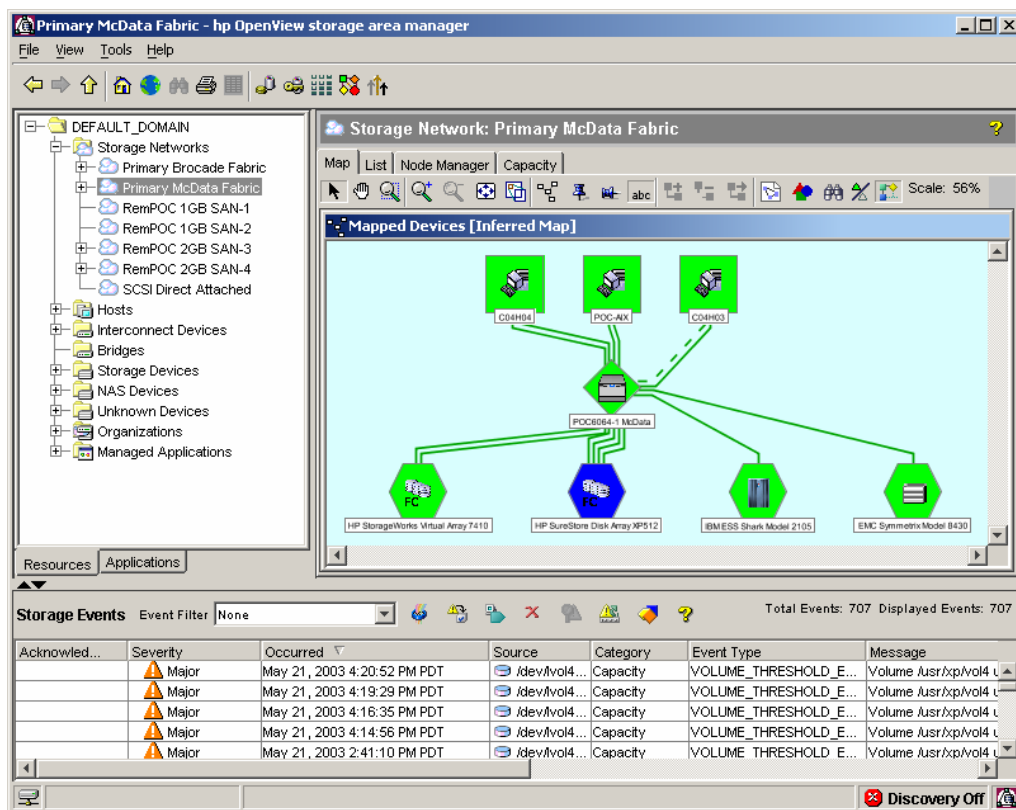


If not in same storage network map

1. Right-click the unmapped device in the Resources tree, and select *Associate with Unknown Device* from the shortcut menu.
2. Select the placeholder device that represents the unmapped device from the list of placeholder devices in the *Select device to associate with* list.
3. Click the *OK* button.

If the association is successful, the unmapped device is removed from the Un-Mapped Devices node bank (if applicable), and the placeholder device in the map assumes the appropriate characteristics of the device. The placeholder device is also removed from the Unknown Devices node in the Resources tree. The applicable storage network is also updated to reflect the association.

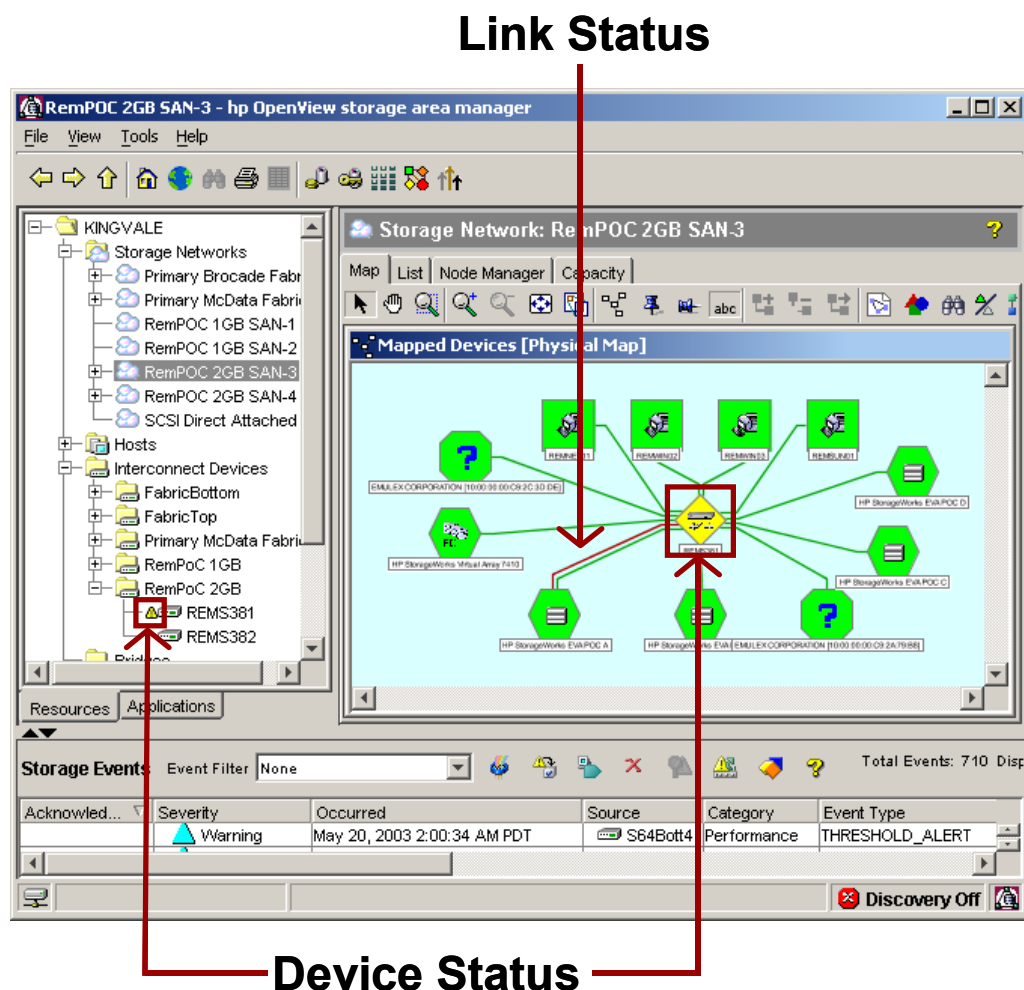
## Inferred mode



Inferred maps display physical and logical devices and device links in the same map. Storage Area Manager estimates the connectivity of logical devices by applying its own map rules to the limited information provided by the devices.

Inferred map mode requires users to validate all inferred links and make link modifications when appropriate. This map mode is recommended for Hub only environments.

## Device and link status



Storage Area Manager displays status for all discovered devices and associated links.

### Device status

Device status does not necessarily correspond with event severity levels displayed in the event panel. Device status is dynamic and displays the current status of the device. Severity levels of events are static for the event at the time it occurred.






#### Note

Some devices display only Normal and Unknown/Unreachable status. See the *hp OpenView Storage Area Manager 3.0 installation guide* to determine Storage Area Manager's status monitoring capabilities for each device it supports.

## Recognizing device status

In the Resources tree, event panel, and view panel, status icons display next to the device. In device maps, device status displays as the background color of the device icon.

The following table lists status from the lowest level of severity to the highest.

Tree Icon Status Symbol	Device Icon Color on Map	Definition
None	Green	Normal
	Blue	Unknown/Unreachable
	Cyan	Warning
	Yellow	Minor
	Orange	Major
	Red	Critical

## Impact of status levels

- **Normal:** Information collected from device indicates that it is operating normally.
- **Unknown/Unreachable:** Status of device is unknown or an attempt to contact device to obtain status was not successful.
- **Warning:** Normal use of device should not be impeded. Escalation to a more severe condition is not likely.
- **Minor:** Potential or impending fault could impact service. Normal use of the device is not likely to be impeded. Repair can be scheduled for a convenient time.
- **Major:** Action required very soon to avoid data loss, system downtime, or other loss of service. Normal use of the device could be impeded. Repair should occur as soon as possible.
- **Critical:** Immediate action required to avoid data loss, system down time, or other loss of service. Condition might already have occurred. Normal use of device should not continue.

## Link status

The device maps also display normal or critical status for links between devices. Device and link status are independent, but might correlate.

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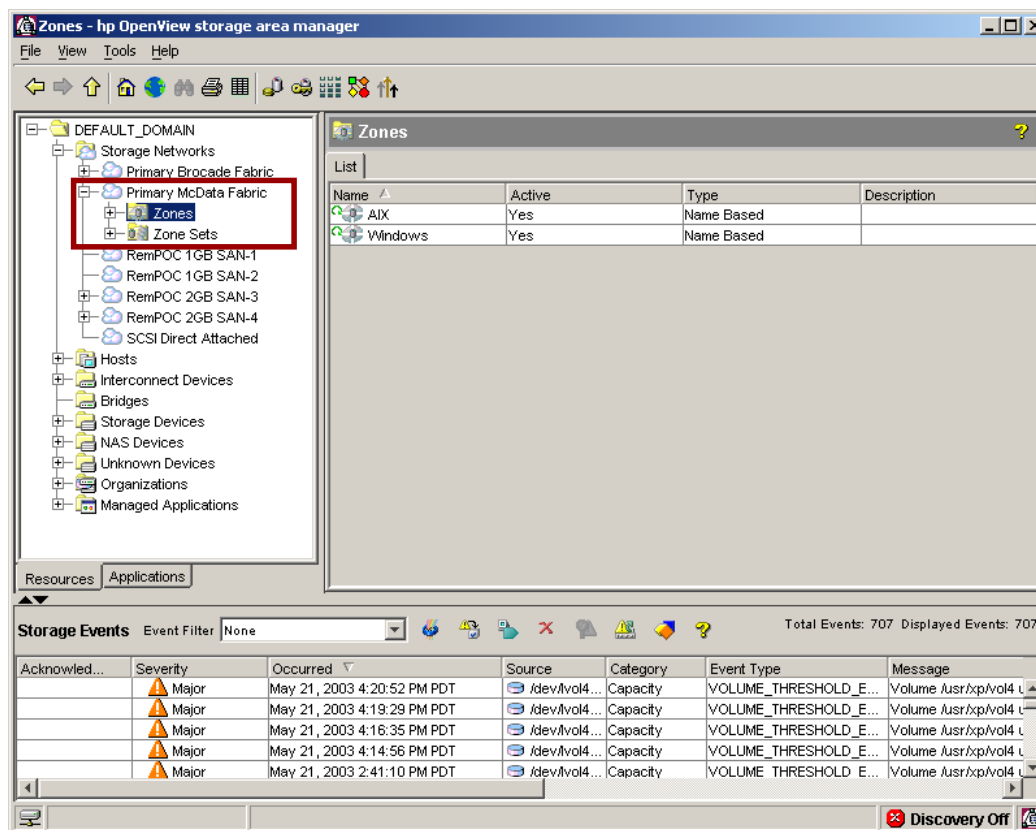
**Note**

If a device with a logical link changes to an Unknown/Unreachable status, the device is removed from the device map. However, the device remains in the Resources tree.

---

Each time a device or link changes status, Storage Area Manager generates a corresponding event and displays it in the event panel.

## Viewing storage network fabric zones

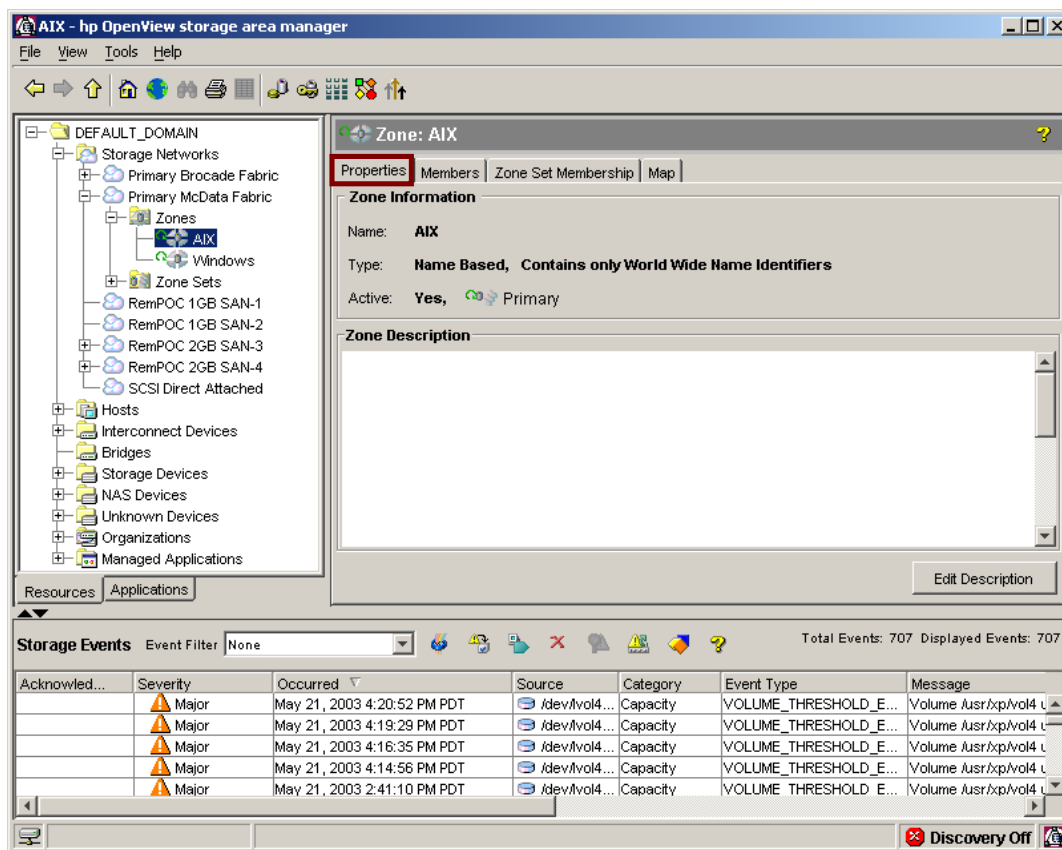


If the storage network is using interconnect hardware to support fabric zoning, Storage Area Manager identifies the preconfigured zones and lists them under the Storage Networks node in the Resources tree. Each zone subnode lists the zone name, the current state (active or not), zone type and an optional description.

### Note

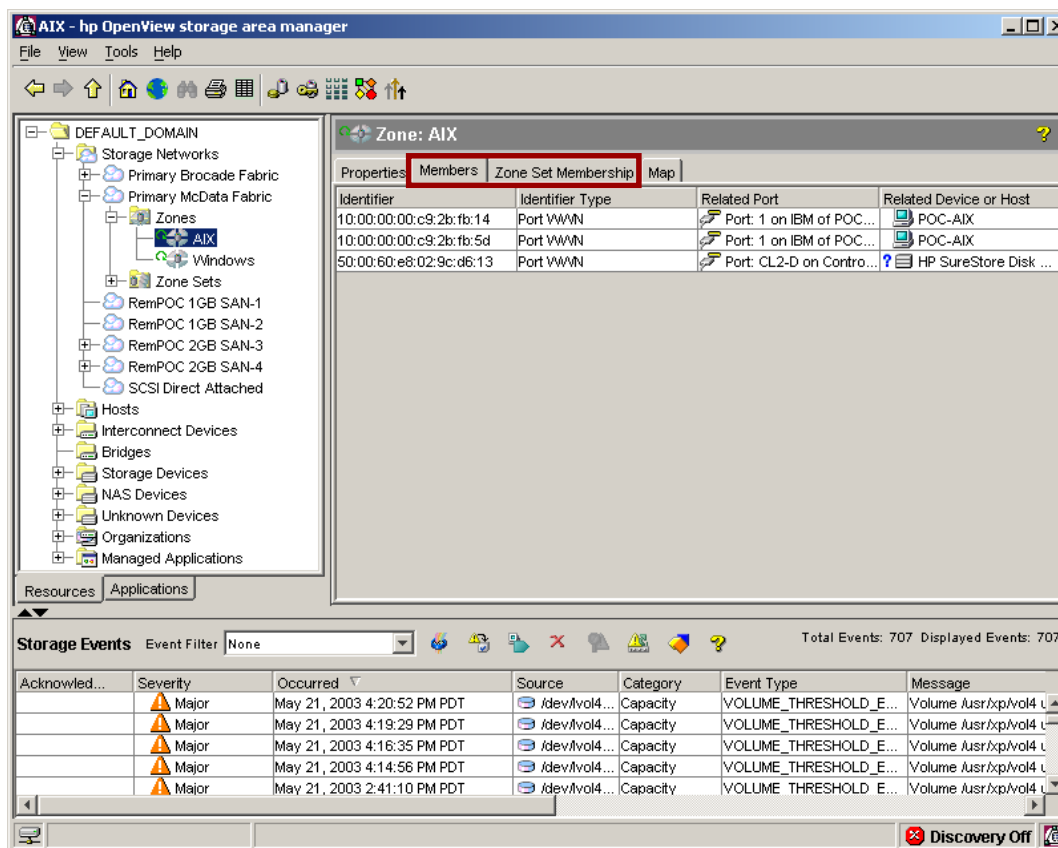
Active and inactive zones are only displayed for Brocade switches. McData switches only show active zones. Brocade stores active and inactive zone information within the switch. McData stores the active zone information in the switch, but the inactive zone information is in the EFC manager (separate computer system used to manage multiple McData switches).

## Fabric zone properties



Zone properties can be displayed for each zone, including zone name, zone type, and current state. A zone description can be added.

## Fabric zone members and sets



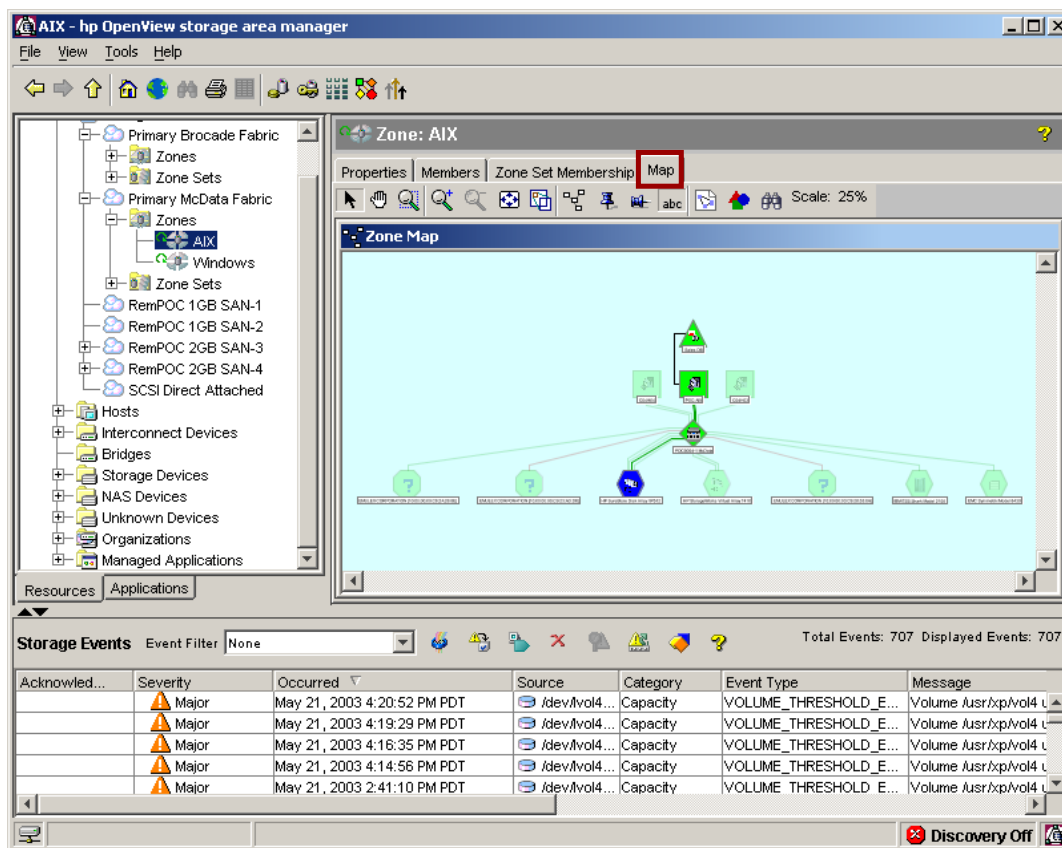
Zones are a named group of zone members. Similar to the way Storage Area Manager defines storage networks, members in a zone are able to communicate with all other zone members.

A zone member can be a member of more than one zone. More than one zone can be active at a time. Storage Area Manager does not manage the activity state of zones.

Zone sets are a named group of zones. A zone can be a member of more than one zone set. Only one set can be active within a storage network. Like zones, Storage Area Manager does not manage the activity state of zone sets.



## Zone map



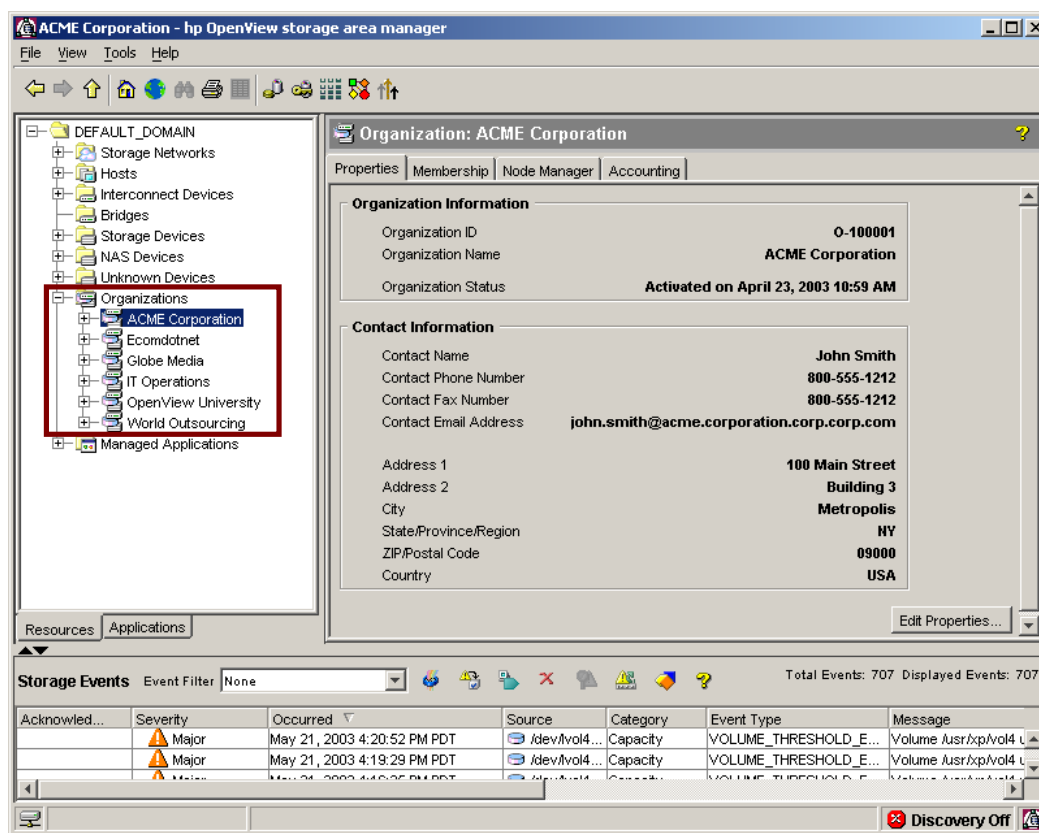
Zone maps graphically represent the effect of the zone on the physical topology. Members not configured in the selected zone are shown as transparent.

## Organizing SAN resources

Storage Area Manager provides two features for organizing SAN resources:

- **Organizations**
  - Used to create “customer views” of your storage network
  - Set capacity thresholds and customer billing per organization
  - Non-exclusive (a resource can be a member of several organizations)
  - Accessible from both Resources tree and Applications trees
  
- **Arbitrary folders**
  - Simple filing cabinet for SAN resources
  - Supports nesting
  - Exclusive (a resource can only be a member to one arbitrary folder at a time)
  - Not visible from the Applications tree
  - No feature specific to Arbitrary folders (for example, thresholds cannot be set on an arbitrary folder)

## Viewing organizations

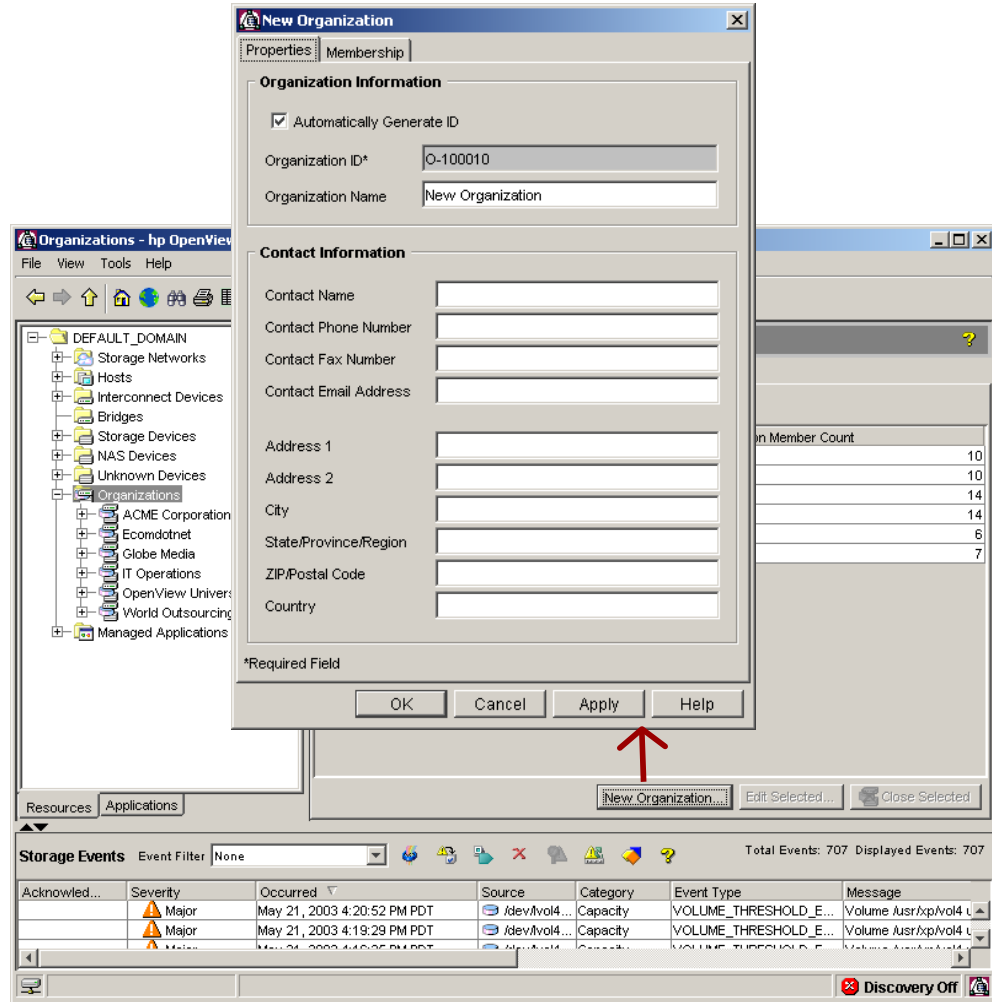


Organizations are supported by Storage Builder and Storage Accountant and allow segmentation of resources for the purpose of reporting. Storage resources can include hosts, bridges, storage devices, interconnect devices, NAS devices, and unknown devices.

Organizations do not necessarily reflect a physical relationship within the storage network. Any storage resource discovered by Storage Area Manager can be added to any organization. A storage resource can be a member of more than one organization. There is no limit on the number of members that can belong to an organization.

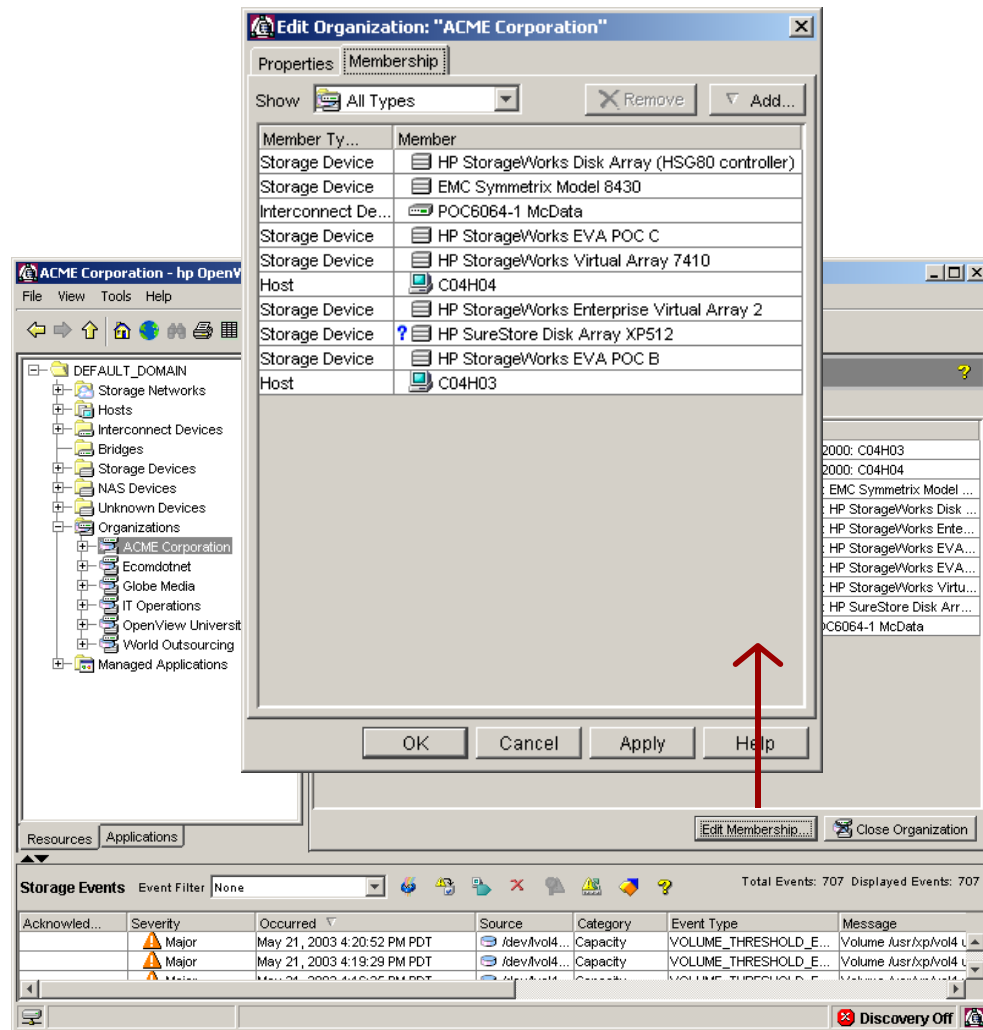
The Organizations node from within the Resources tree contains three tabs: List, Capacity and Accounting. The List view panel displays the organization name and organization member count.

## Adding organizations



To add a new organization, select the *Organizations* node in the Resources tree and click the *New Organization* button.

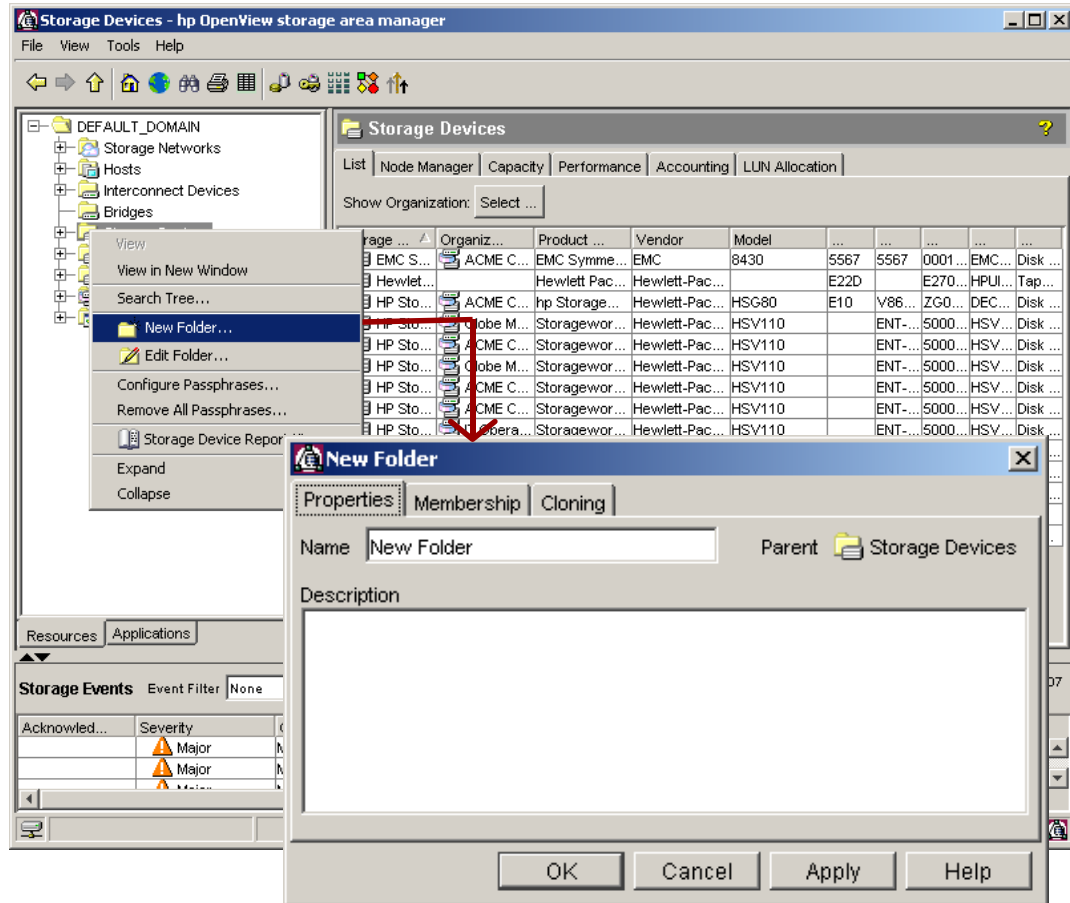
## Adding organization members



To add new members to an organization:

1. Select the *Organizations* node in the Resource tree to view the Organizations view panel.
2. Select the organization to which you want to add a member.
3. Click the *Edit Selected* button.
4. Click the *Membership* tab.
5. Click the *Add* button, and select the device type for the storage resource you want to add as a member. The Add Members window displays.
6. Select the storage resource you want to add, and click the *OK* button. (You can select more than one resource at a time.)
7. Repeat steps 5 and 6 until all the members you want to add to this organization display on the Membership tab.
8. Click the *OK* button to save changes and close the window.

## Creating arbitrary folders

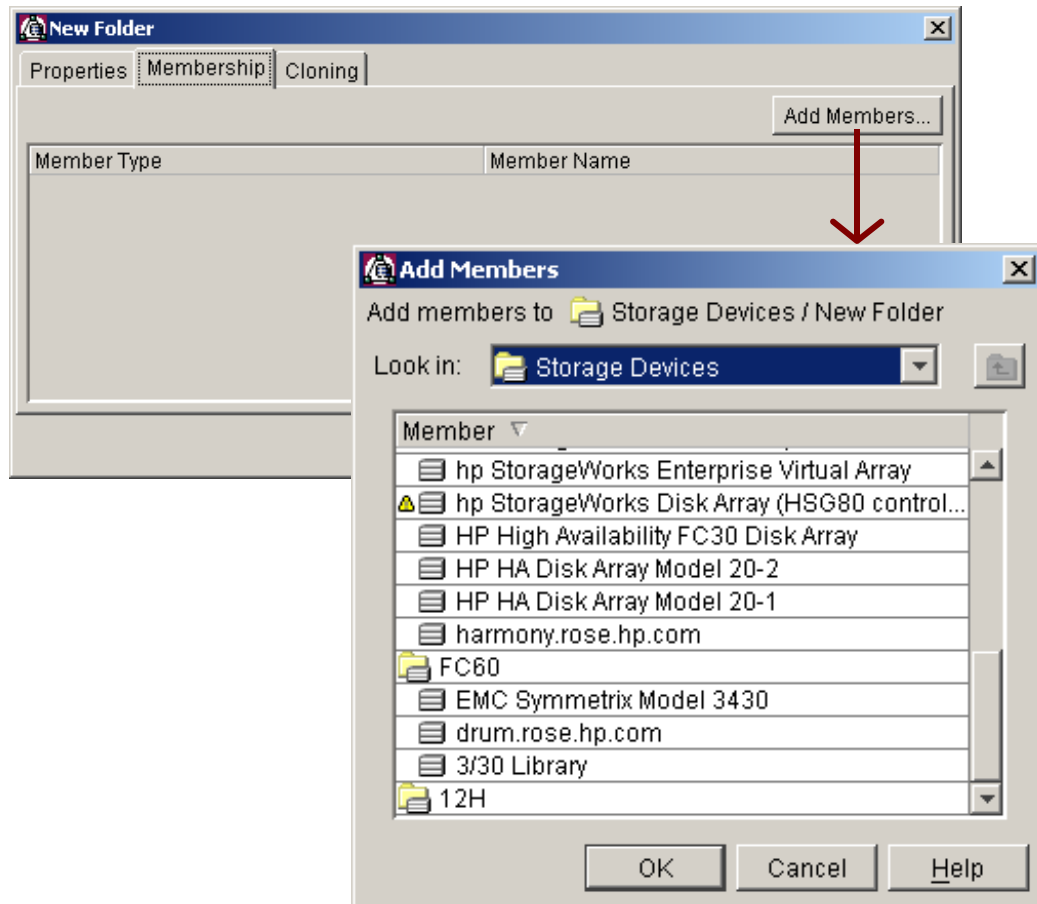


Folders can be created under any tree node in the Resources tree. To create an arbitrary folder, right-click on the node and select *New Folder*.

The New Folder window contains three tabs:

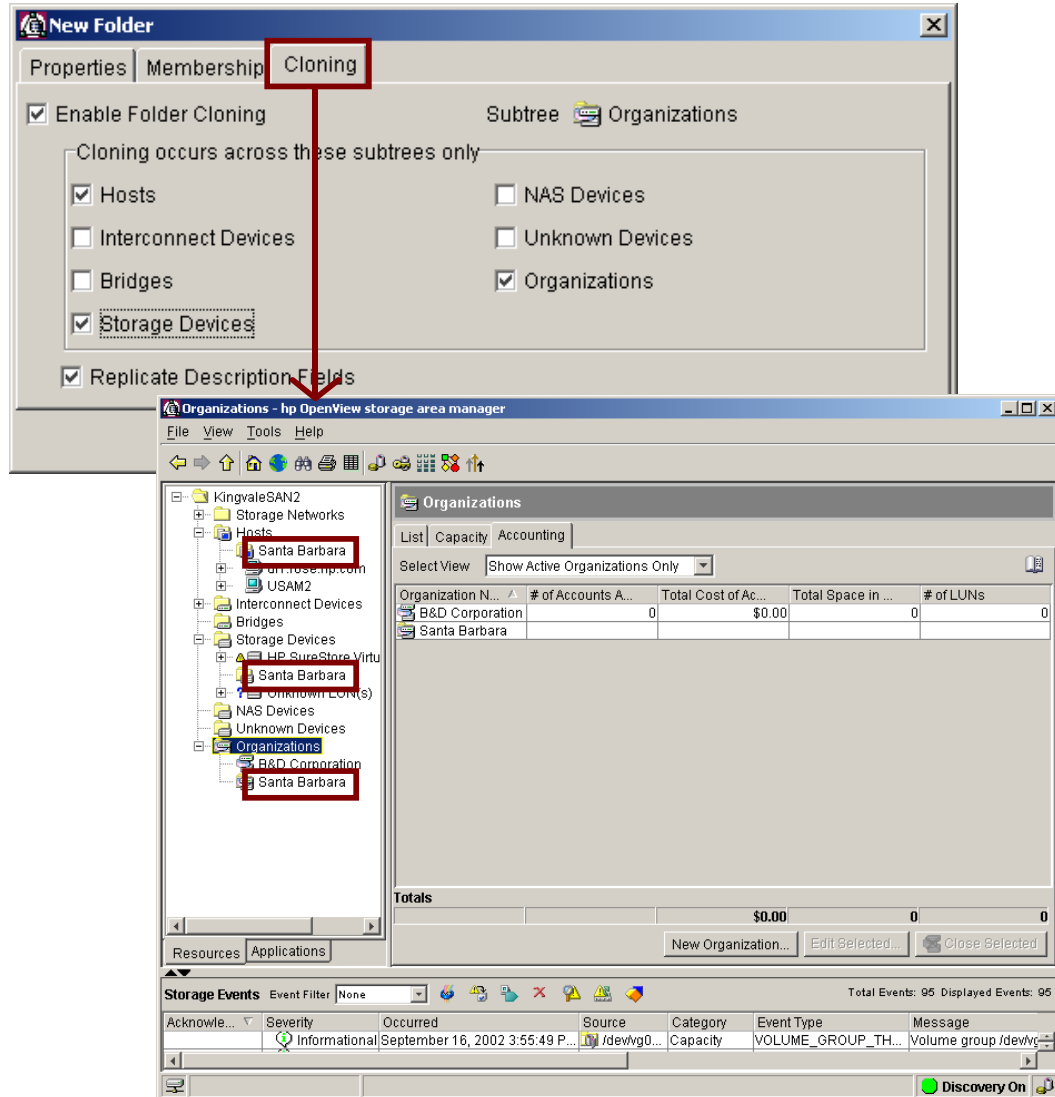
- Properties
- Membership
- Cloning

## Adding/removing members



Members can only include nodes of a same device type. For example, if you create an Arbitrary folder under the Hosts node, you can only add host member types to that folder.

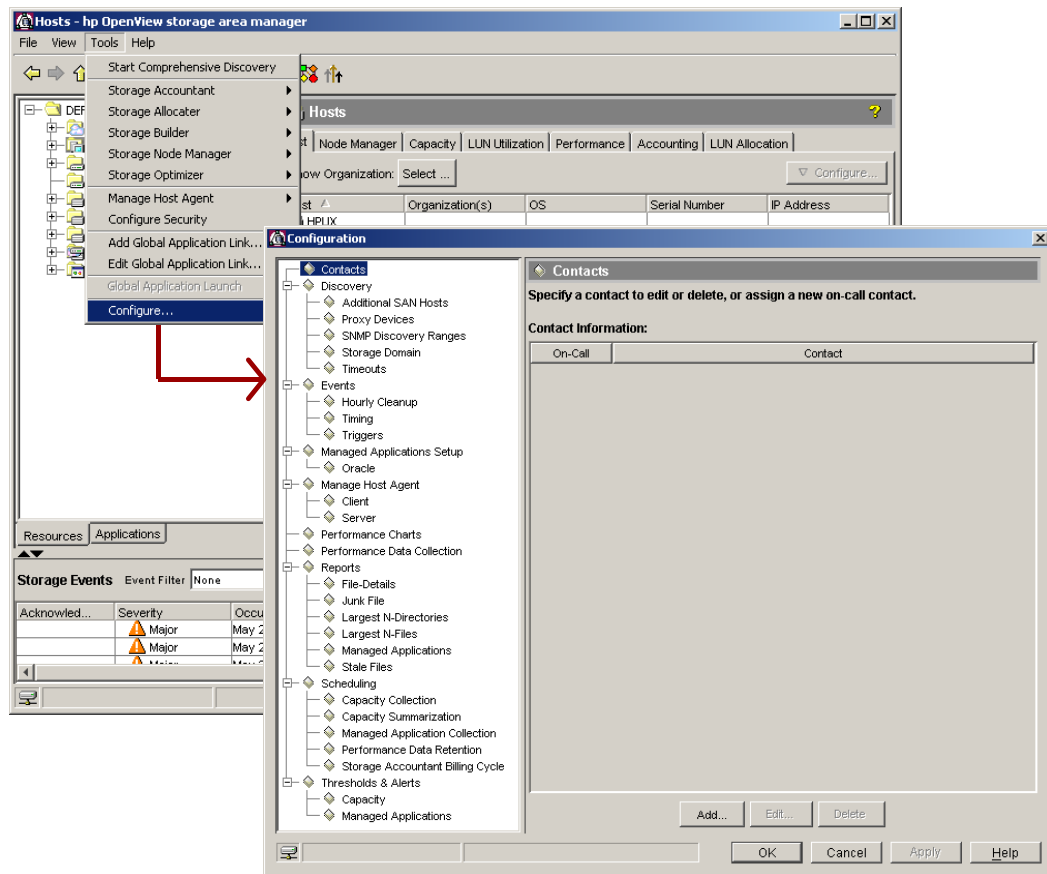
## Cloning arbitrary folders



The cloning feature enables you to add copies of the folder at the same time you add the original folder. For example, you can create a folder named Site A under the Hosts, Interconnect Devices, and Storage Devices nodes.



# Configuration window



The Configuration window enables you to modify and extend the default settings of Storage Area Manager.

This window is designed similarly to the main user interface. Select a menu item in the navigation tree to display its content in the view panel. The menu items available depend on which applications are installed and licensed.

The OK and Cancel buttons at the bottom of the Configuration window are the master controls for all data display in the window. To save any changes made in the window, click the *OK* button before closing the window.

## Command Line User Interface

The command line user interface (CLUI) provides an alternative method to work with Storage Area Manager. Many of the tasks that you perform in the user interface can also be performed from the CLUI.

Like the user interface, the tasks that can be performed within the CLUI are restricted by the Storage Area Manager applications that are installed and licensed and by the privileges assigned to the user name that you use to log in to the CLUI.

To launch the CLUI from the management server

1. At the management server, open a command window.
2. Change to the directory in which the CLUI resides by entering

```
cd "Program Files\Hewlett-Packard\sanmgr\client\bin"
```
3. Launch the CLUI by entering

```
ovsam server
```

The following message displays

```
Connected to HP Storage Area Manager management server
On host localhost.
ovsam:server@localhost>
```

---

**Note**

The CLUI can also be launched from the management client.

---

For complete details see the Storage Area Manager CLUI Reference Manual available at [http://ovweb.external.hp.com/lpe/doc\\_serv/](http://ovweb.external.hp.com/lpe/doc_serv/)

### Common Commands

Command	Description
commandListing	Displays purpose and brief usage for the specified command
help	Displays help and usage summary for the specified command, or if no command is specified returns general help for the Storage Area Manager CLUI
listCommands	Lists all commands associated with the specified help keyword, or if no keyword is specified lists all commands
listHelpKeywords	Lists all help keywords with which commands may be associated
man	Displays detailed help and usage description for the specified command, or if no command is specified returns detailed help and usage for the Storage Area Manager CLUI
ovsam	Launches the Storage Area Manager CLUI. May also be used to start Storage Area Manager user interface
purpose	Displays brief statement of purpose for the specified command
usage	Displays usage summary for the specified command

## Learning check

1. As Storage Area Manager discovers and maps devices in the environment, it places them in the Resources tree and organizes them as storage networks (SAN-1, SAN-2, and so on.). Each storage network is an island of Fibre channel connectivity.  
☐ True  
☐ False
2. List the SAN host requirements for accurate physical mapping.  
.....  
.....  
.....
3. Describe the purpose of Storage Area Manager organizations.  
.....  
.....  
.....
4. Storage Area Manager provides the following three user groups: guest, administrator, and super user.  
☐ True  
☐ False
5. Storage Area Manager device status levels include all of the following EXCEPT
  - a. Unknown/unreachable
  - b. Normal
  - c. Warning
  - d. Critical
  - e. Offline



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# Core Services/Storage Node Manager architecture

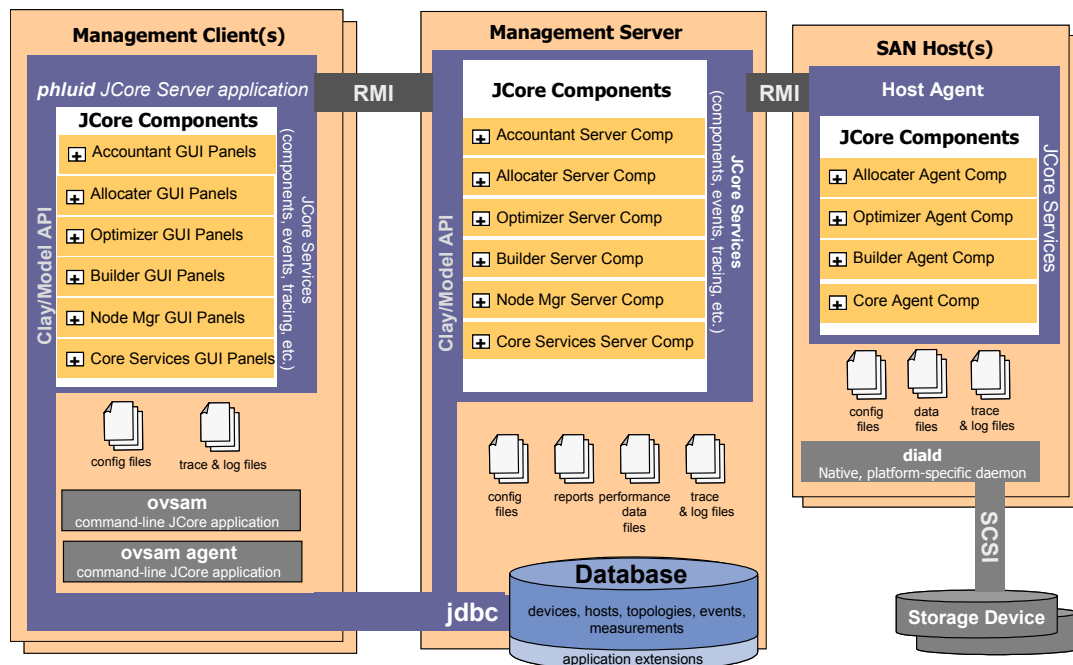
## Module 3

### Objectives

After completing this module, you should be able to:

- Describe the high-level architecture of Storage Area Manager.
- Identify the functions of the Storage Area Manager Core components residing the management server, SAN host, and management client.
- Identify the functions of the Storage Node Manager components residing the management server, SAN host, and management client.
- List the key services/processes that run on the management server and SAN host.
- Describe how the Storage Area Manager discovery process works.
- Describe how the Storage Area Manager event process works.
- Describe the method for integrating new devices into Storage Area Manager after initial product installation.

## Storage Area Manager high level architecture

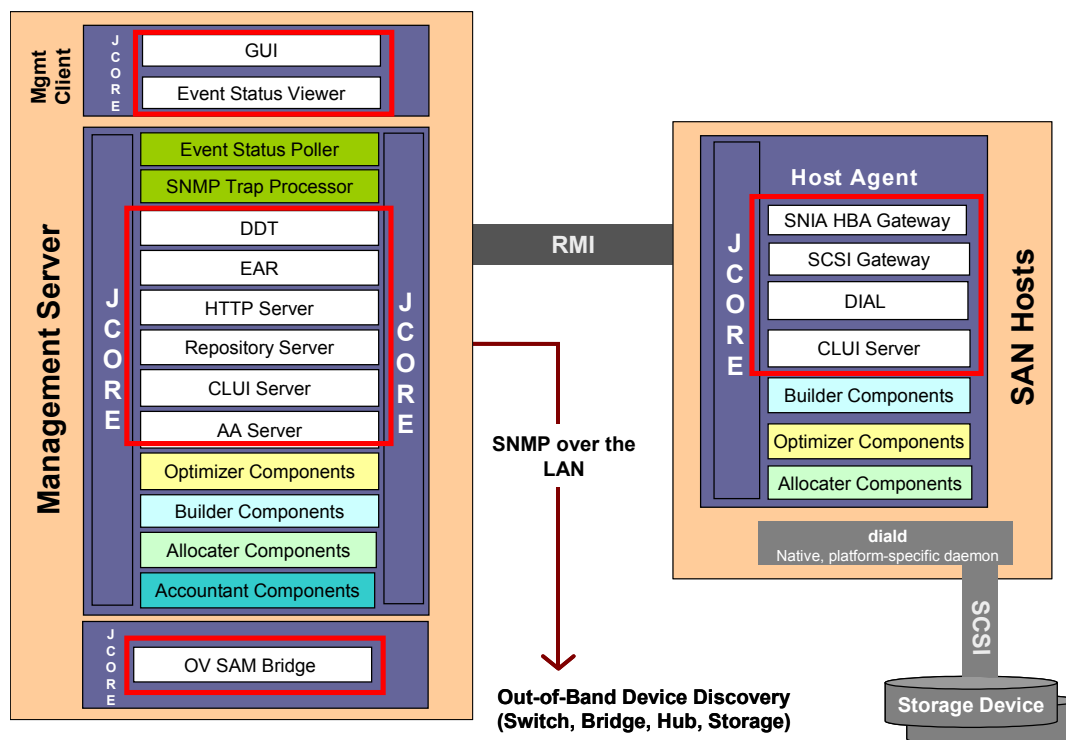


Three major technologies are used in the Storage Area Manager framework:

- **Jcore** — proprietary Java technology that facilitates the component-based and distributed nature of the product. It also offers a suite-wide means for achieving tasks such as logging and tracing, licensing, inter-process event delivery, component-lookup, task scheduling, and so on.
- **Clay** — repository and data model Applications Programming interface (API). Most of Storage Area Manager's information is stored in a central repository that resides on the management server. This repository is a relational database that is remotely accessible to Java calls via JDBC.
- **Phluid** — proprietary platform for building Java applications with a Windows Explorer-type interface. It is the integration framework of the Storage Area Manager GUI. It provides a consistent look and feel throughout the product suite.

These three technologies are fundamental to Storage Area Manager, though could easily be used or reused by other products that have nothing to do with storage management. For example, other products within HP are beginning to use these technologies.

## Core Services component architecture overview



The above diagram illustrates the Core Services Jcore components that reside on the management client, the management server and each of the SAN Hosts.

On the left is the *management server*. The *management client* is comprised of the Graphical User Interface (GUI) and the Event/Status Viewer. This diagram shows the management server and management client installed on the same server (default) though the management client can also be installed independently, on other systems.

The components installed on the management server run as two separate Jcore applications or processes. The first includes the GUI and the Event/Status Viewer. The second application includes the following components: Device Discovery and Topology (DDT), the Event Action Receiver (EAR), a web server, the Repository Server or database, the Command Line User Interface (CLUI) Server, the Access Authorization Server (AA Server) and components for Storage Builder, Storage Optimizer, Storage Allocator and Storage Accountant.

The Host Agent JCore application runs on each SAN host and is comprised of the following components: Device Information Abstraction Layer (DIAL), SCSI Gateway, CLUI Server, and the AutoUpdate Component.

The JCore framework unites all of these Java components into a single virtual machine, which allows resources to be shared and for all of the components to run as a single process.

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**Note**

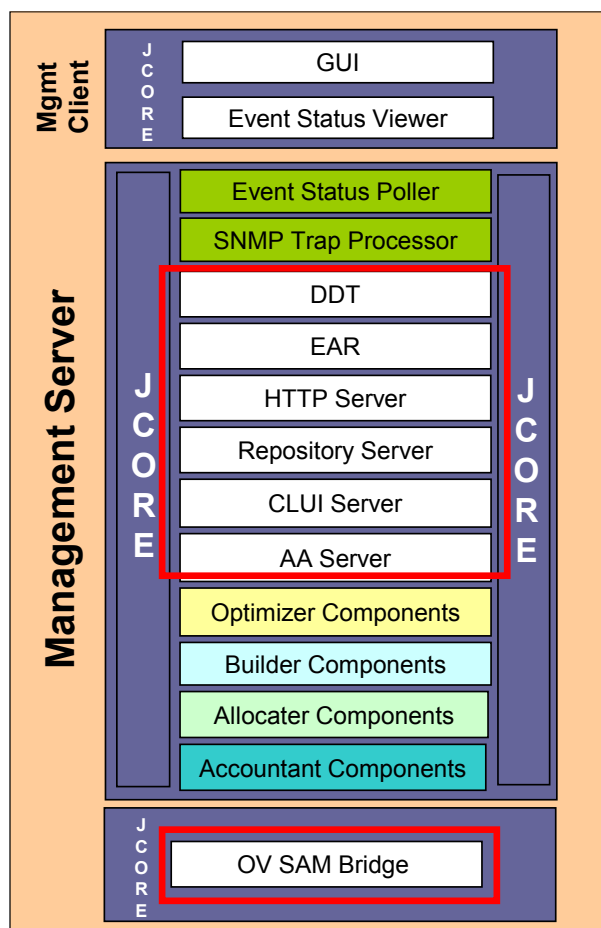
The host agent software can be installed on the management server if it is connected to storage that needs to be monitored.

---

The management server communicates with the SAN hosts using Remote Method Invocation (RMI).



## Core Services management server components



This section covers the Core Services components that reside on the management server. The architecture of the Optimizer, Builder, Allocator, and Accountant components that reside on the management server are covered in modules for each application.

### Device Discovery and Topology (DDT)

DDT searches for SAN hosts, interconnect devices, and storage devices. The discovery process is running continually in the background. Additionally, discovery can also be triggered manually from the GUI. The discovery process has several key components, including:

- Discovery of SAN Hosts:** The management server attempts to discover all SAN hosts (hosts in the environment with Storage Area Manager Host Agent software installed) using TCP. Discovery is performed using a registry-based lookup service that has been architected to allow for the possibility of additional discovery protocol plug-ins in the future (for example, LDAP, WSDL, SLP).

- **Storage device discovery through SAN host(s):** The primary means of discovering storage devices is through SAN hosts via the DIAL discovery engine. DDT discovers the low-level pieces by communicating with the DIAL proxy agents and MIB agents. Once it gathers the attributes of all discovered devices, it determines the topologies that the interconnections of those devices represent.
- **SNMP discovery of storage and interconnect devices:** This process discovers any IP-based storage elements, such as storage devices, infrastructure devices, and Command View XP applications. For this process, the user specifies an IP address or range of addresses in the GUI. For each address, Storage Area Manager attempts to connect, and if the connection is successful, the address is added to a list of “alive” devices. Additional information is gathered, such as *sysobjectid*, from each alive device to enable a more detailed identification.
- **User Specified Host Discovery:** Users may also specify a host using the IP address or host name in the Storage Area Manager *Configuration* window under *Additional SAN Hosts*. Storage Area Manager then knows to contact the device directly to request device information.

## Event Action Receiver (EAR)

The EAR component acts as a funnel that all events go through. It receives events from in-band devices from the Storage Node Manager Event Status Poller (ESP) component and events from out-of-band devices from the Storage Node Manager SNMP Trap Processor (STP) component.

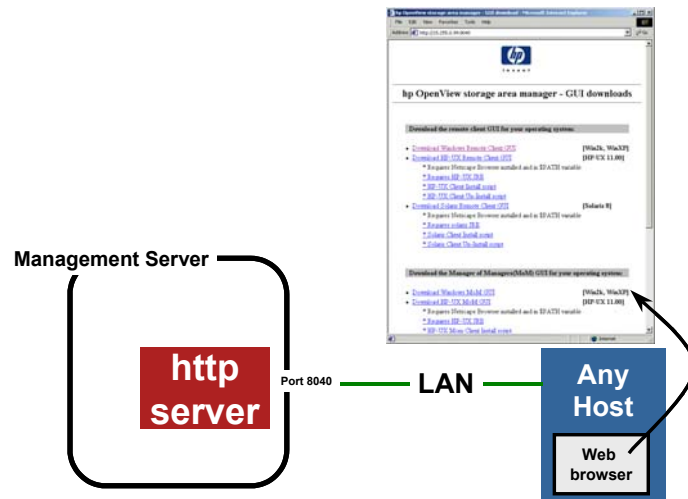
Upon receiving events, EAR matches the events with factory default and user-defined *triggers* and then performs the associated *action*. Common actions include:

- Storing the event in the repository
- Sending an event notification to the SAN administrator on-call
- Running a command
- Forwarding an SNMP trap to other management framework applications

## HTTP Server

The HTTP Server is a very basic web server for the Storage Area Manager. The HTTP port is 8040. It provides two main functions:

- It allows access to the Storage Area Manager GUI Download page through a web browser. This page enables installation of the Management Client, SAN Host, and MoM software on a remote system. Additionally, it enables the client to be authorized to access the management server.



- It allows an Internet Usage Manager (IUM) Collector to read files via HTTP. These files contain LUN and volume usage information that IUM uses for billing and charge-back.

## Repository Server

The Repository Server is the database management component of Storage Area Manager. Solid FlowEngine 3.7 is used as the SQL-compliant embedded data store and provides a standard interface used by the Repository Server.

The Repository Server stores and retrieves user, application, system configuration, Fibre channel device, and logical data, and maintains this information in the backup database.

The Repository Server provides the RMI Java interfaces used by other Storage Area Manager components. RMI is the initial connection layer that enables the Repository Server to communicate with the other modules. Requests to store and retrieve information are received from other modules using RMI. Once storage or retrieval is successful, events are sent to other components using RMI. The components that store data in the database include: DDT, EAR, and the GUI.

When the Repository Server starts, it does an integrity check against the corresponding configuration file stored in the database. Any inconsistency causes an error in the Repository Server. If an error occurs, the Repository Server exits.

The Repository Server uses JDBC (Java Database Client) to convert Java objects into an SQL statement that can be interpreted by the SOLID Server. The JDBC interface allows for future support of other JDBC and SQL-compliant embedded database systems. The SOLID JDBC driver adheres to the Sun Microsystems standard.

Note that Storage Optimizer performance data is not stored in the repository but is stored in a flat-file system.

## Command Line User Interface Server

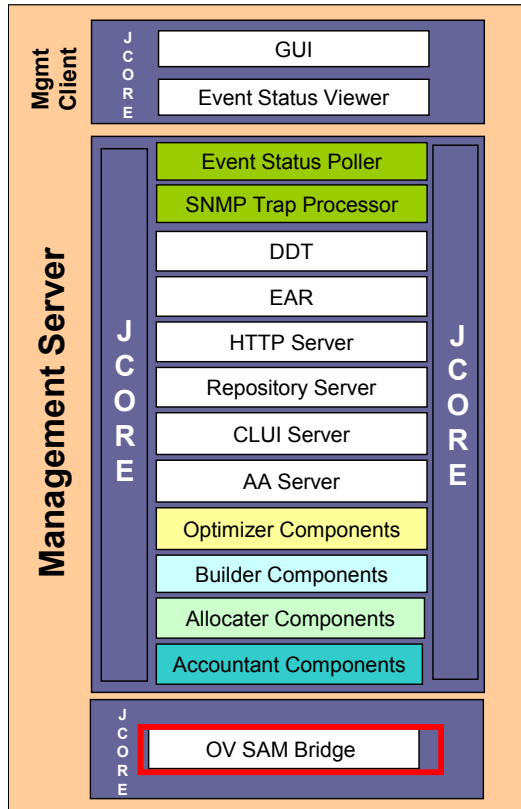
The Command Line User Interface (CLUI) Server allows remote management clients the ability to initiate command-line functionality that is then executed on the management server. Additionally, the CLUI Server allows product-specific command line handlers to be plugged-in at startup. The CLUI server accepts command line arguments from the CLUI Client over RMI, and then executes the appropriate command line handler. The CLUI server also provides the handler with an output and error stream such that the execution results are sent back to the initiator display.

## Access Authorization Server

The Access Authorization (AA) Server controls Storage Area Manager security; keeping track of all users and permissions. It restricts access to only validated clients. Storage Area Manager provides two levels of access privileges:

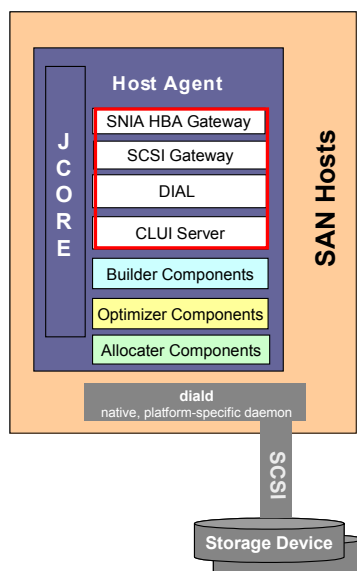
- Read-Only
- Read/Write Authorization access changes are dynamically updated.

## Storage Area Manager Bridge



The Storage Area Manager Bridge is a web server application that allows other applications access to Storage Area Manager's functionality. This access enables tight integration with enterprise applications. Currently, Storage Area Manager provides out-of-the-box integrations with several HP OpenView products. The bridge is able to consolidate information from multiple management servers for use by the application integrating with the bridge. The bridge is automatically installed on the management server when you install Storage Area Manager.

## Core Services components on SAN hosts



Each SAN host requires a set of components that discover storage devices and provide the communication interface to the management server

Components residing on each SAN host include:

- SNIA HBA Gateway
- SCSI Gateway
- Device Interface Abstraction Layer (DIAL)
- CLUI Server

### SNIA HBA Gateway

The SNIA HBA Gateway provides an interface that gathers Port and Node WWN information, as well as provides a way to send SNIA pass-thru commands. The Port WWN is used to estimate how many ports are on devices that do not have Device Plug Ins (DPIs) and the Node WWN is used to improve discovery and mapping of devices without a DPI.

### SCSI Gateway

The SCSI Gateway component provides an API that allows permitted host systems to send SCSI inquiry commands to, and receive data from, any of the discovered storage devices. This interface is used by the management server and third-party applications to gather more detailed information than that is provided by DIAL.

DPIs on the management server use RMI to access the SCSI Gateway component on the SAN host which issues remote commands to SCSI devices.

## Device Interface Abstraction Layer (DIAL)

The DIAL component gathers device identification information. Specifically, DIAL does in-band, fibre channel and SCSI discovery. Its purpose is to discover device LUN paths, HBAs, and get up/down status for device LUN paths. It is installed on each SAN host and each platform has its own version. The management server uses XML over RMI to communicate with DIAL. One of DIAL's key features is the persistent database. When the management server is rebooted, DIAL checks against its database to see if there have been any changes but it doesn't go through the entire discovery process again.

### DIAL discovery process

The DIAL discovery process is made up of four steps:

1. DIAL gathers a list of attached devices. The method for determining attached devices is OS dependent.
  - HP-UX: `ioscan -kFn` is used to determine the attached devices
  - Solaris 2.6: A combination of system commands and system files are used to determine what devices are attached. These include: `prtconf` and `/etc/name_to_major` `/etc/path_to_inst`.
  - Solaris 7 and above: A system provided API (`libdevinfo`) is used to walk down the I/O nodes and identify attached devices.
  - Linux: A custom shared library (`libuser.so`) that provides an interface to the SCSI layers within the Linux kernel is used to determine which devices are attached.
  - AIX: The Online Device Manager (ODM) database is used to determine attached devices.
  - Windows: A system provided API (`QueryDosDevice`) is used to list the HBAs. The HBAs are then queried for the devices attached.
  - Tru64: A system provided API called the Kernel Set Manager (KSM) API is used to browse through and identify the attached devices.
2. DIAL uses an in-band pass thru mechanism to send information gathering commands to each device. Commands issued include:
  - Standard Inquiry, Page 0x80 Inquiry (serial number)
  - Page 0x83 Inquiry (device identification)
  - Read Capacity (size/capacity of disk/direct access devices)
3. After all LUN paths are determined, DIAL retrieves the status of each LUN path by issuing a Standard Inquiry command.
4. All of the obtained information (discovery, device information, and status) is stored in the DIAL persistent database.

## DIAL processes and services

On Unix SAN hosts, the DIAL discovery process (all four steps) runs in a single process called *diald*.

On Windows SAN hosts, it runs as service called *opendial.exe*. When the service is started or stopped, the corresponding *diald* process starts or stops as well. The *opendial.exe* service also monitors *diald* to ensure the process is running and healthy. If not, it will restart *diald*.

On Unix SAN hosts, there is a similar service called *hostwatchdog*.

## DIAL timing and CPU usage

By default, DIAL discovery is initiated every 19 minutes. By default, status is obtained every seven minutes.

Both poll intervals are configurable and are located in `config/dial.cfg`.

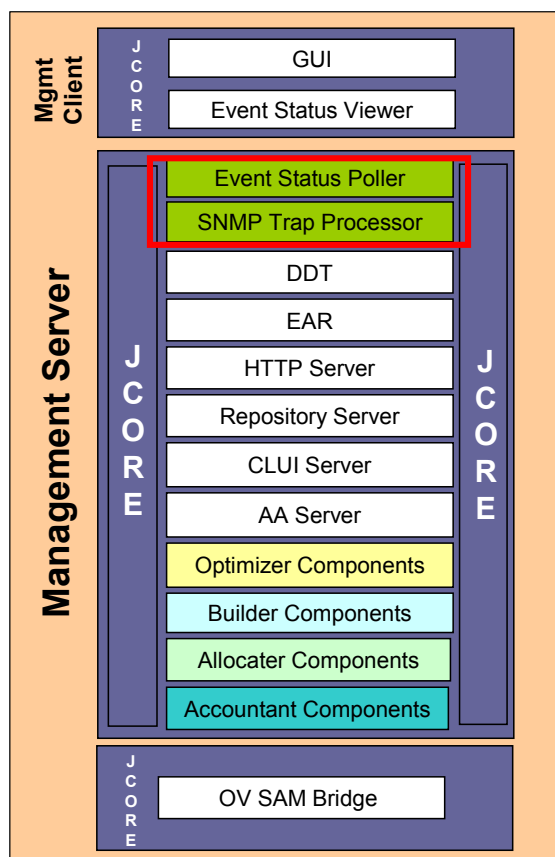
The *diald* process has a very minor impact (usually below 1% CPU usage during idle periods and 2-3% during discovery/status).

## CLUI Server

The CLUI Server also resides on the SAN host. Its purpose is to allow remote execution of command lines.



## Storage Node Manager components



With the exception of the GUI panels, all of the Storage Node Manager JCore components reside on the management server. They include:

- Event Status Poller (ESP)
- SNMP Trap Processor (STP)

### Event Status Poller (ESP)

ESP provides two main functions:

- It uses the *device interface* of each discovered storage network device's DPI to poll periodically for the device's status. This provides a centralized, host-independent method of gathering this information. The status value returned can have six different values, reflecting six levels of concern about the health of the device
- It uses the events interface of each discovered storage network device's DPI to poll periodically for any "events" that have occurred recently on the devices. This polling is necessary because many storage network devices have no asynchronous method (for example, sending SNMP traps) of communicating events to Storage Area Manager.

## SNMP Trap Processor (STP)

The STP component registers for, and receives asynchronous events from SNMP-managed devices in the form of SNMP traps. It uses the *SnmpEvents* interface of the DPI to improve the readability of the event text. When an SNMP trap is received from a device, STP calls a method in the interface to get user-friendly text describing the event that occurred. It then passes this information as a storage event to the Core Services EAR component, which stores it in the database, and optionally invokes a user-configured action (for example, sending an email).

The STP component attempts to place the IP address of the management server into each device's list of addresses which traps should be sent. Since there is no standard SNMP MIB that provides this functionality, this is only possible with devices that have DPIs, and some of these devices do not support the setting of this information via SNMP. Therefore, some SNMP-managed devices will require the user to manually configure the address of the management server, and they may require manual setting of other properties such as enabling SNMP trap sending, or setting the severity level of problems that will be reported via SNMP traps.

## DPIs

DPIs are comprised of three components:

- **Property File:** A property file is a plain text file associated with a specific device. Its required values that enable Storage Area Manager to recognize devices, place them in the directory tree, and display icons. Optional values allow Storage Area Manager to display an image of the device, to launch a device management application, and to access a DPI Core Class.
- **Discovery Code:** Discovery code tells Storage Area Manager how to uniquely recognize a device. The discovery code may either be standard or be an optional custom Discovery Class.
- **DPI Core Class:** The DPI Core Class defines the level of information Storage Area Manager can provide about a device. The information available is device dependent and may included detailed events, performance and capacity information.

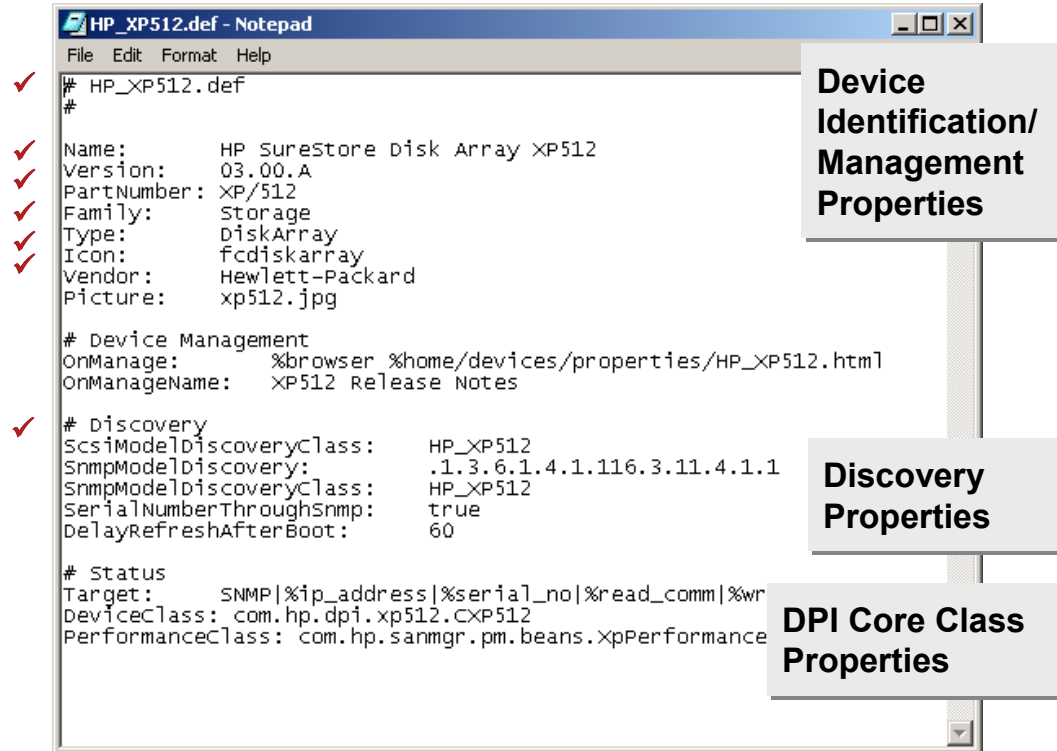
### Integrating new devices between releases

Hewlett-Packard creates new DPIs on an on-going basis. To add support for devices after initial product installation, download DPIs from the HP Openview DPI website at <http://openview.hp.com/products/sam/index.asp>.

Additionally, customers and external vendors can create DPIs to fit their immediate needs by using the Storage Area Manager Software Developer's Kit (SDK). Download the SDK from [http://www.openview.hp.com/partners/developers/General\\_HTML-218.asp](http://www.openview.hp.com/partners/developers/General_HTML-218.asp).

Customers and external vendors work closely with Hewlett-Packard in creating a DPI. Once the DPI is created and approved by Hewlett-Packard, it is posted on the HP OpenView DPI website.

## Example property file



✓ = Required values

The property file is a plain-text file that contains three distinct sections: *Identification/Management*, *Discovery*, and *Status*.

Required values enable Storage Area Manager to identify detected devices, to place them in the proper branch of the directory tree, and to display representative icons. Optional values allow Storage Area Manager to display an image of the device, to launch a device management application, to instantiate custom DPI and discovery classes, and more.

The *Identification/Management* section is a required section. It contains property-value pairs that characterize a device model; for example, a Brocade 2800 switch, StorageTek 20/700 tape library, or HP FC60 SureStore Disk Array. Additionally, identifies any device-specific applications that can be launched from the Storage Area Manager GUI. For example, device management applications and device-specific release notes, and so on.

The *Discovery* section is a required section. It is used by Storage Area Manager to determine how the device is discovered and uniquely identified. The format is <DiscoveryType>: <Vendor ID>, where *Discovery Type* is either a *standard discovery method* or an optional *custom discovery class*.

There are two standard discovery methods:

- **ScsiModelDiscovery** — standard SCSI based discovery provided by Storage Area Manager
- **SnmpModelDiscovery** — standard SNMP based discovery provided by Storage Area Manager

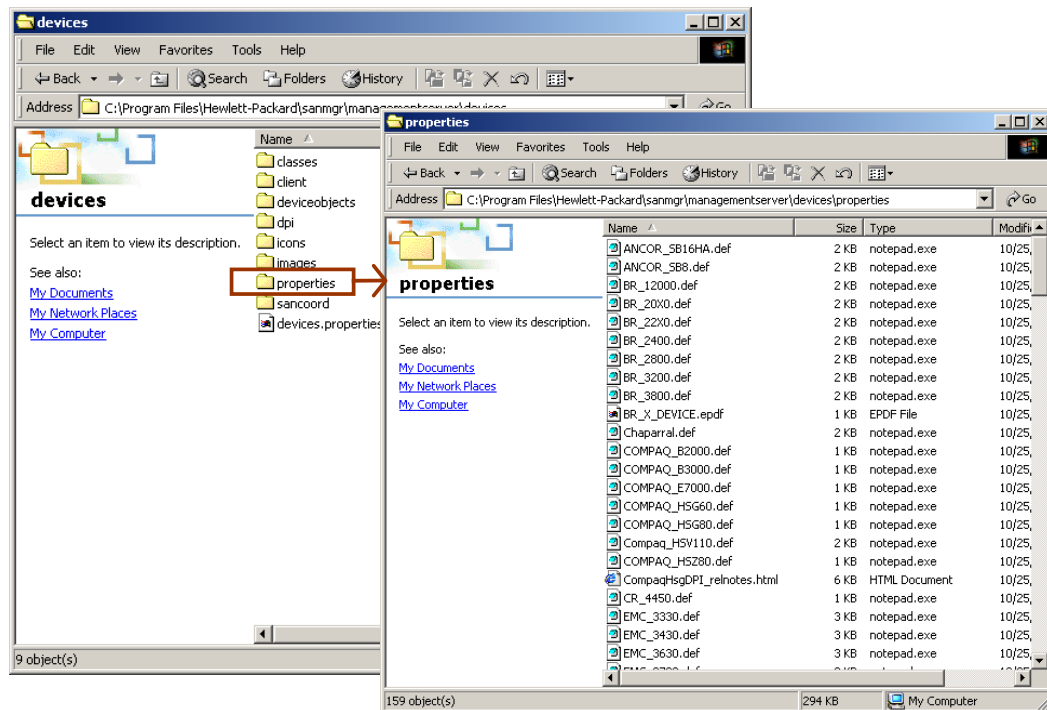
When using optional custom discovery classes, the property file references the following keywords and provides the name of the custom discovery class.

- ScsiModelDiscoveryClass
- SnmpModelDiscoveryClass

The custom discovery class itself must also be provided.

The *Status* section is an optional section. It is used to tell Storage Area Manager where the DPI Core class resides. The *DPI Core Class* an executable .jar file that contains information regarding how to access device-specific information.

## Location of property files



All device specific files are located on the management server  
 sanmgr\managementserver\devices\properties directory.

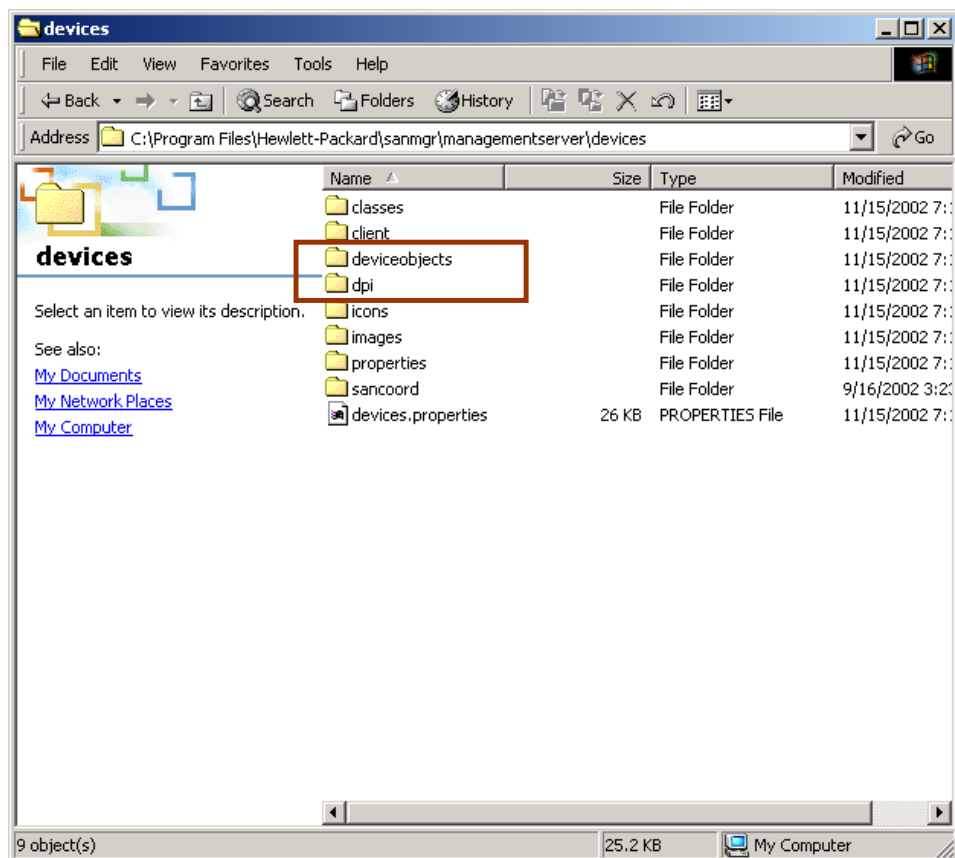
Additionally, if a device has associated release notes, a corresponding .html file will also reside in the properties directory.



### Important

Device-specific release notes are available for those devices that have any special circumstances. To view release notes, right-click the device, either in the tree or the map, and select *devicename Release Notes*.

## Location of DPIs (Core DPI Java Archive files)

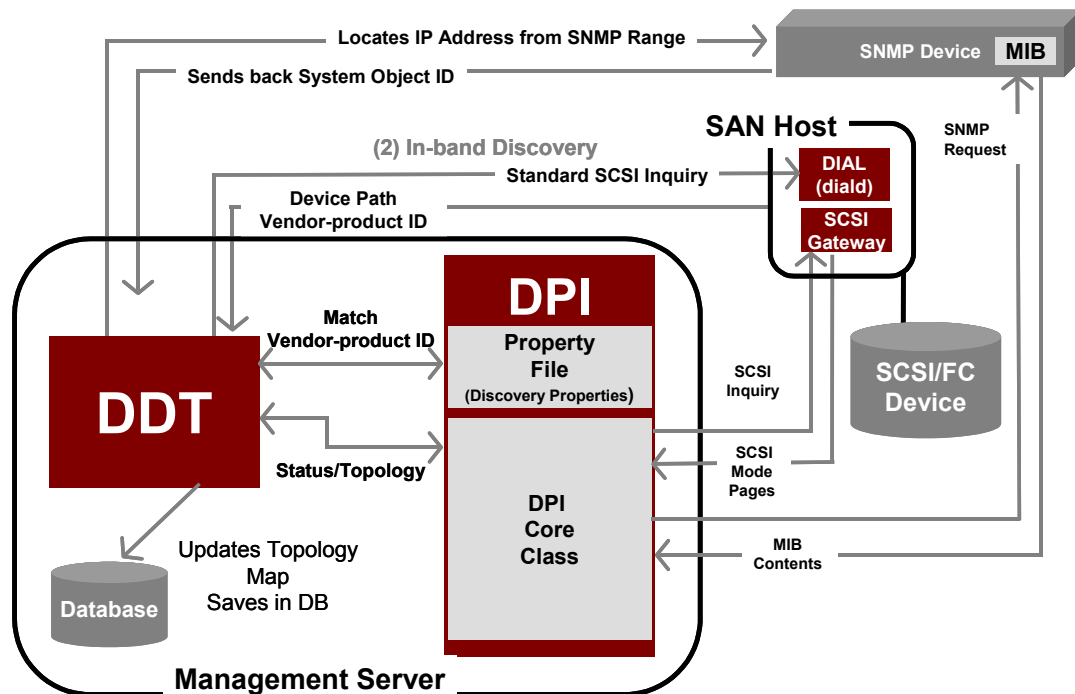


DPIs are stored on management server in two directories:

- \sanmgr\devices\dpi
- \sanmgr\devices\deviceobjects

DPIs for all devices supported by Storage Optimizer reside in the dpi directory; all others are placed in the deviceobjects directory.

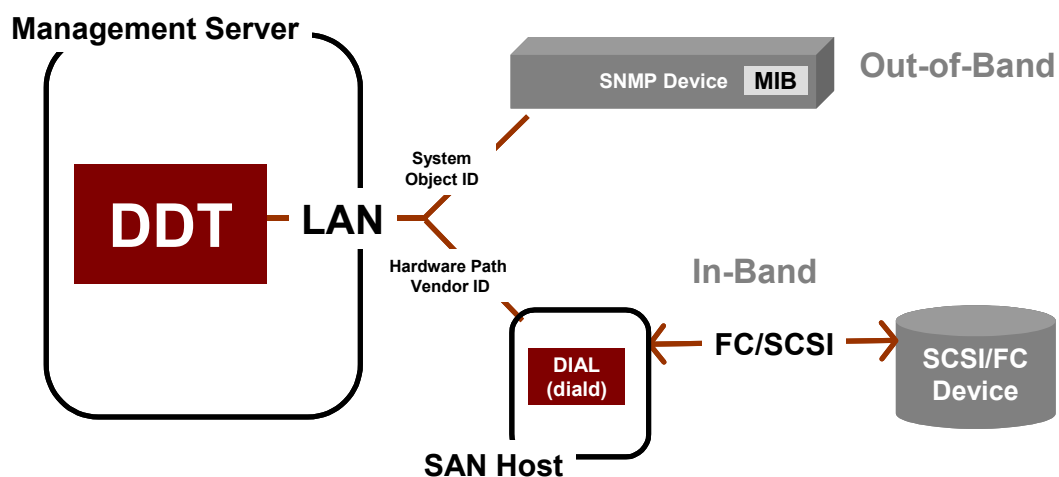
## Device discovery and topology process



The components involved in the Device Discovery and Topology process reside on both the management server and the SAN hosts. They include: DDT, DIAL and the SCSI Gateway. All three components use information contained in the DPI associated with each device.



## Discovery step 1



Step 1 of the device discovery process is performed by the **DDT** component that resides on the management server and the **DIAL** component that resides on each SAN host. OV SAM discovers devices on the storage network by (1) pinging the network for a user-specified range of IP addresses (out-of-band discovery), and (2) sending SCSI Standard Inquiry commands through all hosts with deployed Host Agent software (in-band discovery).

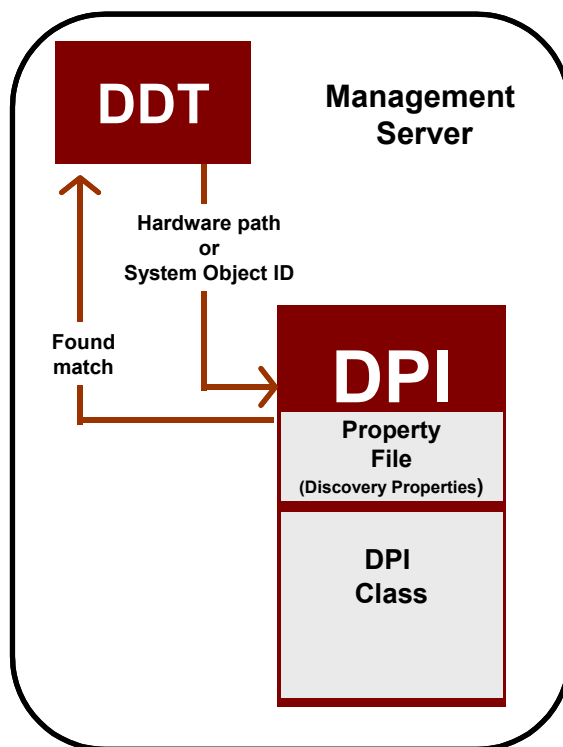
### Out-of-band devices

This process discovers any IP-based storage elements, such as infrastructure devices and some storage devices that support SNMP communication. For this process, the user specifies an IP address or range of IP addresses in the GUI. For each IP address, an attempt is made to connect to the device, and if the connection is successful, the address is added to a list of “alive” devices. Further information is gathered, such as **sysobjetid**, from each alive device to enable a more detailed identification later.

### In-band devices

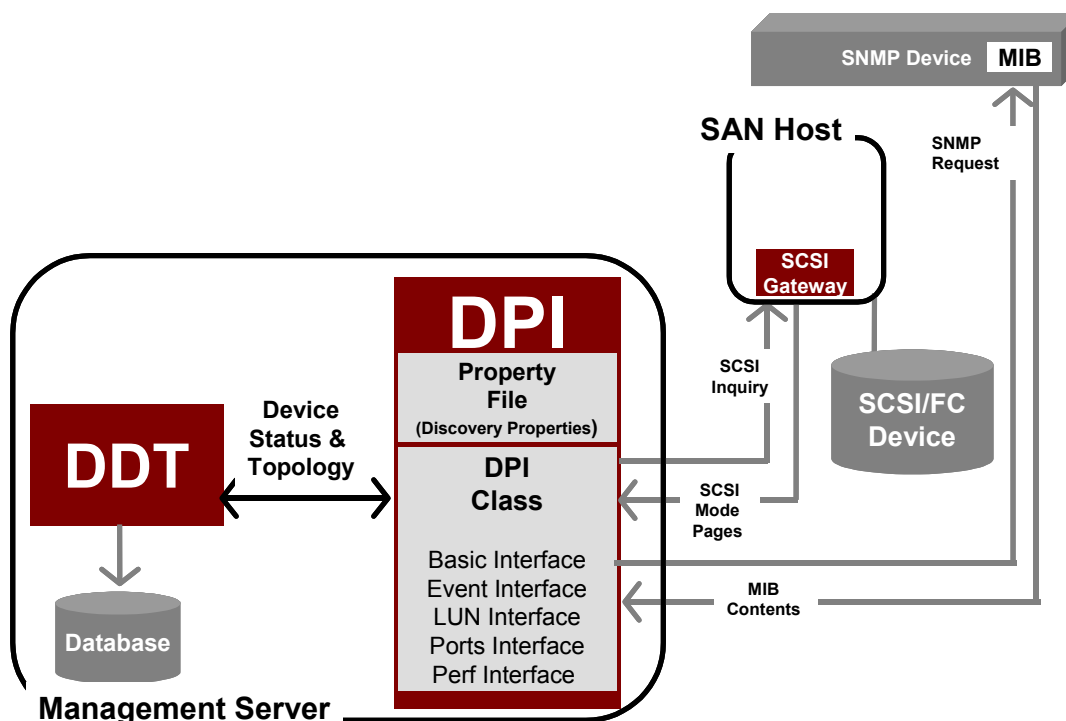
DIAL, which is provided for free on the product CD, is used by Storage Area Manager to gather device identification information. Specifically, DIAL does In-band, Fibre channel and SCSI discovery. Its purpose is to discover device LUN paths, HBAs, and get up/down status for device LUN paths. It is installed on each SAN host and each platform has its own version. The management server uses XML over RMI to communicate with DIAL.

## Discovery step 2



In Step 2 of the Discovery process DDT scans all property files located on the management server attempting to find matches with the devices it knows about. Finding a match identifies the model of the device. If a match is found, DDT generates a identifier for the device. By default, this is done using the IP address of an SNMP device and a concatenation of the vendor-product ID and the serial number of a SCSI device. If a custom discovery class exists, this default unique ID may be overridden.

## Discovery step 3



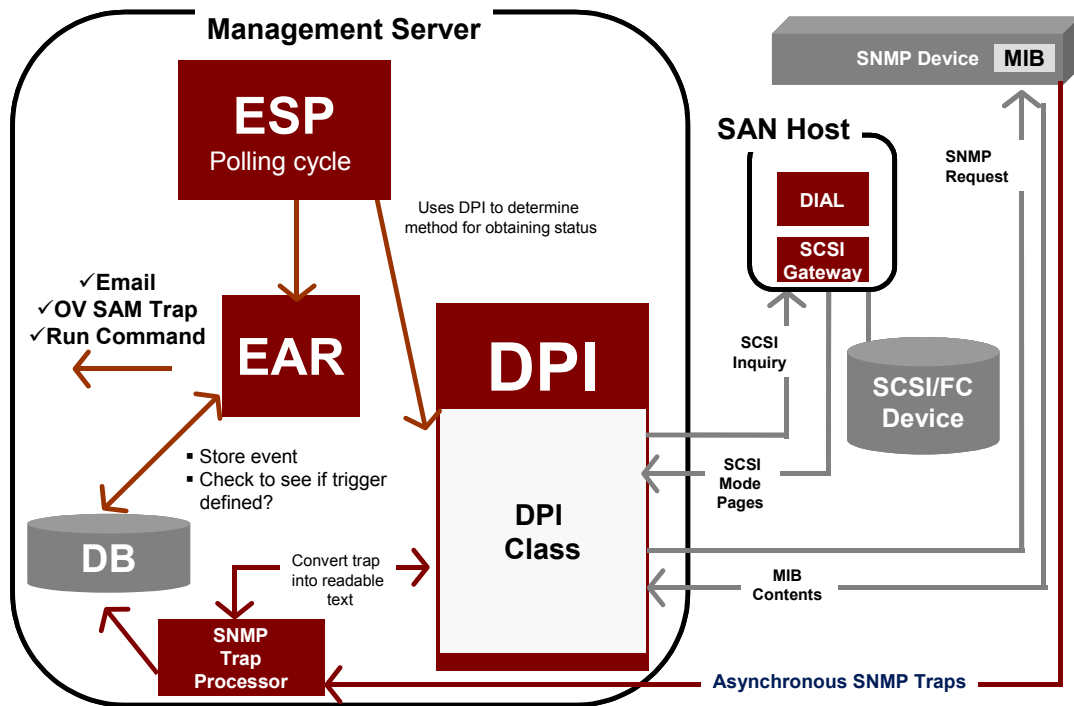
The key components involved in the final step of the discovery process are DDT and the SCSI Gateway. DDT uses the DPI information to determine how to communicate with the device on a more detailed level. For example, the DPI holds the MIB formatting information for SNMP based devices and proprietary SCSI page information for Fibre channel/SCSI devices.

The SCSI Gateway component provides an API that allows permitted host systems to send SCSI inquiry commands to, and receive data from, any of the discovered storage devices. This interface is used by the management server to gather more detailed information than that is provided by DIAL. (DIAL provides identification and up/down status only.)

DDT uses RMI to access the SCSI Gateway component on the SAN host which issues remote proprietary SCSI commands to the attached devices. The detailed device information collected in this step depends on the interfaces implemented in the DPI for the device. For example:

- **Basic Interface:** Reports Status
- **Event Interface:** Generates events if the device becomes unreachable
- **LUN Interface:** Provides mapping between HostLUN and internal name of the storage device
- **Ports Interface:** Identifies the ports on the device
- **Performance Interface:** Provides Optimizer performance data

## The event and status process



Storage Node Manager polls the storage network at defined intervals and reports any status changes that are found at both the link level and the device level.

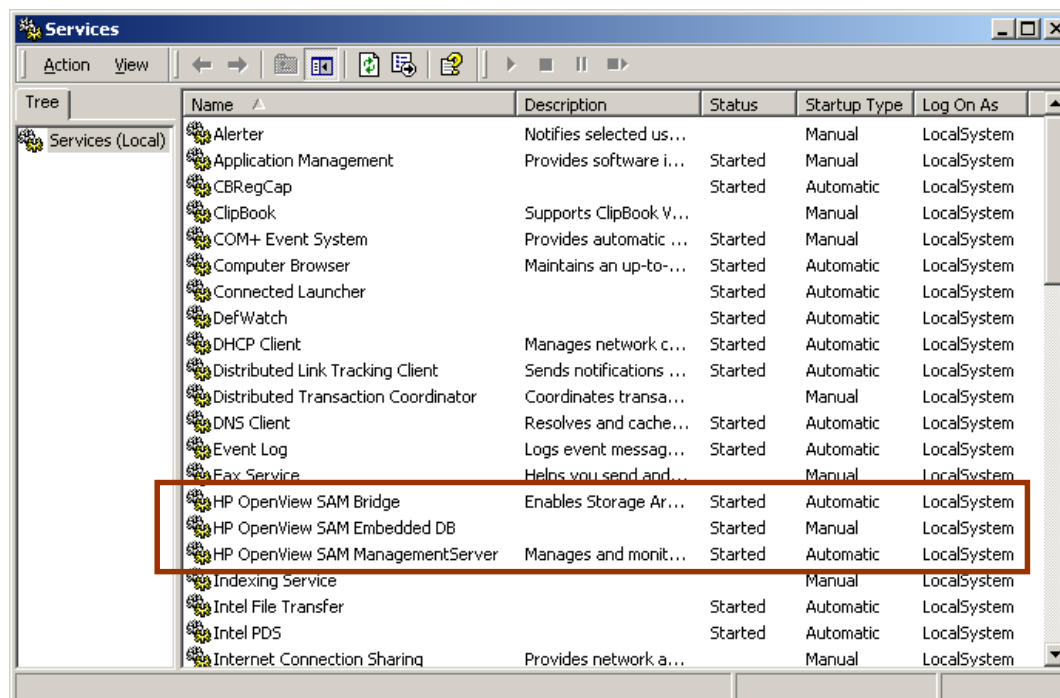
The same “pipe-line” is used in obtaining this link and device status that is used in the discovery process. The only difference is that it is initiated by the Storage Node Manager ESP component. The other component involved in event processing is the Core Services EAR.

ESP is made up of two sub-components: the Status Poller and the Event Poller. The Status Poller runs every 10 minutes by default, and uses the DPI to obtain the method for collecting status:

- In-band status is obtained using the SCSI Gateway
- Out-of-band status is obtained asynchronously using SNMP Traps or using the MIB contents

The Event Poller retrieves device events and passes them to the EAR. The EAR checks to see if an event trigger that matches the incoming event has been defined. If it has, the EAR executes the association action.

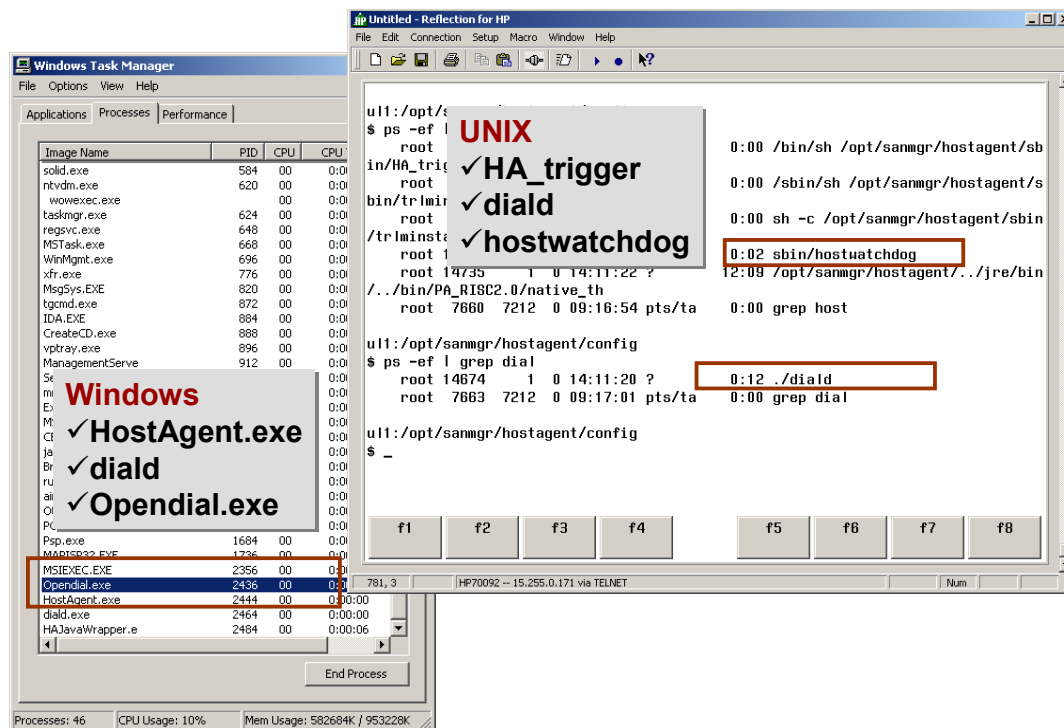
## Management server services



Three services run on the management server on an on-going basis:

- **Bridge** — a web server application that allows other applications access to Storage Area Manager's functionality. This access enables Storage Area Manager tight integration with other HP OpenView enterprise applications. The Bridge is also able to consolidate information from multiple management servers for use by the application integrating with the Bridge. The Storage Area Manager Bridge is automatically installed and started during installation.
- **Embedded DB** — controls SOLID database used for the Storage Area Manager repository.
- **ManagementServer** — provides a bulk of Storage Area Manager functionality (discovery, event management, and so on)

## Host Agent processes



Several processes/services run on each SAN host. The process/services are operating system dependent and are responsible primarily for in-band device communication using the DIAL component.

The processes/services that run on Windows SAN hosts include:

- HostAgent.exe
- diald.exe
- Opendial.exe
- HAJavaWrapper.exe

The processes that run on Unix SAN hosts include:

- HATrigger start/stop
- Diald
- Hostwatchdog

## Directories and content

The following directories reside on the management server in the `\sanmgr\managementserver` directory:

### Management server directories and content

Directory	Contains
<code>\apps</code>	Information needed for launching other applications from the GUI
<code>\config</code>	Configuration files for each Storage Area Manager software component. Also, <code>authorizedclients.dat</code>
<code>\data</code>	Data stored by other components such as Storage Builder
<code>\db</code>	SOLID database and event database
<code>\depots</code>	OS-specific files required for Host Agent software deployment
<code>\sanmgr\devices</code>	Property and class files for devices supported at this release. May also include 3 <sup>rd</sup> party files via SDK
<code>\doc</code>	Documentation
<code>\events</code>	User-defined event action Java files
<code>\help</code>	Online help files
<code>\lib</code>	Java .jar files
<code>\logs</code>	Log files for each of Storage Area Manager components
<code>\newconfig</code>	Default configuration files
<code>\sbin</code>	Support commands
<code>\solid</code>	SOLID database executable
<code>\webroot</code>	Data used by the web server

The following directories reside on the management client in the `\sanmgr\client` directory:

### Management client directories and content

Directory	Contains
<code>\bin</code>	Internal product commands
<code>\config</code>	Management client configuration files
<code>\doc</code>	Documentation
<code>\help</code>	Online help files
<code>\lib</code>	Java .jar files
<code>\logs</code>	Management client log files
<code>\sbin</code>	Support commands

The following directories reside on Windows SAN hosts in the \sanmgr\hostagent directory:

### Windows SAN host directories and content

Directory	Contains
\config	Configuration files including access.dat which lists the management server authorized for communication
\data	path.xml
\hostagent\log\	dialog.log dialevents.log HostAgent.log

The following directories reside on Unix and Linux SAN hosts:

### Unix and Linux SAN host directories and content

Directory	Contains
/opt/sanmgr/hostagent/	Configuration files including access.dat which lists the management server authorized for communication
/var/opt/sanmgr/hostagent/dial /data	path.xml
/var/opt/sanmgr/hostagent/dial /log	dialevents.log dialog.log
/var/opt/hostagent/log	HostAgent.log



## Learning check

1. Match the Storage Area Manager component with its description.
 

a.	AA Server	.....	Receives and processes events
b.	Bridge	.....	Basic web server that allows access to the GUI download page
c.	DDT	.....	Key host agent component that does in-band, Fibre channel and SCSI discovery
d.	DIAL	.....	The database management component
e.	EAR	.....	Host Agent component that that gathers Port and Node WWN information, as well as provides a way to send SNIA pass-thru commands
f.	SNIA HBA Gateway	.....	Management server component that handles discovery and figuring out the topology
g.	HTTP Server	.....	Controls security; keeps track of all users and permissions
h.	Repository Server	.....	A web server application that allows other applications access to Storage Area Manager's functionality. This access enables Storage Area Manager tight integration with other HP OpenView enterprise applications
  
2. What is the primary method Storage Are Manager uses to discover SAN hosts?  
 .....

3. The three major technologies used in the Storage Area Manager framework are
  - a. RMI, SNMP, DIAL
  - b. Phluid, Jcore, Clay
  - c. Clay, RMI, SNIA
  - d. Jcore, DDT, SNIA

4. Which of the following is NOT true regarding DPIs?
  - a. They are device-specific plug-in components that enable Storage Area Manager to obtain detailed information.
  - b. They are used to discover SAN hosts using multicast.
  - c. DPIs for newly supported devices can be integrated after initial installation.
  - d. They are comprised of the following three components: property file, discovery code, DPI Core class.

5. At a high-level, describe the discovery process.

.....

.....

.....

.....

6. List the two methods ESP uses to collect device status.

.....

.....

7. List the three services that run on the management server

.....

.....

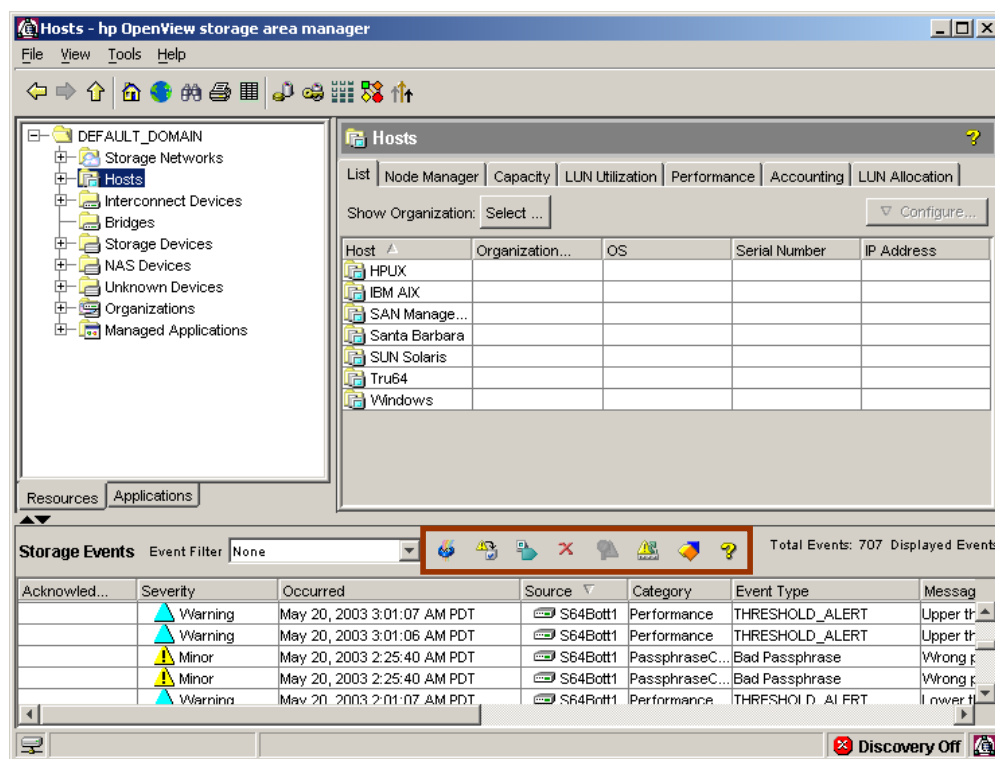
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### Objectives

After completing this module, you should be able to:

- Sort and filter events.
- Recognize event categories.
- Recognize severity levels and their corresponding impacts.
- Delete events manually.
- Configure Storage Area Manager to delete events automatically.
- Export events.
- Configure event triggers and actions.

## Viewing events










By default, Storage Area Manager sorts events by severity level (highest level first). However, you can sort the table by any column, in ascending or descending order.

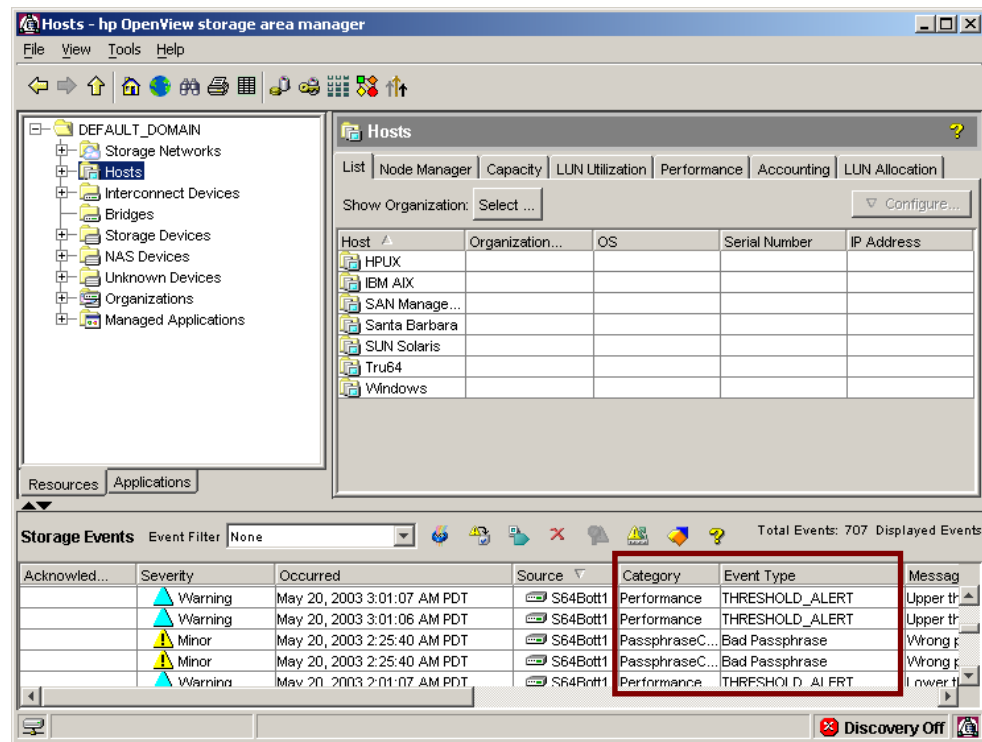
The event toolbar is located at the top of the event panel. It contains icons that enable additional event management tasks.

The following table lists each toolbar icon and its function:

### Event toolbar functions

Icon	Function
	Adds, modifies, or deletes event filters.
	Acknowledges selected events, all events in event panel, or all events in database.
	Exports selected events, all events in event panel, or all events in database to a .txt, .csv, or .xml file.
	Deletes selected events, all events in event panel, or all events in database.
	Displays details of selected event.
	Adds, modifies, or deletes event triggers.
	Displays the event legend.

## Categories and event types

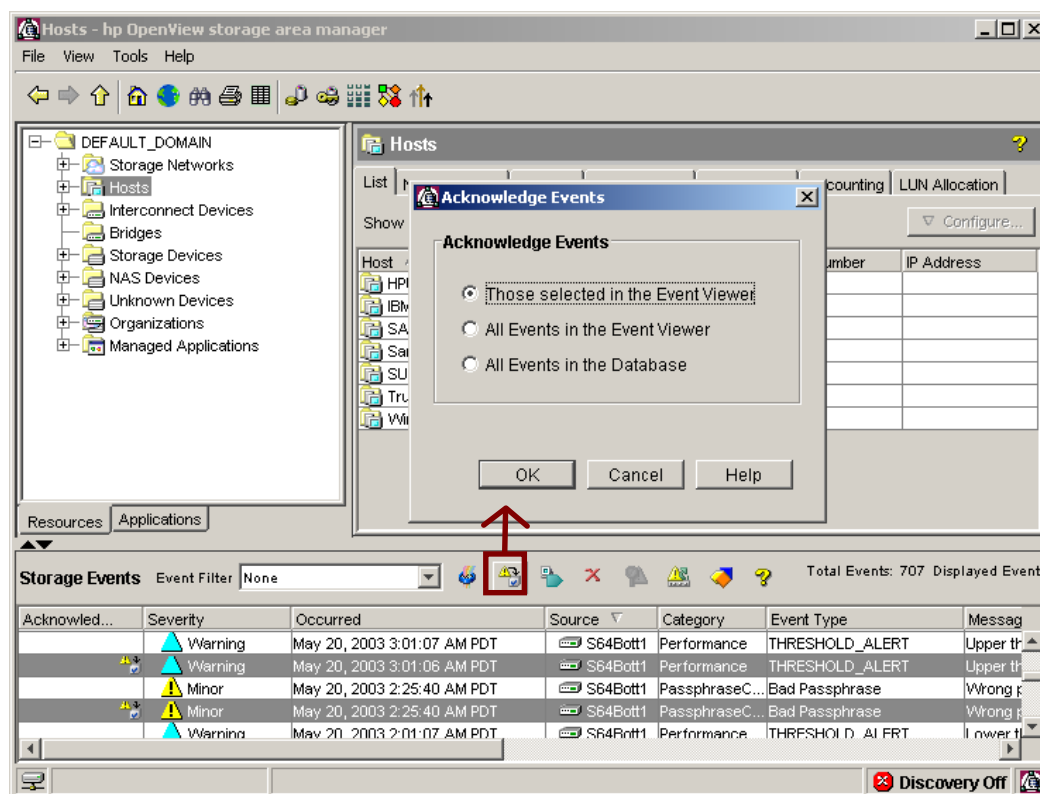


Storage Area Manager defines all events within a category. Event categories describe which area of Storage Area Manager communicated the event message. Specific events are defined within the following event categories:

- Discovery
- Database
- Framework
- Event management
- Model
- Passphrase cache
- Device
- Capacity
- Performance
- Storage accountant
- Allocator

Event categories are used extensively with event triggers.

## Acknowledging events

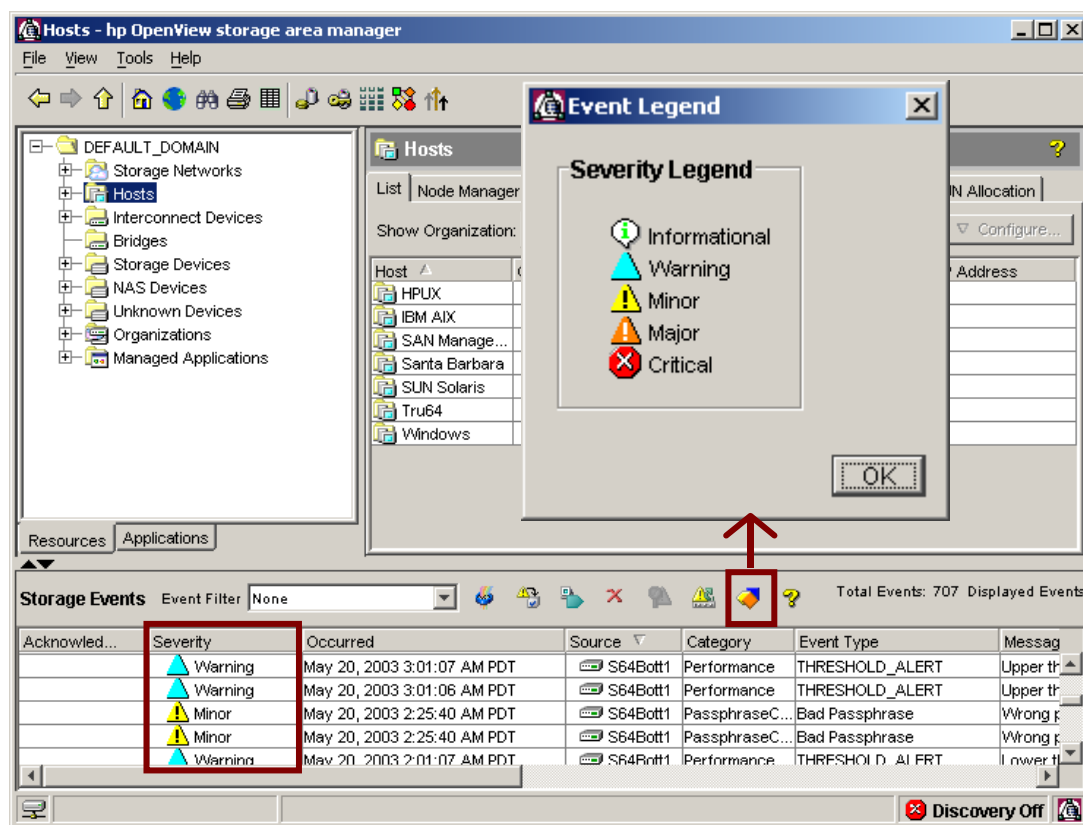


Storage Area Manager's event management system enables you to acknowledge events that appear in the event panel or are stored in the database. For example, if an event has been assigned to a storage administrator, you can mark the event as “acknowledged”.

### Note

Storage Area Manager may have additional events stored in its database that are not displayed in the event panel. For example, if you apply an event filter to the event panel, then only events meeting the filter's criteria display in the event panel.

## Recognizing event severity

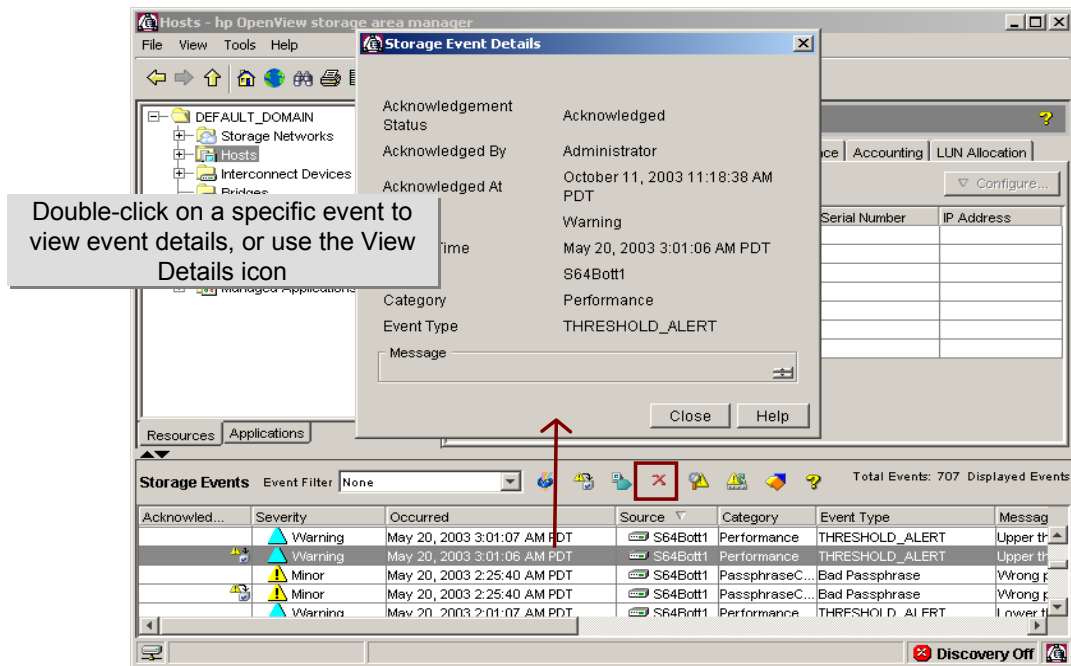


Storage Area Manager defines all events with a severity level. Severity levels do not necessarily correspond to the status of the device displayed in the Source column of the Event panel. The severity level is static for the event at the time it occurred. Device status is dynamic and displays the current status of the device listed in the Event panel.

### Event severity levels

Severity Level	Impact
Information	An event has occurred that is expected as part of the normal operation of the hardware. No action is required.
Warning	A difficulty has been detected that should be corrected. Normal use of the hardware is not affected and escalation to a more severe condition is not likely to occur.
Minor	A potential or impending problem may affect service. Normal use of the hardware is not likely to be impeded, and repair can be scheduled for a convenient time.
Major	Action is required very soon to avoid data loss, system downtime, or other loss of service. It does not imply that any of these conditions has already occurred. Normal use of the hardware may be impeded and repair should occur as soon as possible.
Critical	Immediate action is required to avoid data loss, system downtime, or other loss of service. It could also mean that data loss or loss of service has already occurred. Normal use of the hardware cannot, or should not, continue.

## Viewing event details

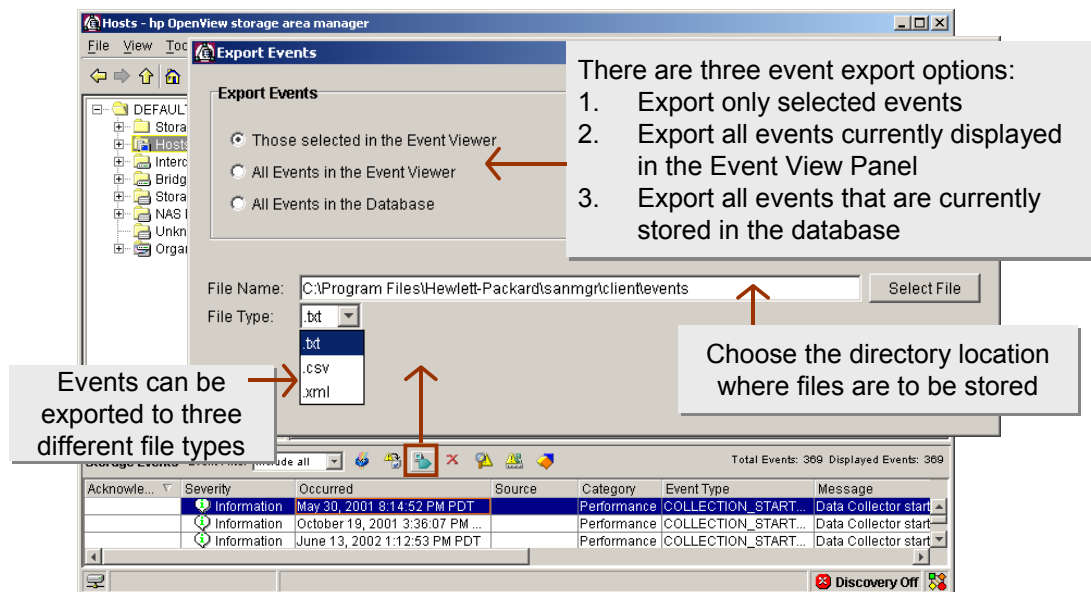


Event details are available for each event displayed in the Event panel.

These details include all of the information available in the Event panel in an easy-to-read format. If the event was acknowledged, the user who acknowledged it, as well as the date and time the event was acknowledged, displays.



## Exporting events

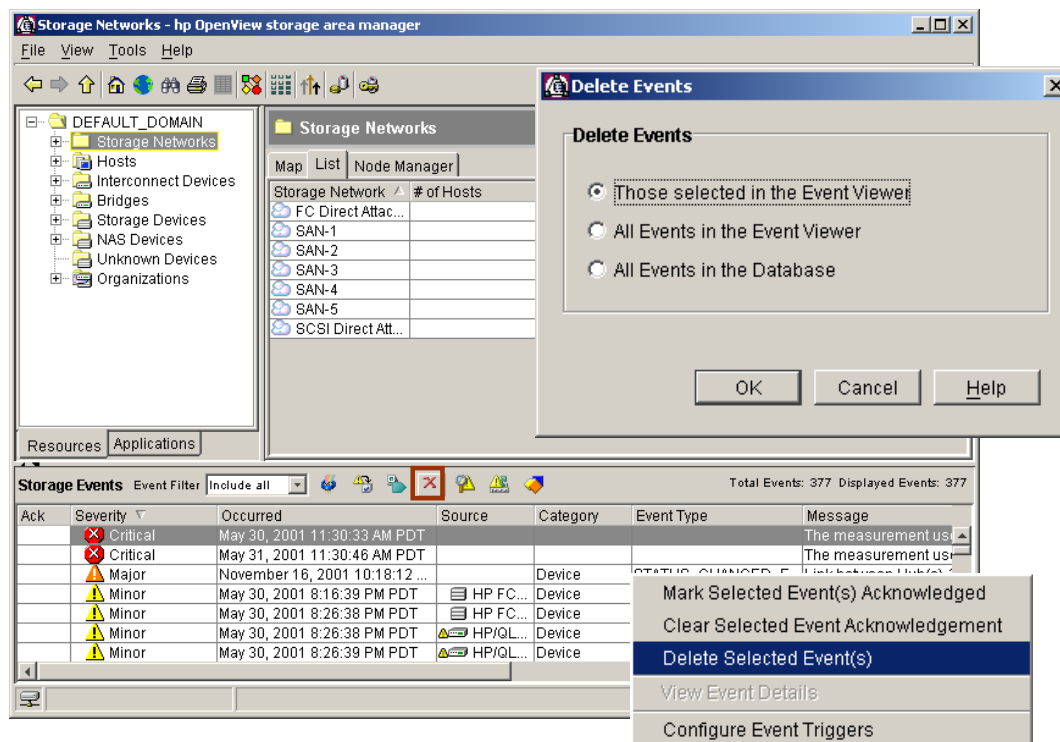


Storage Area Manager's event management system enables you to export events that appear in the Event panel or are stored in the database. Export events to a .txt, .csv, or .xml file. For example, export events for record-keeping purposes before deleting them from the event panel.

### Note

Storage Area Manager may have additional events stored in its database that do not display in the Event panel. For example, if you apply an event filter to the Event panel, only events meeting the filter's criteria display.

## Deleting events manually



Events are saved in the Storage Area Manager database and contribute significantly to the growing size of the database. To manage the number of events in the Event panel and the size of the database, delete events on a regular basis.

Delete events manually by clicking the *Event* icon, or right-clicking on one or more events in Event view panel and selecting *Delete Selected Event(s)*. You can also configure Storage Area Manager to automatically delete events based on criteria you set.

Consider the following when deleting events:

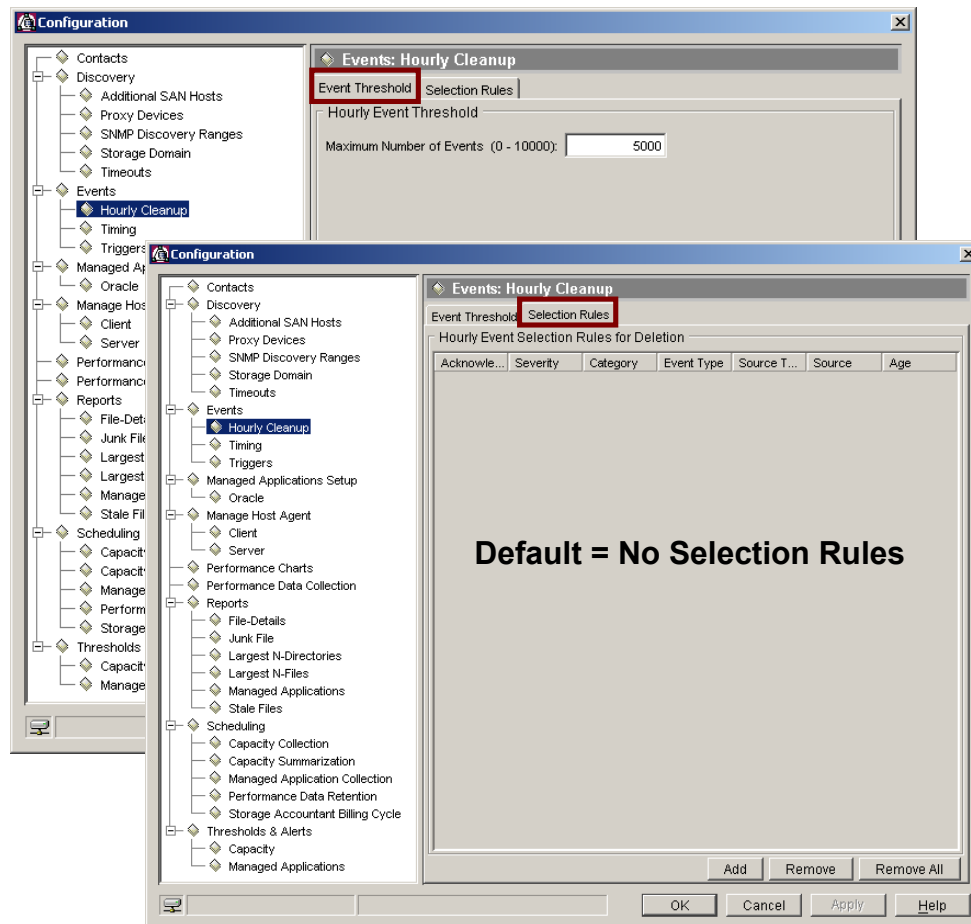
- **Current device status** — If a device has returned to “normal” status, consider deleting the series of events that identified its previous status
- **Event status** — Once the issue that caused the event has been resolved, consider deleting the event
- **Event severity** — consider reviewing and deleting events with low severity levels (for example, "Information" events)



### Caution

You cannot restore an event after you have deleted it from the Event panel. Consider exporting events before deleting them.

## Automatic event deletion – hourly cleanup



You can define rules that Storage Area Manager uses to automatically delete events on an hourly basis. You can also define multiple event deletion rules.

For example, define a rule to automatically delete all Informational events that are 60 days or older. Define a second rule to automatically delete all “acknowledged” events. If an event matches the criteria of either rule, it will be deleted during the next event cleanup cycle.

The event cleanup process consists of two phases. If the number of events stored in the database exceeds the maximum number of events threshold, phase 1 is initiated. In this phase, events are automatically deleted based on the criteria set on the Selection Rules tab. If the number of events stored in the database continues to exceed the threshold after phase 1 is complete, then phase 2 is initiated. In this phase, the oldest events are automatically deleted until the maximum event threshold is met.

---

**Note**

You cannot restore events after they have been deleted. Consider exporting events at regular intervals for record-keeping purposes.

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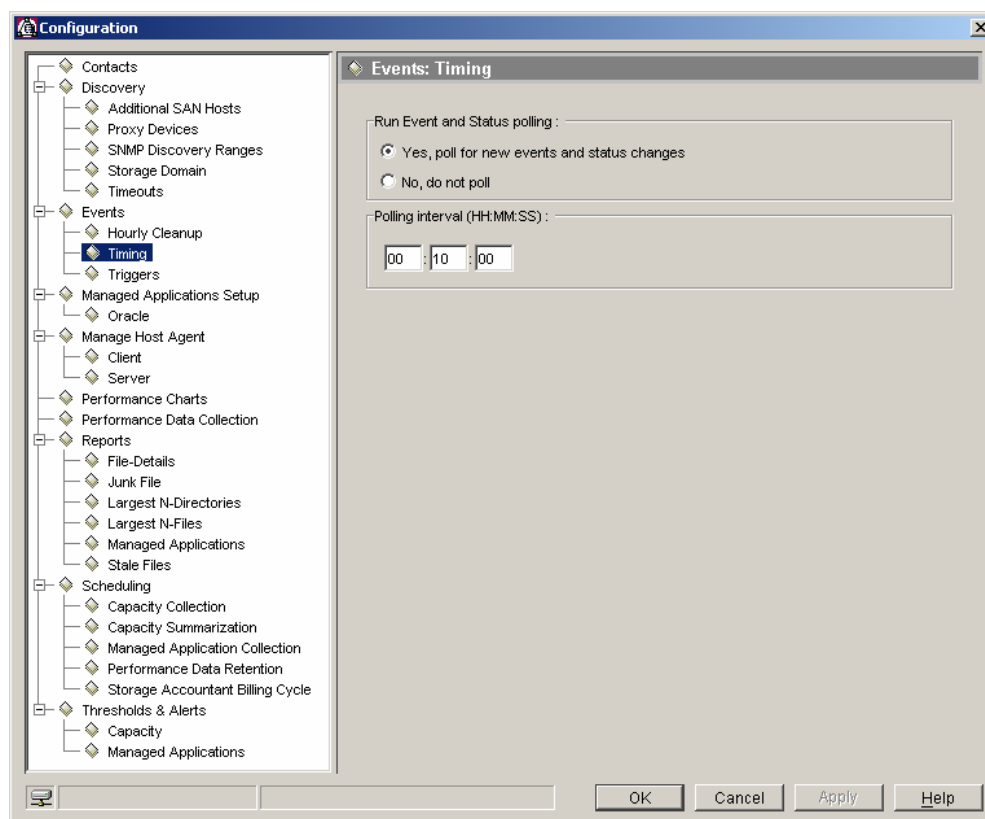
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**WARNING**

By default, there are no rows in the selection rule table. If there is an empty row created, **all** events will be deleted every hour.

---

## Event timing



Storage Area Manager queries the storage domain for new events and changes in status of the storage resources managed within the storage domain. This query is initiated at a preset interval. The default setting is every 10 minutes.

The Events: Timing window allows you to turn the events and status query on or off, and modify the interval setting. It has the following options:

- **Yes, poll for new events and status changes.** Select this radio button to enable Storage Area Manager to poll for new events and device and link status changes at the preset interval.
- **No, do not poll.** Select this option button to disable event and device and link status polling. Any new events occurring in the storage domain or changes in status do not display in Storage Area Manager.
- **HH:MM:SS.** Enter the interval at which Storage Area Manager initiates the event and status polling cycle.

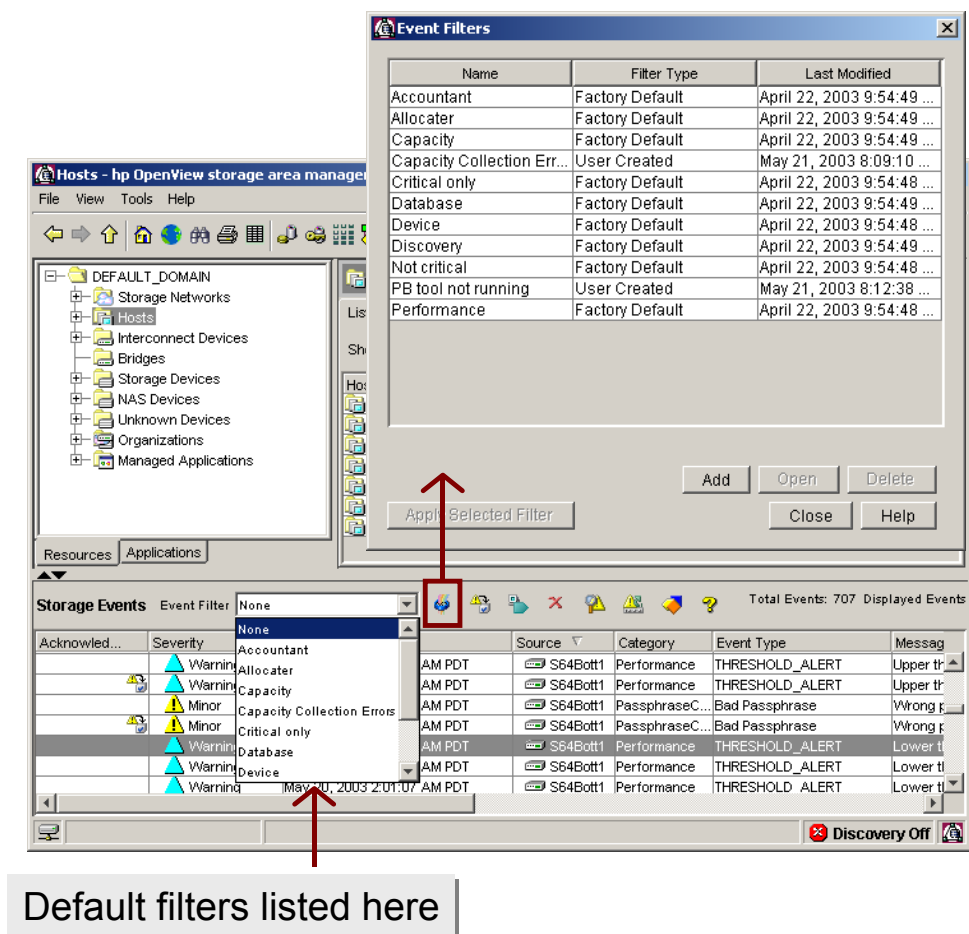


### Important

If a customer is planning on shutting down some hosts and switches for maintenance, turn off the status/event polling before so that unnecessary events do not indicate the hosts and devices are down. After the devices are back up, turn polling back on.

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## Event filters



Events are sent to the Event view panel through the StoreAction trigger. As this trigger is read only, use the event filter feature to customize which events display in the Event panel.

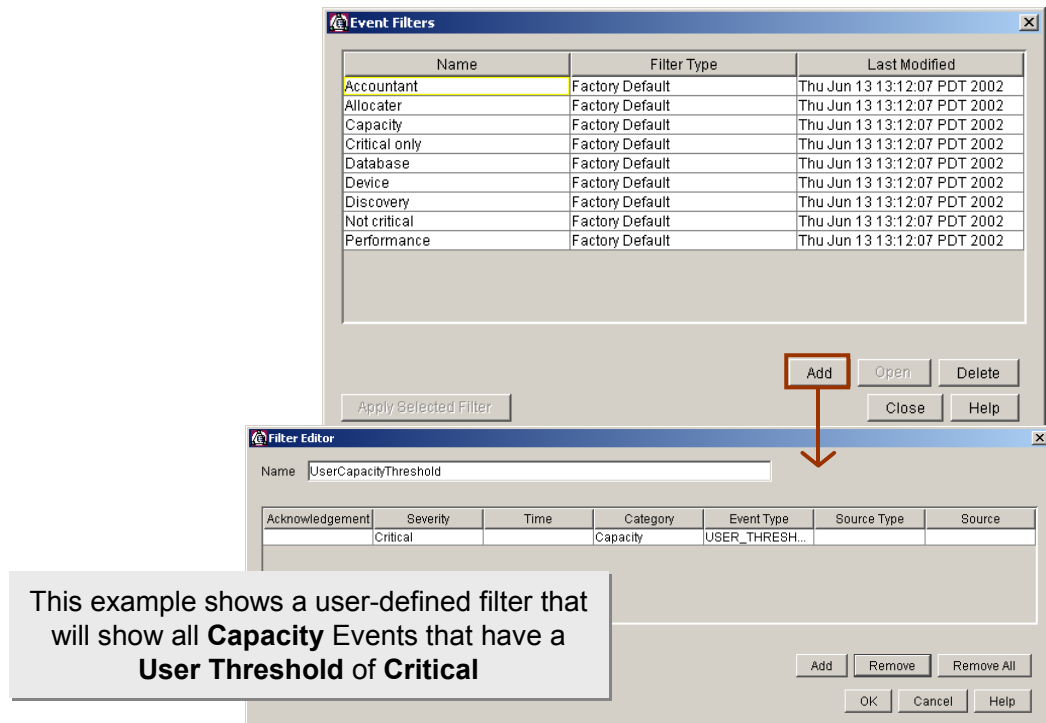
Default filters include:

- Accountant
- Allocator
- Capacity
- Critical only
- Database
- Device
- Discovery

### Note

By default, Storage Accountant-related events are logged to a separate Storage Accountant event viewer.

## Adding new event filters



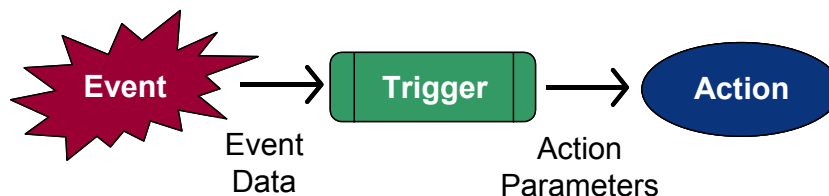
By default, Storage Area Manager displays all events. Select one of the default filters or create filters to only display events that meet specified criteria.

For example, create an event filter that only displays critical events for a particular device.

Criteria includes:

- Acknowledgement state
- Event severity
- Time
- Category
- Type
- Source Type
- Source

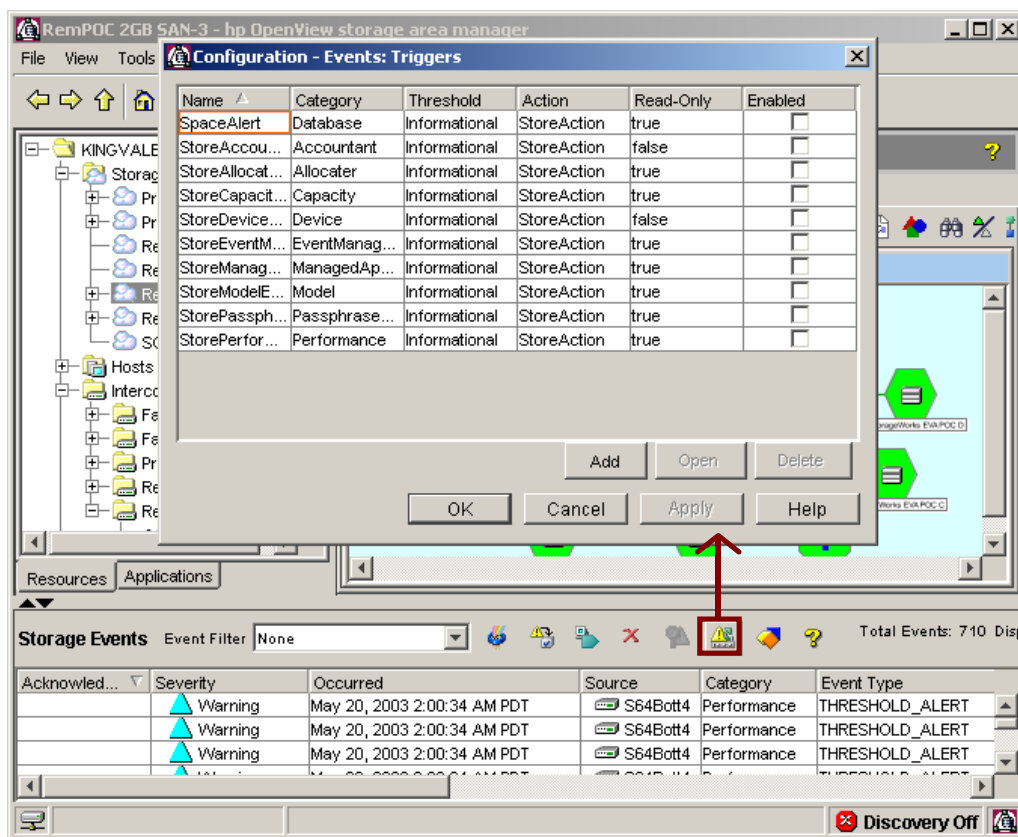
## Event triggers and actions



Event triggers enable you to assign actions to events that meet criteria you specify. Triggers listen for events and perform a specified *action* when the event occurs. The trigger configures the parameters of the action. Actions are available tasks that can be performed.

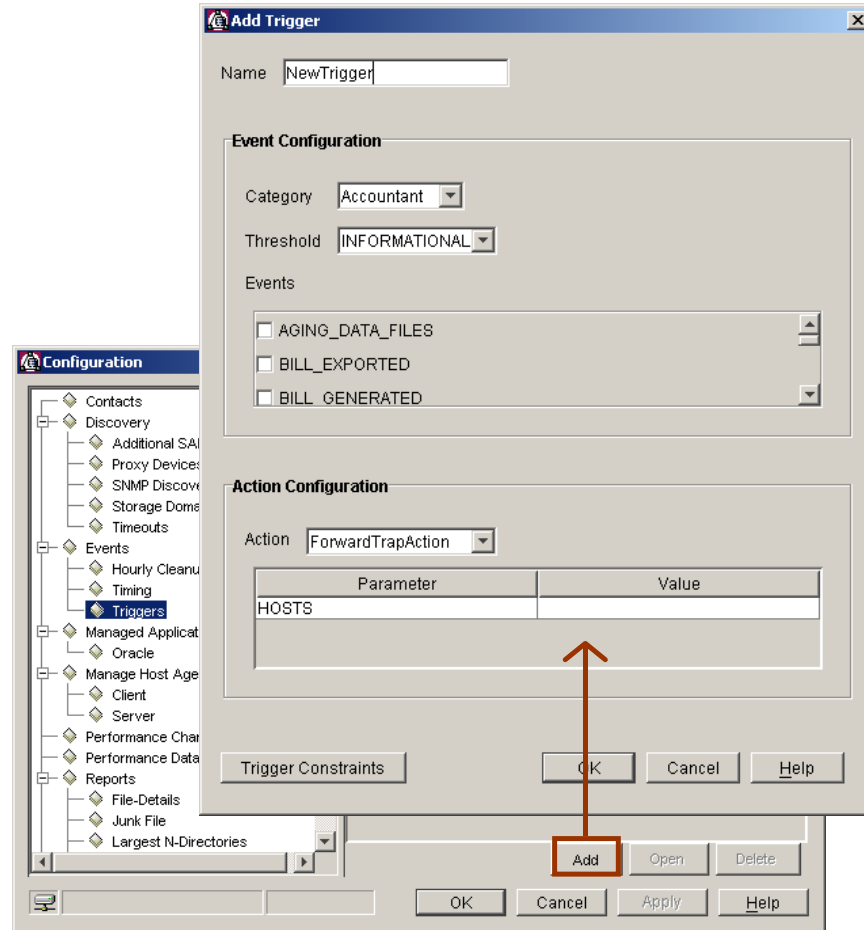
Storage Area Manager includes several default event triggers. Each trigger sends events to the Event View panel. Default triggers cannot be modified or deleted, but they may be disabled.

Create additional event triggers appropriate for the specific environment.





## Creating event triggers



To create an event trigger:

1. Click the *Event Triggers* button on the event toolbar, or select *Triggers* in the Configuration window.
2. Click the *Add* button. The Add Trigger window displays.
3. Enter a name for this event trigger in the Name box. The trigger name may not include white space characters, brackets ({,}), or periods.

Events are defined by their category (for example, Device), specific type (for example, STATUS\_CHANGED\_EVENT), and severity level (for example, WARNING). The action defined by this event trigger will initiate when all event criteria are met.

4. Select the event category in the Category box.
5. Select the event severity in the Threshold box.

Events for this trigger include the selected severity and above. For example, if you select “INFORMATIONAL”, all event severities are included. However, if you select “MAJOR”, only events with severity levels of Major and Critical are included.

6. Check the checkbox for each event you want to include in the Events box.  
Available events depend on the Category selected. You can check more than one event checkbox.
7. Select which action to initiate for this trigger in the Action box. The parameters displayed in the table below the Action box are based on the action you select. The StoreAction action does not have any parameters associated with it.
8. Click the *Value* cell next to each Parameter, and enter the appropriate information.  
  
For example, if you selected ForwardTrapAction in the Action box, click the cell next to HOSTS, and enter the IP address of the host to which you want to forward events.  
  
You can also enter event- and contact-related macros supplied with Storage Area Manager in the Value box.
9. To add constraints to this event trigger, click the *Trigger Constraints* button.
10. Click the *OK* button to add the event trigger to the list and close the Add Trigger window.
11. Click the *OK* button to save changes and close the Events: Trigger window.

## Trigger action constraints

### Example Shown:

Constraint 1 restricts POLLED\_EVENTS with severity "Informational" for any storage device to not cause the trigger action for a minimum count of 20 and a minimum period of 1 minute.

Constraint 2 restricts all events with "Warning" severity to a minimum time period of 2 minutes.

You can prevent the execution of this trigger by specifying constraint rules in the table below. These rules have two types of fields: fields that specify storage events (Severity, Event Type, Source Type and Source), and fields that specify restrictions (Minimum Count and Minimum Duration).

Constraint rules are processed in the order they are listed in the table, from top to bottom. If a storage event matches the selection fields of more than one rule, only the restrictions of the first rule to be processed will take effect. You can change the order by selecting a constraint and clicking the Up or Down buttons.

Constraint	Severity	Event Type	Source Type	Source	Minimum Count	Minimum Duration...
1	Informational	POLLED_EVENT	Storage Device		20	60
2	Warning					120

Up Down

Add Remove Remove All

OK Cancel Help

Trigger Constraints

You can constrain an event trigger to prevent it from initiating based on certain event criteria. You can also configure exceptions to the constraint based on count and duration of the constraint.

For example, if you configure an event trigger for a source type of *interconnect devices*, the trigger will initiate for all interconnect devices discovered. However, if you do not want the trigger to act on events contributed by a particular interconnect device (Device A), you could add a constraint.

Each row in the Trigger Constraints window represents a constraint to apply to the event trigger. Each constraint is defined by a set of criteria. For a constraint to take effect, the event that initiated the event trigger must meet all criteria set for the constraint.

An event trigger can include more than one constraint. If so, the constraints are applied in the order in which they are listed. For example, if an event meets the criteria of two different constraints, the constraint that is listed first in the list is applied first.



### Caution

If the first row (rule) in the table is blank and succeeding rows contain rule criteria, this feature interprets the blank row as "always constraint this trigger" and applies it as such. If the first row is blank and no other rows appear for this constraint, then the trigger is not constrained.

## About SNMP traps

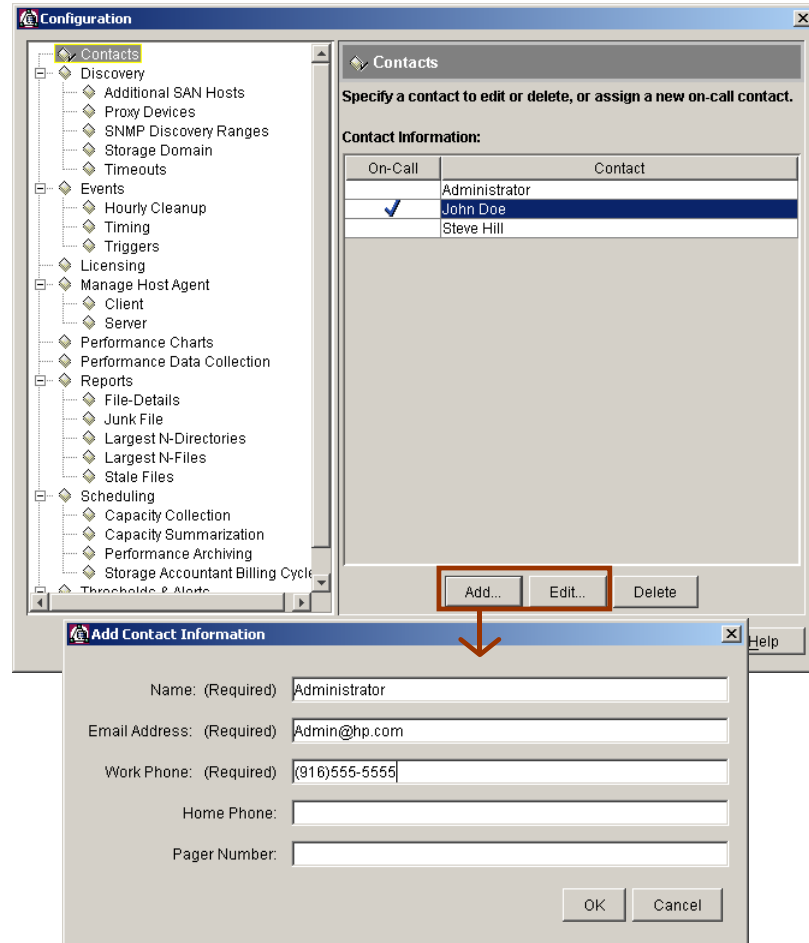
When forwarding SNMP traps, Storage Area Manager uses six different SNMP trap enterprises, each with five specific trap types that correspond to event severities. This allows the receiving applications to appropriately sort/filter the incoming events based on the Storage Area Manager application sending the event and the event severity. SNMP trap enterprises include

- hpovsamGenericTrap
- hpovsamDeviceTrap
- hpovsamAccountantTrap
- hpovsamAllocatorTrap
- hpovsamBuilderTrap
- hpovsamOptimizerTrap

The Storage Area Manager MIB Names are

- HPOVSam.mib (for NNM and other applications)
- HPOVSam\_IM.mib (for Compaq Insight Manager)

## Using contact information in triggers



The Contacts feature provides a convenient place to store phone numbers, pager numbers, email addresses, and other information about the administrators of the storage network.

A checkmark in the On-Call cell indicates that the contact is designated as the on-call contact. This contact can then be automatically notified by email when a specific event occurs by creating an event trigger that specifies %contactEmail for the TO/CC parameter.

## Trigger macros

Storage Area Manager offers the following contact- and event-related macros for use with event triggers.

### Contact-related macros

These macros correspond to information entered for the "on-call" contact.

For SendMailAction, use the following macros as values for the SUBJECT or BODY\_FILE parameters. For RunCommandAction, use the following macros as values in the COMMAND parameter.

#### Contact-related macros

Macro	Value
%contactName	Corresponding information from "on-call" contact
%contactHomePhone	
%contactWorkPhone	
%contactPager	
%contactFax	
%contactEmail *	

\*can also be used for SendMailAction TO and CC parameters.

### Event-related macros

These macros correspond to information saved in the event's record.

For SendMailAction, use the following macros as values for the SUBJECT or BODY\_FILE parameters. For RunCommandAction, use the following macros as values in the COMMAND parameter.

#### Event-related macros

Macro	Value
%date	Date the event occurred
%category	Event category
%text	Event message
%code	Numeric representation for a specific category
%severity	Event severity

## Learning check

1. Event severity levels correspond directly to the status of the device displayed in the Source column of the event panel.

- ☐ True  
☐ False

2. Once deleted, events can be restored from the Configuration window for up to 30 days.

- ☐ True  
☐ False

3. Describe the purpose of event triggers.

.....  
.....  
.....

4. By default, Storage Area Manager queries the storage domain for new events and changes in status of the storage resources every:

- a. 30 seconds  
b. 2 minutes  
c. 10 minutes  
d. 30 minutes

5. List the three file formats in which events can be exported.

.....





### Objectives

After completing this module, you should be able to:

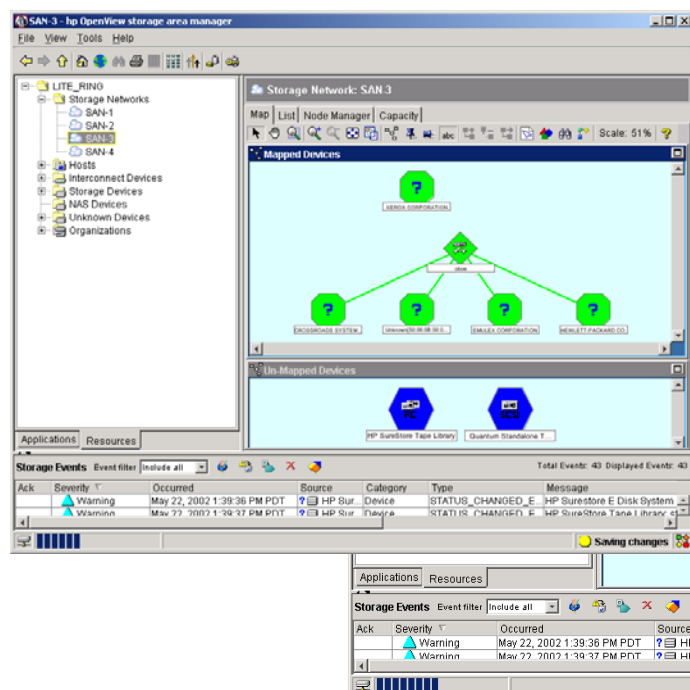
- Identify the two Storage Area Manager map modes.
- Describe the purpose of the Un-Mapped Devices node bank.
- List the Storage Area Manager requirements for physical mapping.
- List the three types of links that appear in device maps.
- Associate unknown placeholders with actual devices.
- Describe where discovered NAS devices appear in Storage Area Manager.
- Add, move, and remove device links.

## Viewing device maps

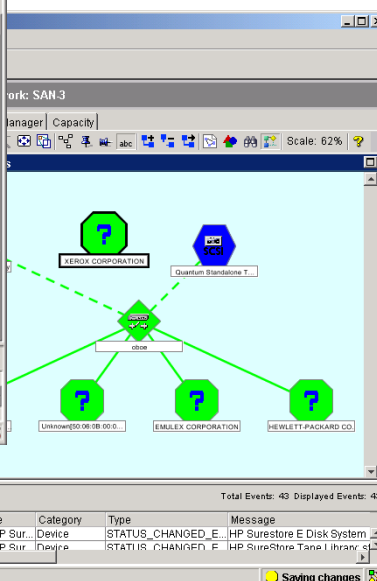
As Storage Area Manager discovers devices in the environment, it places them in device maps. This section covers the features that Storage Area Manager provides for viewing the device maps.

### Map modes

#### Physical Mode



#### Inferred Mode

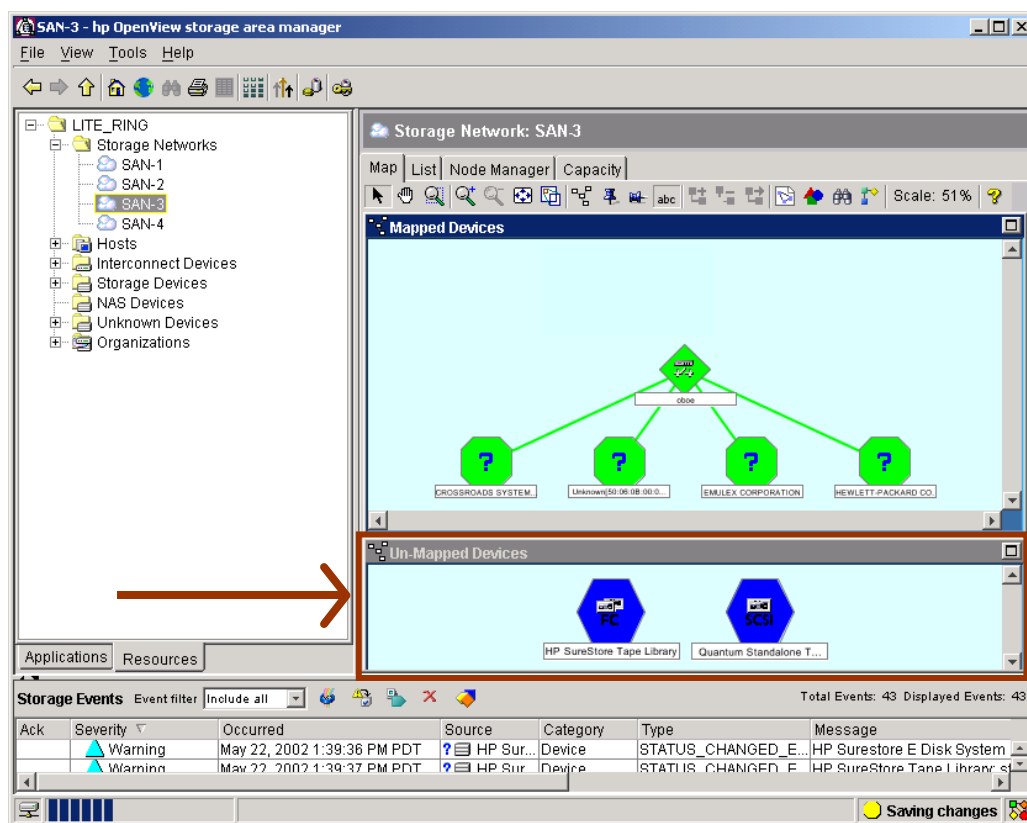


Storage Area Manager provides two device map modes: physical and inferred. The current mode displays in a banner at the top of the map.

Devices that appear on physical maps provide enough information for Storage Area Manager is able to establish their identify and connectivity properties. Devices that do not provide sufficient information for Storage Area Map to map them with certainty display in a node bank at the bottom of the map. Physical maps display physical and user-defined links only.

In Inferred mode, instead of placing devices in a node bank, Storage Area Manager attempts to infer their connections based on the limited information it can obtain. This mode is recommended for hub environments.

## Un-Mapped devices panel



When in Physical Map mode, instead of inferring the connections of devices for which it cannot obtain all required information Storage Area Manager places those devices in a holding area called the Un-Mapped Devices node bank.

Consider the devices in the Un-Mapped Devices node bank as a “to-do” list for complete mapping.

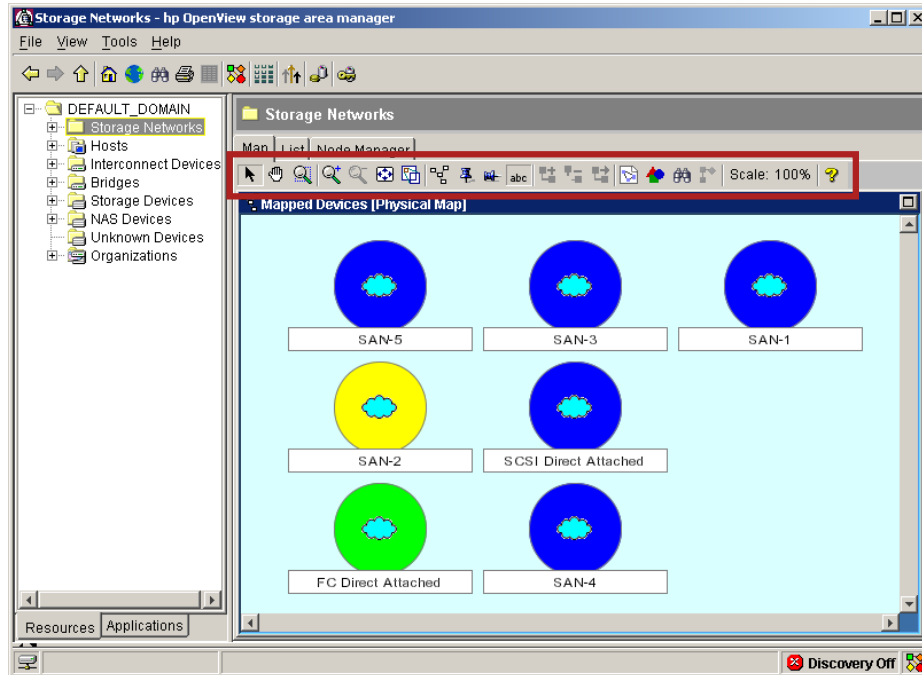
Drag and drop these devices onto corresponding nodes in the main Map in order to:

- Associate hosts and devices with unknown devices
- Associate interconnect devices with inferred hubs
- Add links from unmapped devices to already mapped devices

### Note

For Storage Area Manager to place devices in the Un-Mapped Devices panel, the device must at least have a property file.

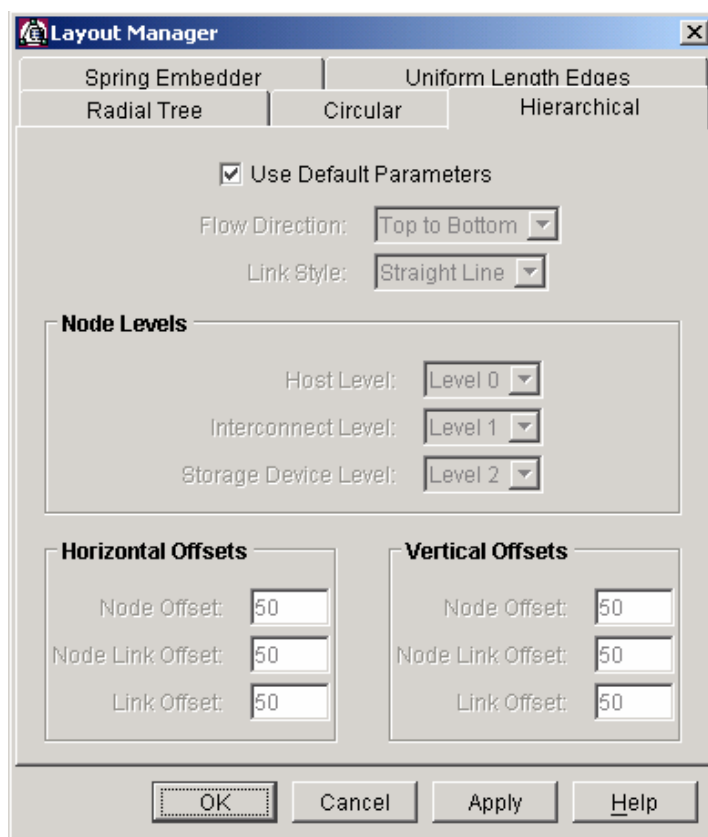
## Map toolbar



Storage Area Manager provides an extensive toolbar to facilitate mapping features. Functions available from the toolbar include:

- Select Node
- Pan Window Mode
- Select Region to Zoom
- Zoom
- See Everything
- Display Overview Window
- Re-layout Nodes
- Pin down Nodes
- Un-pin Nodes
- Show/Hide Labels
- Add/Move/Remove Links
- Map Layout Manager
- Show Map Legend
- Find in Map
- Map Toggle
- Map Help

## Map layout manager



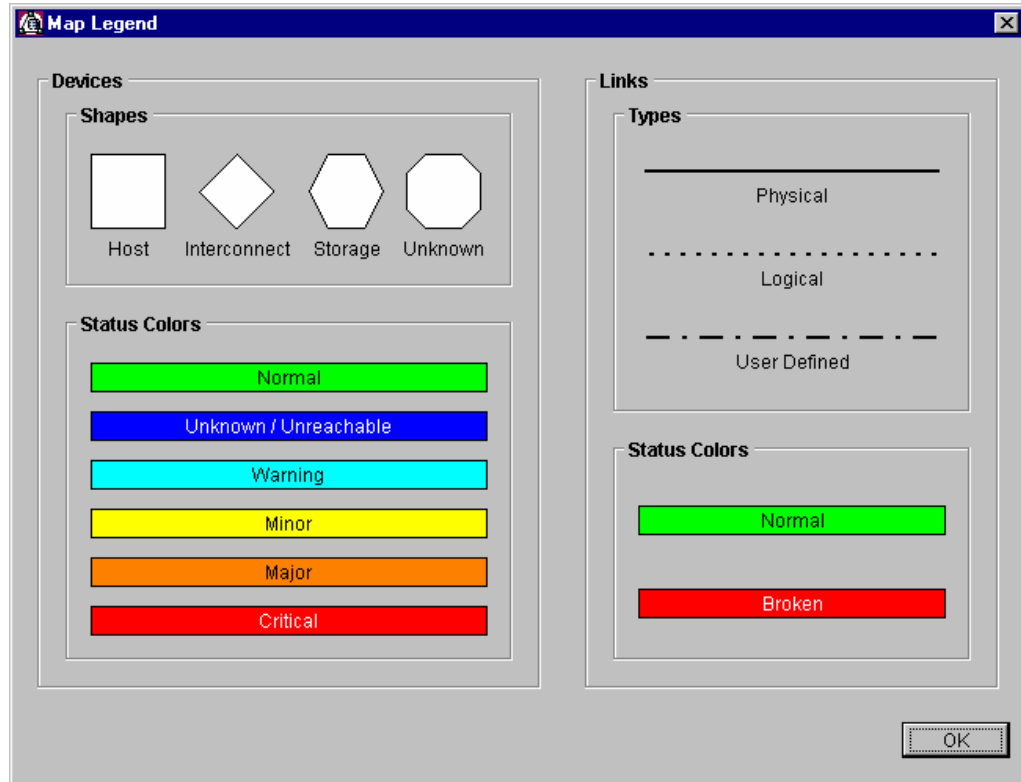
Storage Area Manager uses a default layout when positioning and linking devices. However, the Layout Manager offers the following additional, pre-configured layouts:

- **Circular** — positions devices in a circle. This map minimizes device icon overlapping and provides a clean map.
- **Hierarchical** — positions device types (host, interconnect, and storage) together and in a hierarchy (top-to-bottom, left-to-right, and so on).
- **Radial Tree** — positions devices in a tree. Branches are determined by device links. For example, a fibre channel switch that produces two links will create a branch in the spring.
- **Spring Embedder** — positions devices in a manner that minimizes the number of link crossings.
- **Uniform Length Edges** — positions devices so that their links are of equal length.

To return to the default map layout:

1. Display the device map for which you want to return to the default layout.
2. Click the *Re-Layout Nodes* button on the map toolbar.

## Map legend



View the Map Legend to display the shapes, colors, and lines used to depict various devices, status, and link types on the device maps.

## Device links

While mapping devices, Storage Area Manager also links them using information obtained from the devices. Links may be physical, logical, or user-defined and are uniquely identified as such in the device maps.

### Link types

- **Physical:** Storage Area Manager can gather enough data (in-band and out-of-band) to discover the device and determine how it is connected.
- **Logical:** Storage Area Manager can discover the device, but cannot determine how it is connected (no DPI, no SNIA library) and must make logical inferences.
- **User-defined:** The user has specified the device connection, most commonly to more accurately reflect a logical inference.

### Keys to physical links

To obtain the information necessary to map devices accurately, Storage Area Manager has specific requirements on SAN hosts and devices.

### SAN host requirements

For improved map accuracy, Storage Area Manager requires SAN hosts to have HBA(s) that support the SNIA API. Sometimes referred to as a SNIA library, these HBAs provide industry-standard functionality, such as the ability to retrieve world wide names, issue commands, and so on.

<b>INTERNET</b>	Go to <a href="http://www.software.hp.com/SUPPORT_PLUS/hwe.html#install">http://www.software.hp.com/SUPPORT_PLUS/hwe.html#install</a> to obtain the latest revision of SNIA libraries for HP-UX HBAs. For other HBAs, contact the HBA vendor for HBA drivers with SNIA libraries.
-----------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

## Device requirements

For improved map accuracy, Storage Area Manager also requires that devices have DPIs installed. DPIs are internal code, instantiated by the Core Service DDT and ESP components, that tell Storage Area Manager how to retrieve information for a device.

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**INTERNET** Go to <http://www.openview.com/products/sam/index.asp> to download DPIs not included on the Storage Area Manager 3.0 CD.

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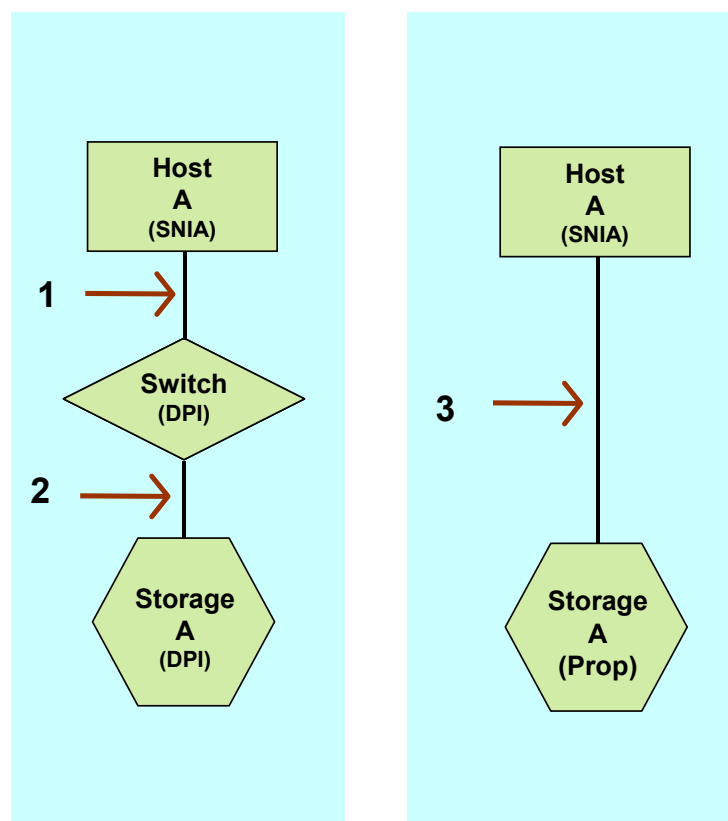
### **Note**

In Storage Area Manager 3.0, SNIA libraries are used more extensively than in 2.x. For example, all World Wide Names for each LUN are gathered using SNIA libraries. If no LUN exists, Storage Area Manager relies on the device plug-in for obtaining storage device information.

---



## Map example for physical links



Storage Area Manager uses several basic rules as it discovers and maps storage networks. Most of the rules are based on whether the components (SNIA libraries and DPIs) required for physical mapping are available.

---

### Note

HP-UX HBAs have functionality similar to SNIA libraries. For the following rules, consider HP-UX HBAs and HBAs with SNIA libraries as synonymous.

---

Storage Area Manager creates physical links when:

- An HP-UX host, or host with a SNIA library, is connected to a fibre channel switch with a DPI (1 in the above example).
- A switch with a DPI is connected to a storage device with a DPI (2 in the above example).

---

### Note

If the storage device is seen by an HBA with a SNIA library through a switch, link #2 will be physical even if the storage only has a property file.

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- The fibre channel or SCSI links are directly attached (3 in the above example).

## Unknown placeholders

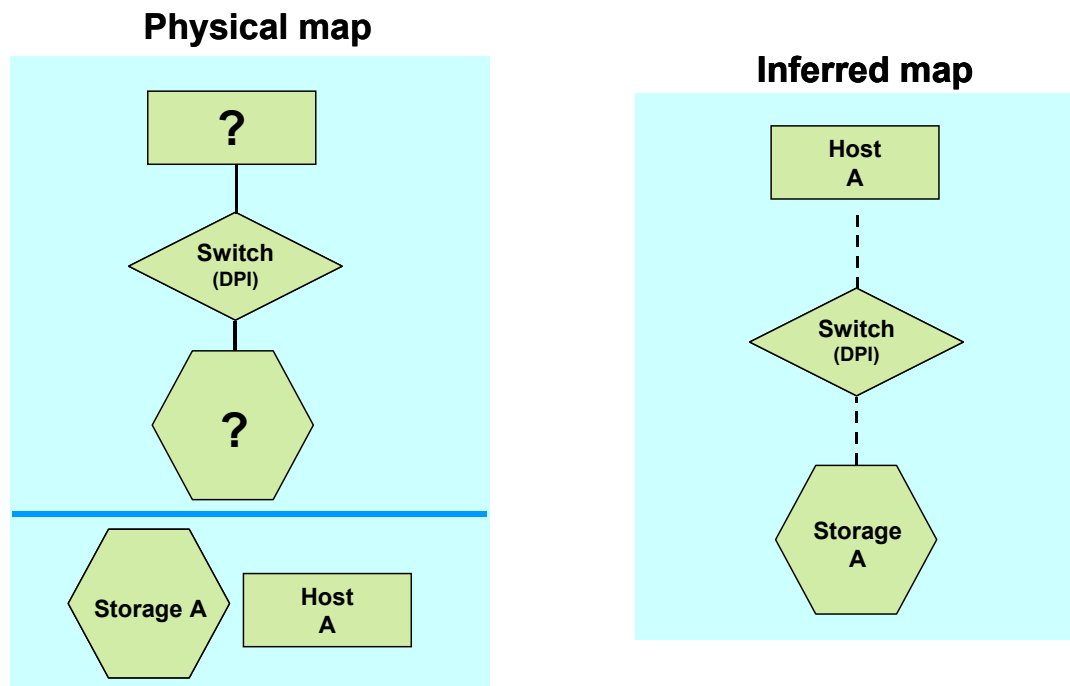
Storage Area Manager creates an Unknown placeholder using a specific icon when an HBA without a SNIA library or a fibre channel device without a property file is connected to a fibre channel switch with a DPI. The placeholder is typically identified by the device vendor.

In this case, Storage Area Manager is able to obtain only limited information such as the world wide name of the HBA or fibre channel device from the switch they are connected to.

As a result, Storage Area Manager creates an Unknown placeholder and displays link status for the device in the Map view panel. The actual device, as well as its status, appears in the Resources tree and the Un-mapped devices panel.

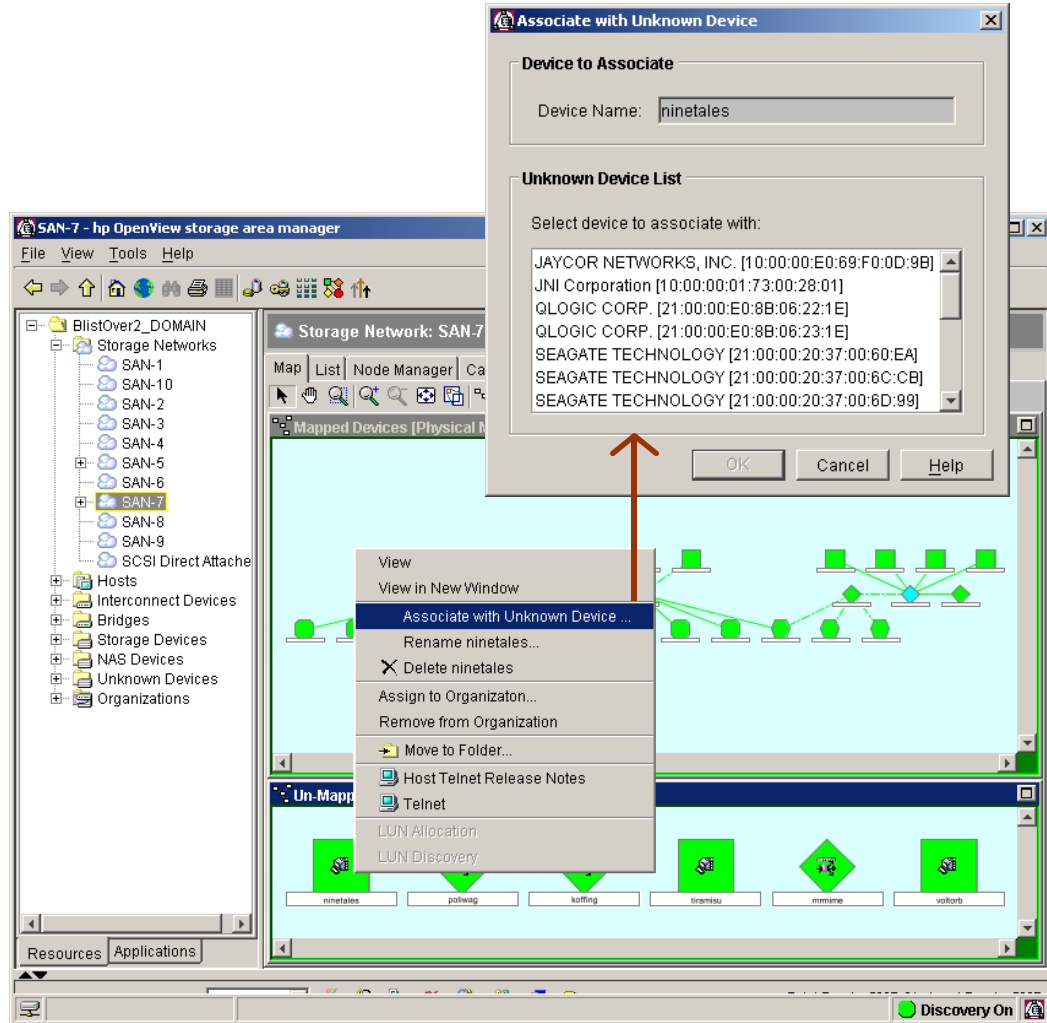
Associate the two devices by dragging and dropping the actual device from the Un-mapped devices panel to the Unknown placeholder in the Map view panel. Once the association takes place, the Unknown placeholder will be deleted and detailed device information will be available for the actual device, which now appears in the Map view panel and Resources tree.

## Map example for unknown placeholders



The example above illustrates how the Physical and Inferred maps appear when a host without a SNIA library is connected to a switch with a DPI and the switch is connected to a fibre channel storage device without a DPI.

## Associating an unknown placeholder



Storage Area Manager provides two methods for associating unknown devices with their placeholder icons depending on whether or not the unknown device and placeholder device are shown in the same storage network map.

If in the same storage network map

1. Select the unknown device in the Un-Mapped Device node bank.
2. Drag the unknown device and drop it onto the placeholder icon in the device map.

If the association is successful, the unmapped device is removed from the Un-Mapped Devices node bank, and the placeholder device in the map assumes the appropriate characteristics of the device. The placeholder device is also removed from the Unknown Devices node in the Resources tree.

If not in the same storage network map

1. Right-click the unmapped device in the Resources tree, and select *Associate with Unknown Device* from the shortcut menu. The Associate with Unknown Device window appears.
2. Select the placeholder device that represents the unmapped device from the list of placeholder devices in the Select device to associate with list.
3. Click the *OK* button.

If the association is successful, the unmapped device is removed from the Un-Mapped Devices node bank (if applicable), and the placeholder device in the map assumes the appropriate characteristics of the device. The placeholder device is also removed from the Unknown Devices node in the Resources tree. The applicable storage network is also updated to reflect the association.

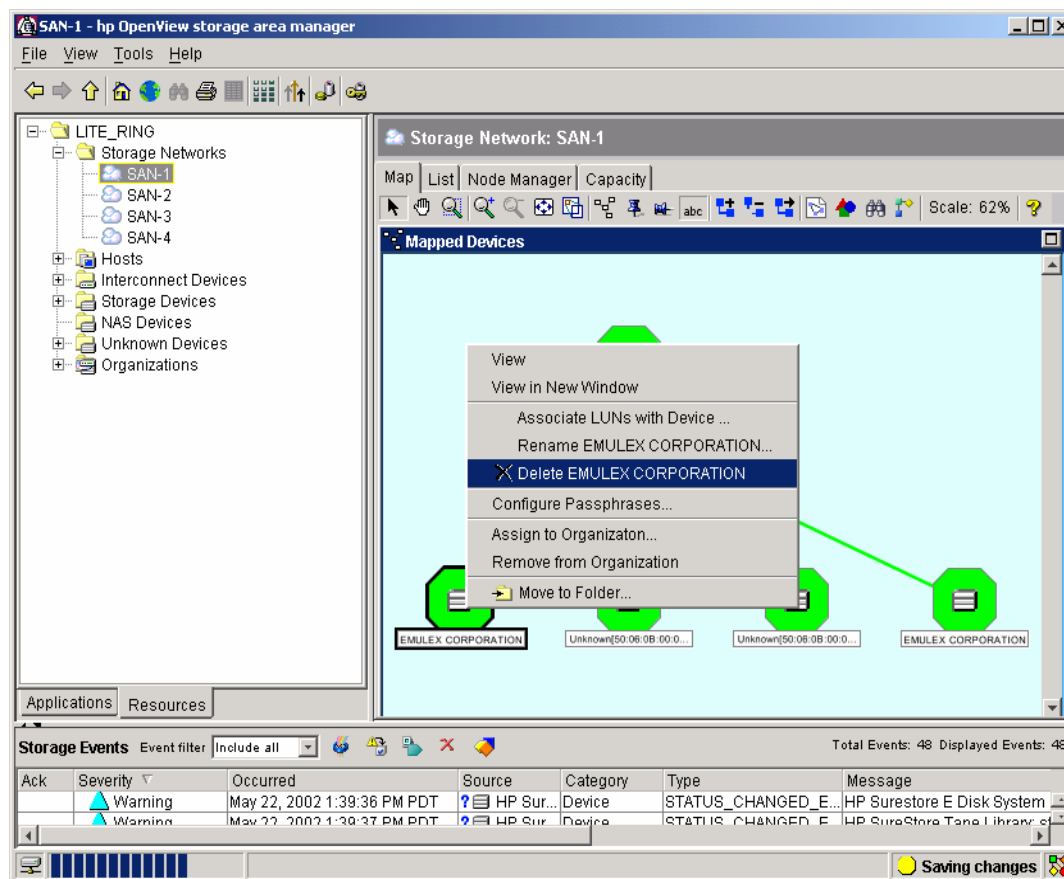
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**Note**

In some configurations, multiple placeholder devices may be associated with the same unmapped device. The above result completes when the final placeholder device is associated with the unmapped device.

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## Correcting a device association



To change a device association that was incorrectly made, delete the device from the tree or map. The device will be recreated after next discovery cycle completes.



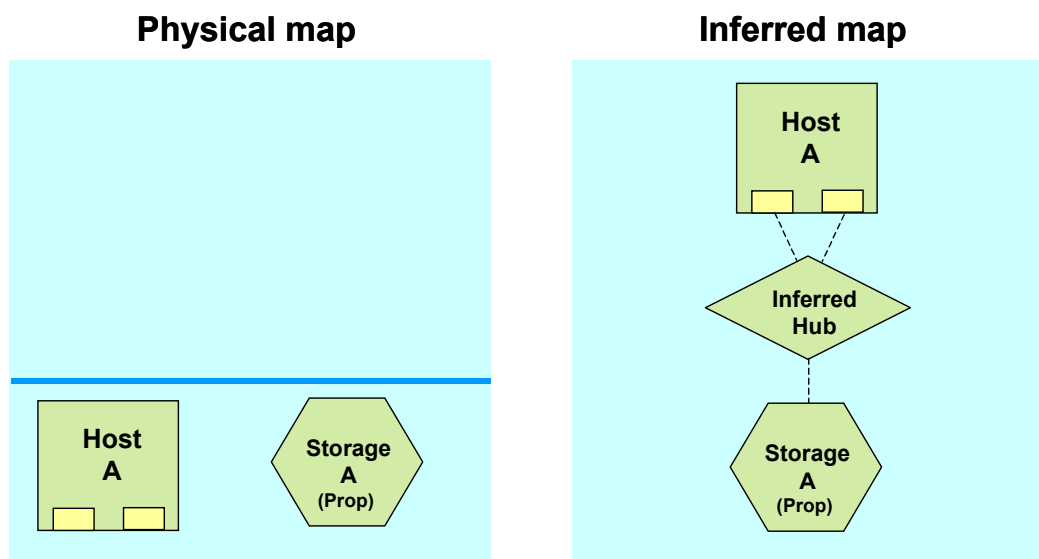
### WARNING

Deleting a device from the tree or map will delete all device history.

## Inferred hubs

Due to a lack of device intelligence, Storage Area Manager must infer the existence of hubs in the environment. Storage Area Manager infers the existence of a hub when multiple HBAs can communicate with the same set of fibre channel devices.

### Map example #1 for inferred hubs



The example above illustrates how Physical and Inferred maps appear when a Host with multiple HBAs is connected to a storage device with only a property file. Since the device does not have a DPI, Storage Area Manager assumes the device only has one port. As a result, Storage Area Manager infers that the host and storage device must be connected using a hub since multiple HBAs can access it.

Only devices that can be mapped with 100% accuracy are placed on the Physical map, therefore when Storage Area Manager is in Physical mode the devices appear in the Un-mapped Devices node bank.



#### Important

Using Inferred Map mode is recommended for hub environments.

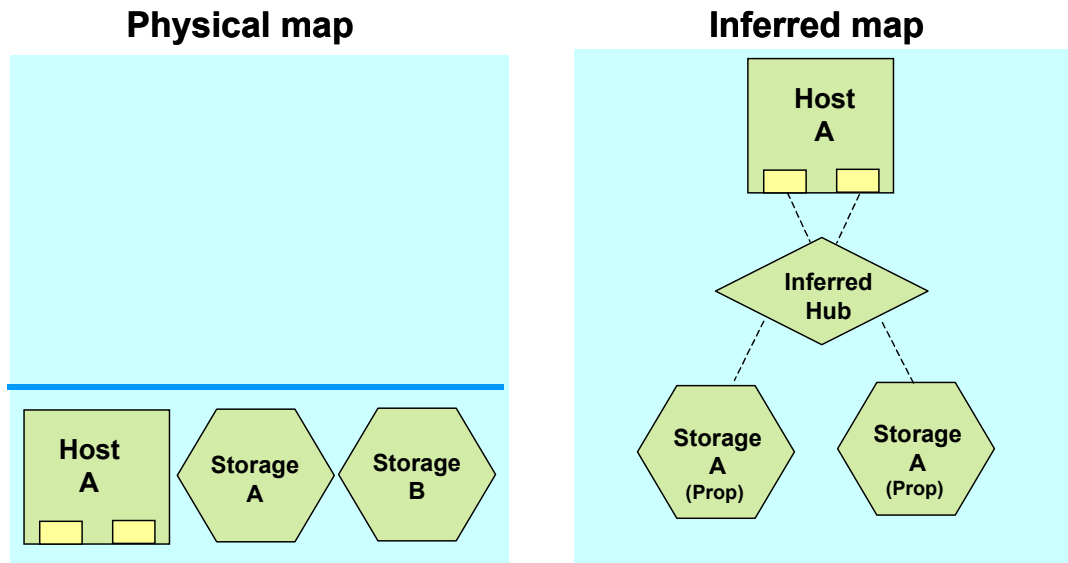
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#### Note

If the hub has a property file and it has been discovered, it will show up in the Unmapped Devices node bank for ALL SANs.

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## Map example #2 for inferred hubs

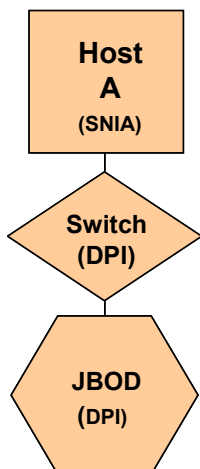


The example above illustrates how Physical and Inferred maps appear when a Host with multiple HBAs is connected to multiple storage devices with only a property files. Again, due a lack of information that cannot be obtained with DPIs, Storage Area Manager infers that the host and storage devices are connected using a hub.

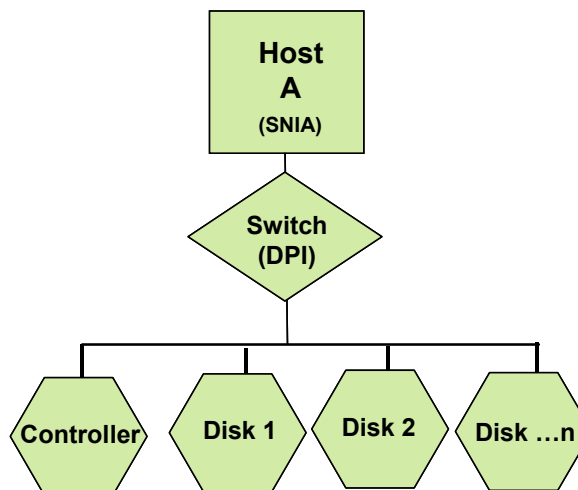


## Map example for JBODs

**Actual connectivity**

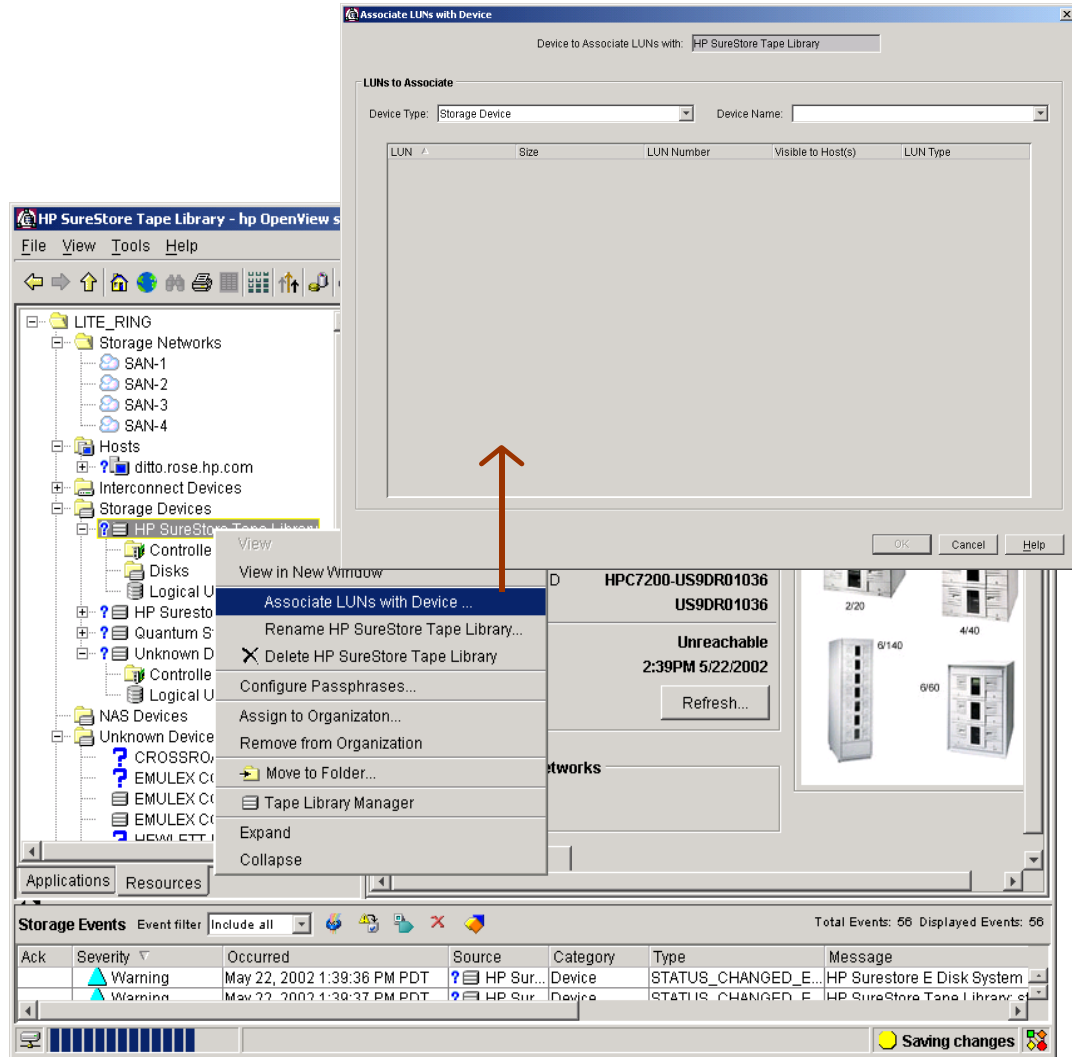


**Physical map and inferred map**



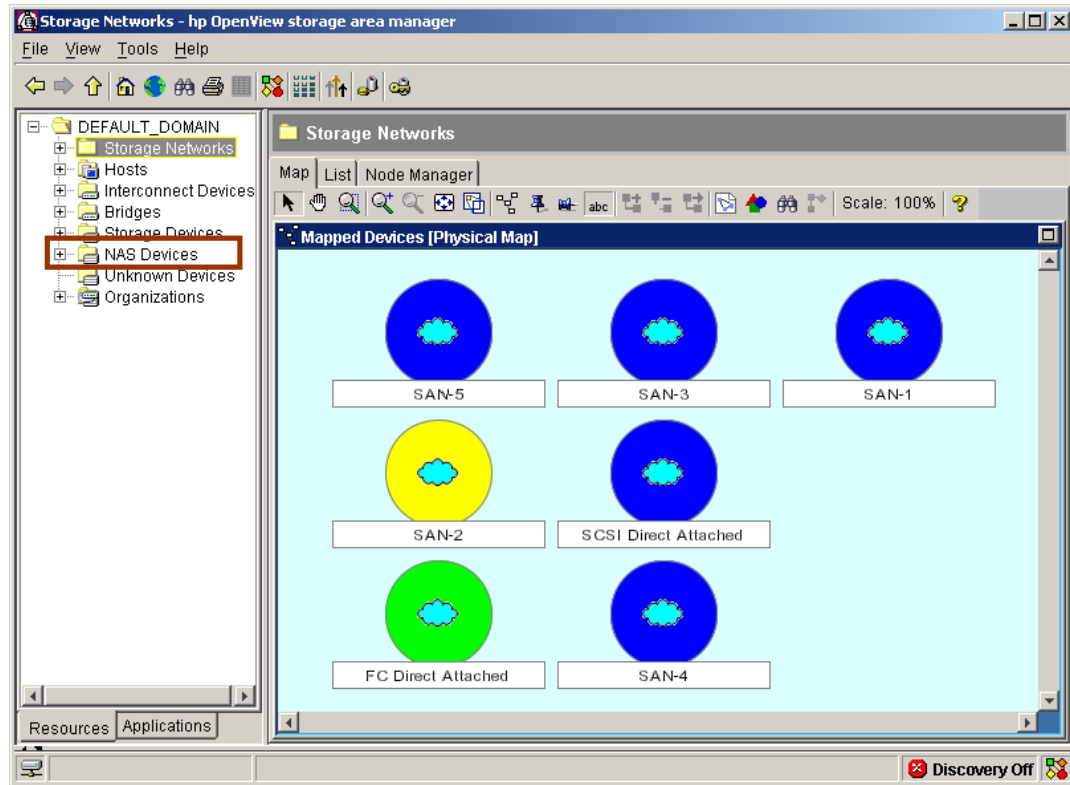
The example above illustrates how Storage Area Manager maps JBODs. Storage Area Manager obtains the WWN of the controller as well as all of the disks. Thus, all appear on the device map.

## About LUN association



Storage Area Manager provides a feature to associate unknown LUNs with a storage device. The most common use of this feature is to associate JBOD disks with its controller.

## About NAS devices



Storage Area Manager discovers NAS devices through Ethernet. NAS devices only appear in the Resources tree not in device maps.

## Working with device links

Storage Area Manager provides the ability to add, move, and remove device links. This section covers the operational rules that apply to the different link types as well as the procedures for modifying device links.

### Operational rules for device links

#### Physical links

- Appear in both Physical and Inferred map modes
- Cannot be added or moved (exception is Direct-attach links)
- Can be removed if Critical (red)

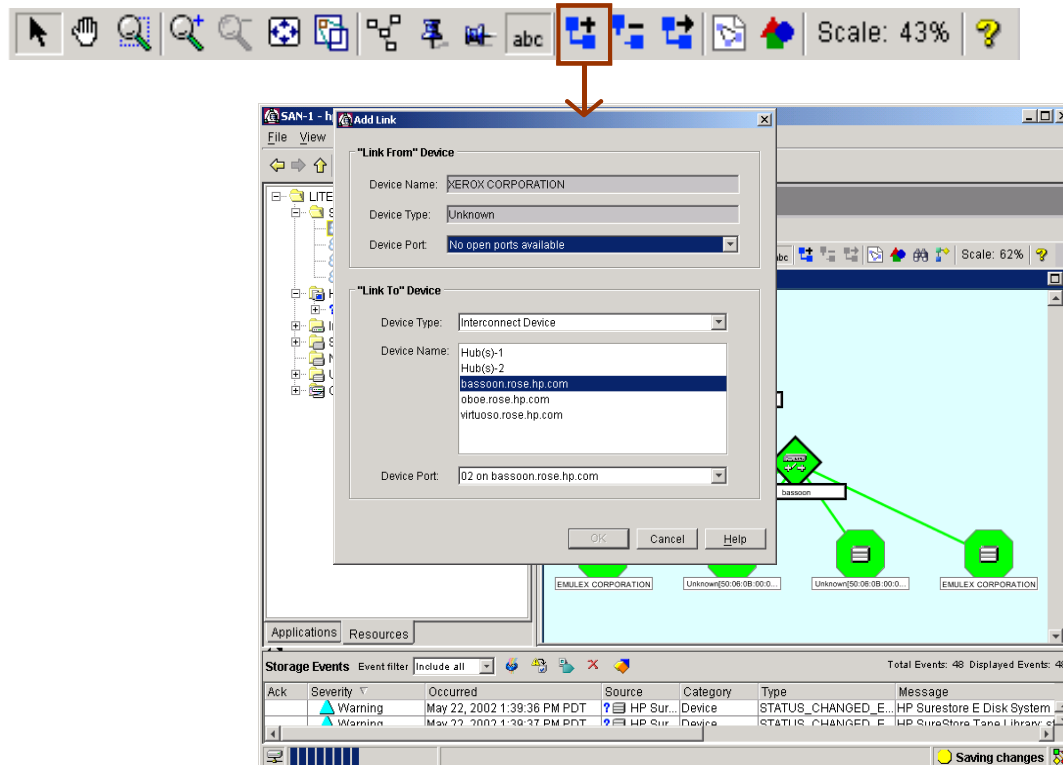
#### Logical links

- Only appear in Inferred Map mode
- Cannot be added
- Can be removed, but may return due to ongoing device discovery
- Can be moved (automatically promotes the link to user-defined)
- Moving contrary to information Storage Area Manager gathers results in a user-defined link as well as the possible return of the inferred link during ongoing device discovery

#### User-Defined Links

- Can appear in both Physical and Inferred map modes
- Can be added, moved, or removed

## Adding a device link

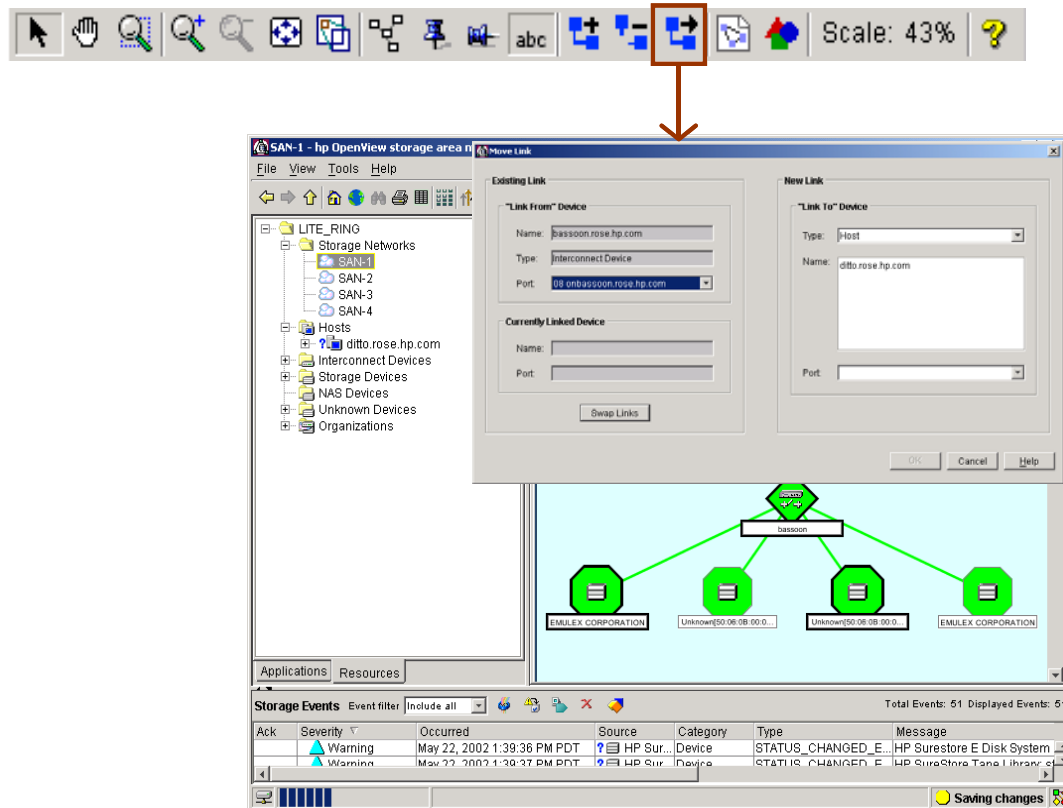


To add a device link:

1. Display the device map which includes the device from which you want to draw the link.
2. Select the icon for the device you want to link to another device.
3. Click the *Add Link* button on the map toolbar. The Add Link window appears.
4. In the *Links From Device* section, select the device port from which the link is drawn.
5. In the *Links To Device* section, select the type of device (host, interconnect, bridge, storage, or unknown) to which you are connecting.
6. Select the device to which the link is connecting.
7. Select the device port to which the link is drawn.
8. Click the *OK* button. A confirmation message appears.
9. Click the *Yes* button to add the device link.

Alternatively, select both the *to* and *from* devices in the map and then click the *Add Link* toolbar button or use the right-mouse dialog to select *Add Link*. As a result of either of these actions, the Add Link dialog is pre-populated.

## Moving an existing device link



It might be necessary to move a device link, for instance, if Storage Area Manager incorrectly inferred the connection due to a lack of device information.

You can only move logical and user-defined links. You cannot move physical links, except those that are directly attached. If you move a logical link, Storage Area Manager redefines it as a user-defined link. However, if the condition that caused the logical link remains, Storage Area Manager returns the logical link as part of the ongoing discovery process.

To move a device link:

1. Display the device map that includes the device link you want to move.

When moving links, one “end” of the link will remain the same while the other end is moved. For the next step, select the device icon that will remain the same.

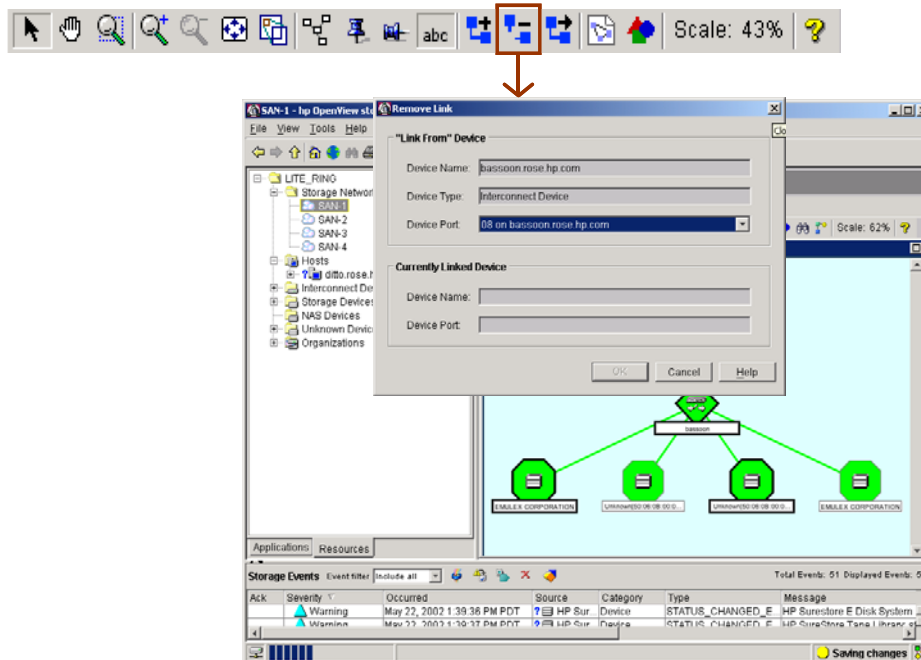
2. Select the device icon that is connected to the link you want to move.
3. Click the *Move Link* button on the map toolbar. The Move Link window appears.

### Note

Click the Swap Links button to change the “end” of the link that will move. The devices displayed in the *Link From Device* and *Currently Linked* boxes will interchange.

4. In the New Link section, select the type of device (host, interconnect, bridge, storage, or unknown) to which you are moving the link.
5. Select the device to which you want to move the link in the Name box.
6. Select the device port to which you want to move the link in the Port box.
7. Click the *OK* button. A confirmation message appears.
8. Review the information in the message, and click the *Yes* button.

## Removing an existing device link



You cannot remove physical links except those that are directly attached.

If you remove a logical link, the link may reappear as part of the ongoing discovery process if the factors that resulted in the original link inference still exist.

To remove a device link:

1. Display the device map which includes the device from which you want to remove the link.
2. Select the icon for the device from which you want to remove the link.
3. Click the *Remove Link* button on the map toolbar. The Remove Link window appears.
4. In the Links From Device section, select the device port from which you want to remove the link.
5. Verify that you are removing the link you want by reviewing the information in the Currently Linked Device section.
6. Click the *OK* button. A confirmation message displays.
7. Click the *Yes* button if this is the link you want to remove.

### Note

If a fibre channel link is physically removed from a device, the discovery cycle appears to hang. This behavior may be due to a 0 timeout value setting in the Fibre channel driver for the JNI HBAs (Solaris only). Set the JNI Fibre channel driver's "FailoverDelay" setting to a non-zero value.



## Learning check

1. List the two Storage Area Manager map modes and describe the recommended use of each.  
.....  
.....  
.....
2. Describe the purpose of the un-mapped devices node bank.  
.....  
.....  
.....
3. List the three types of device links.  
.....  
.....  
.....
4. Describe two methods for associating an unknown placeholder with the actual device.  
.....  
.....  
.....  
.....
5. NAS devices appear in the Resources tree and on device maps.  
☐ True  
☐ False
6. The most common use of the Associate Unknown LUNs feature is to
  - a. Associate JBOD disks with its controller
  - b. Associate unknown placeholders with their actual devices
  - c. Associate inferred hubs with switches
  - d. Associate inferred links with actual device links



### Objectives

After completing this module, you should be able to:

- Launch global and device-specific application
- Access device-specific release notes
- Link applications to the overall Storage Area Manager interface
- Use the Application Link Wizard to link applications to specific devices or device types
- Recognize application parameter keywords

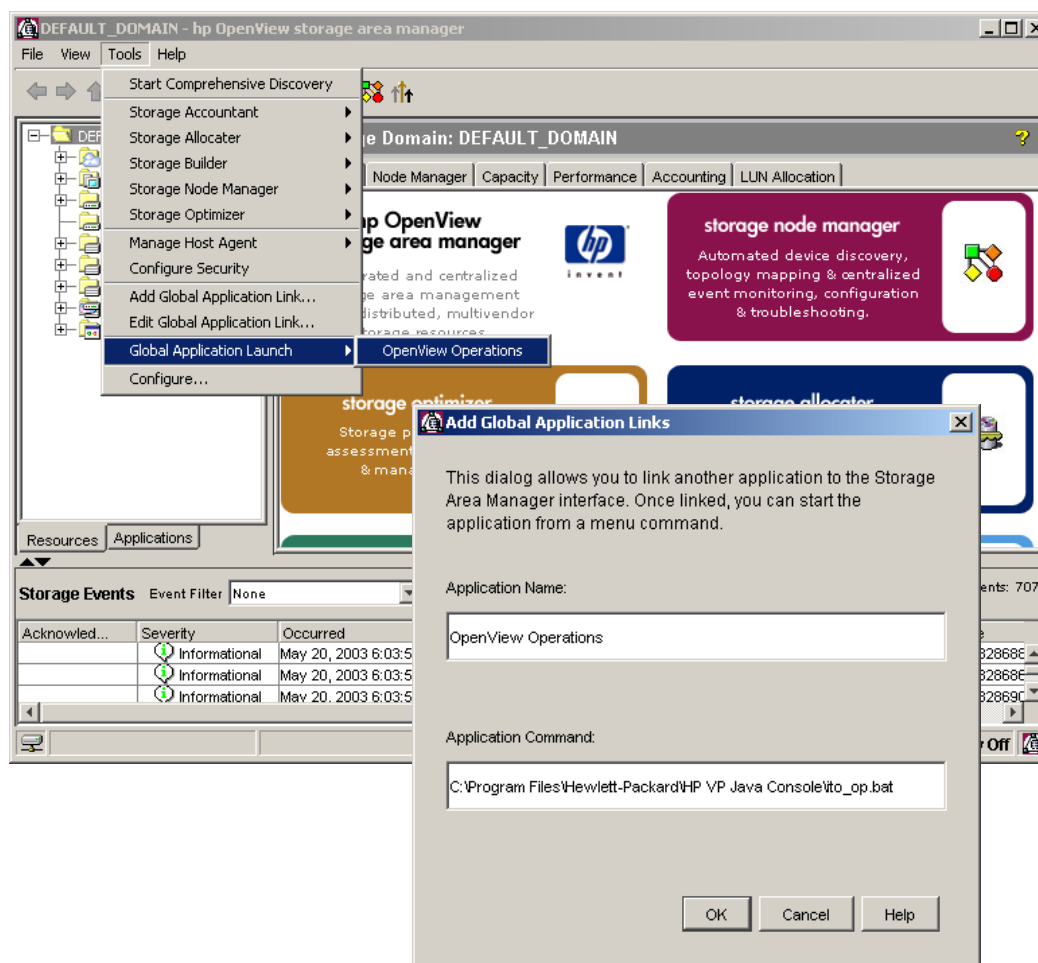
## About application links

The application link feature allows you to link other applications to Storage Area Manager and start them from commands added to the Storage Area Manager user interface when you successfully link an application. Two types of links are available: global and device-specific.

Global Applications are always available regardless of which device or object is selected in the user interface.

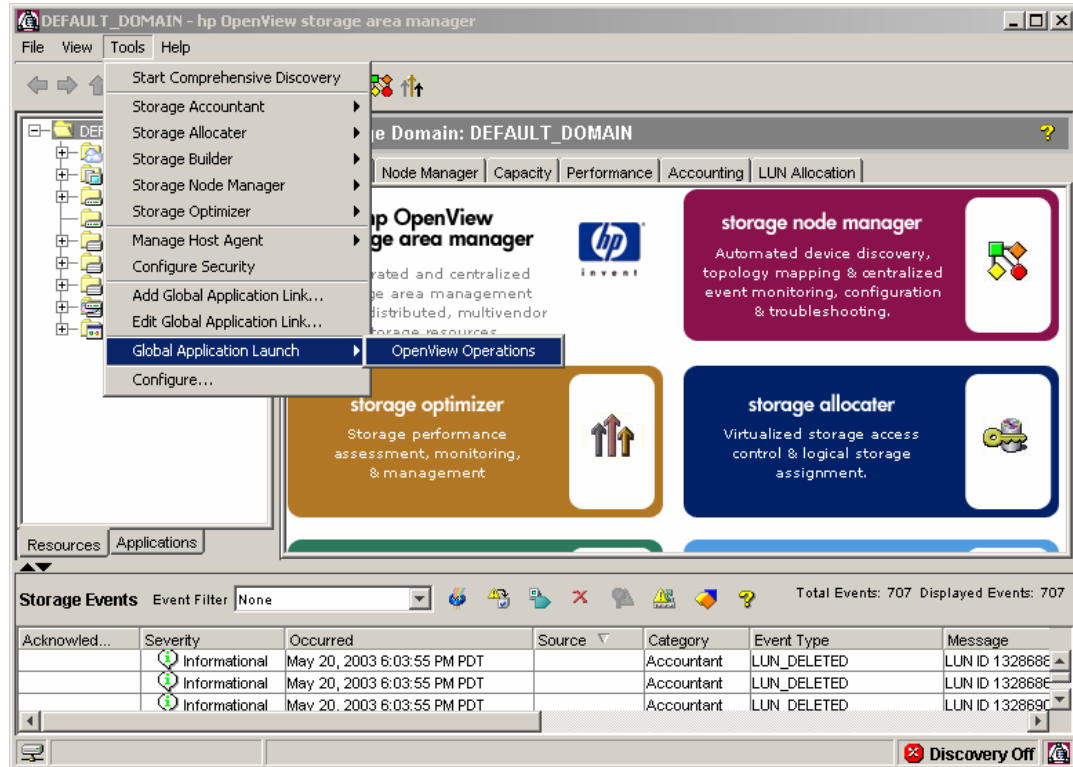
Device-specific Applications are linked only to a specific device or device model. You can only start these applications by right-clicking the applicable device in the directory tree or device map. For example, you may want to link a specific device management application to a particular device in your storage network. Storage Area Manager provides default device-specific application links for many of the devices it supports.

## Global application links



Storage Area Manager's global application link feature allows you to start another application from Storage Area Manager's user interface. For example, you may want to create a link to a management framework application.

## Starting global applications



You can start other management applications from Storage Area Manager's user interface if the application was previously linked. For example, you could start HP OpenView Operations.

## Device managers

Device managers are applications that manage and monitor storage and interconnect devices. These applications are independent of Storage Area Manager and are typically shipped with the hardware device or downloaded from the HP Software Depot at <http://software.hp.com>.

Storage Node Manager provides the ability for device managers to be launched for a specific device or type of device from directly the Storage Area Manager GUI.

### Storage Area Manager pre-enabled device managers

The following device managers are pre-enabled by Storage Node Manager:

- Ancor
- McData
- Brocade
- CommandView SDM
- CommandView XP
- Galactica
- Fibre Channel Manager
- SMC Symmetrix
- EVA Element Manager

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**Note**

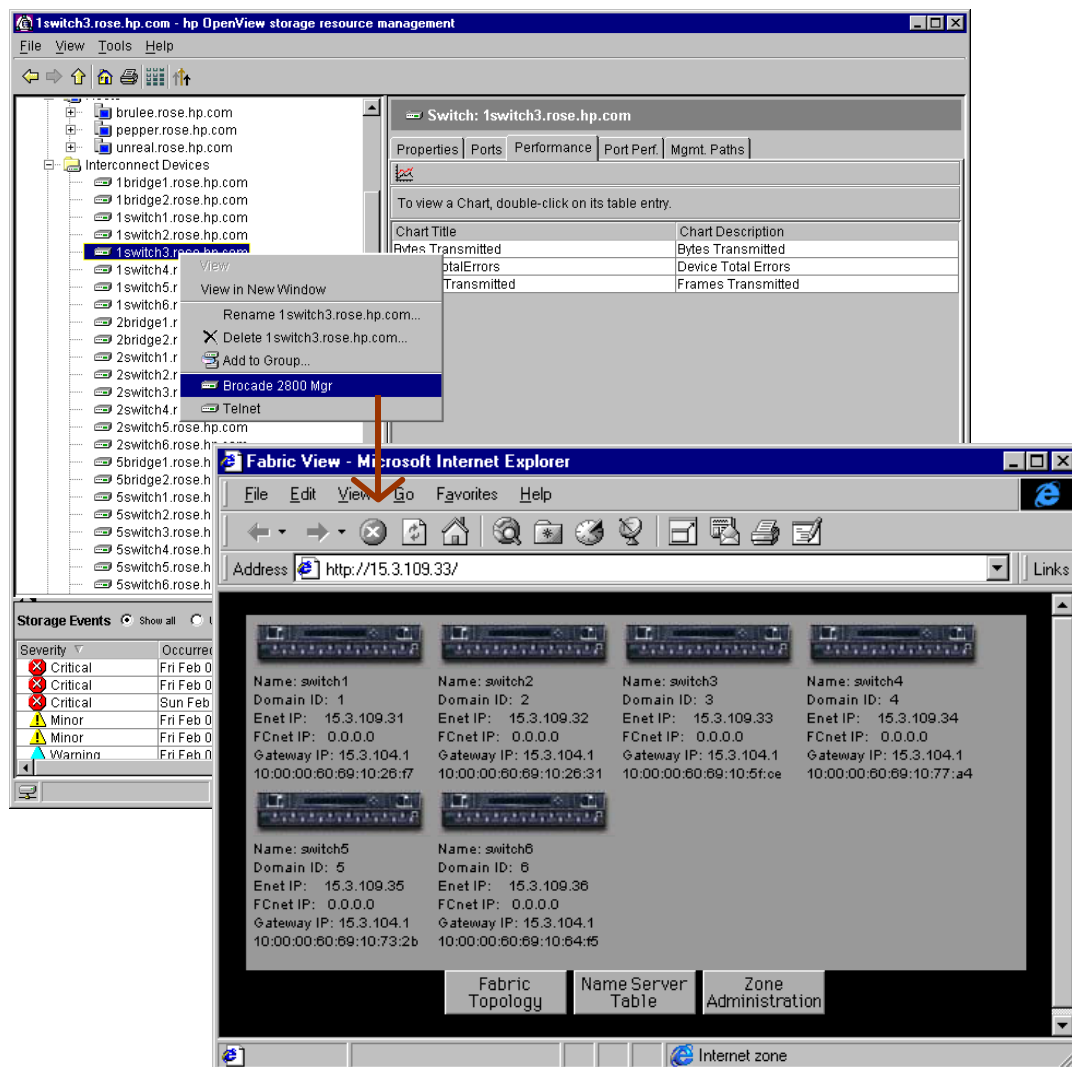
In order for the device manager to be successfully launched, it must be installed and configured per the device specifications (default location).

---

Beyond the device managers that are pre-enabled, Storage Node Manager also provides the ability to link other applications to a specific device or type of device.

The command for launching the device manager is included in the device's property file as the OnManage command.

## Launching device manager applications



Right-click the device for which you want to launch a linked application in the Resources tree or device map.

Select the menu command that represents the application from the device's shortcut menu.

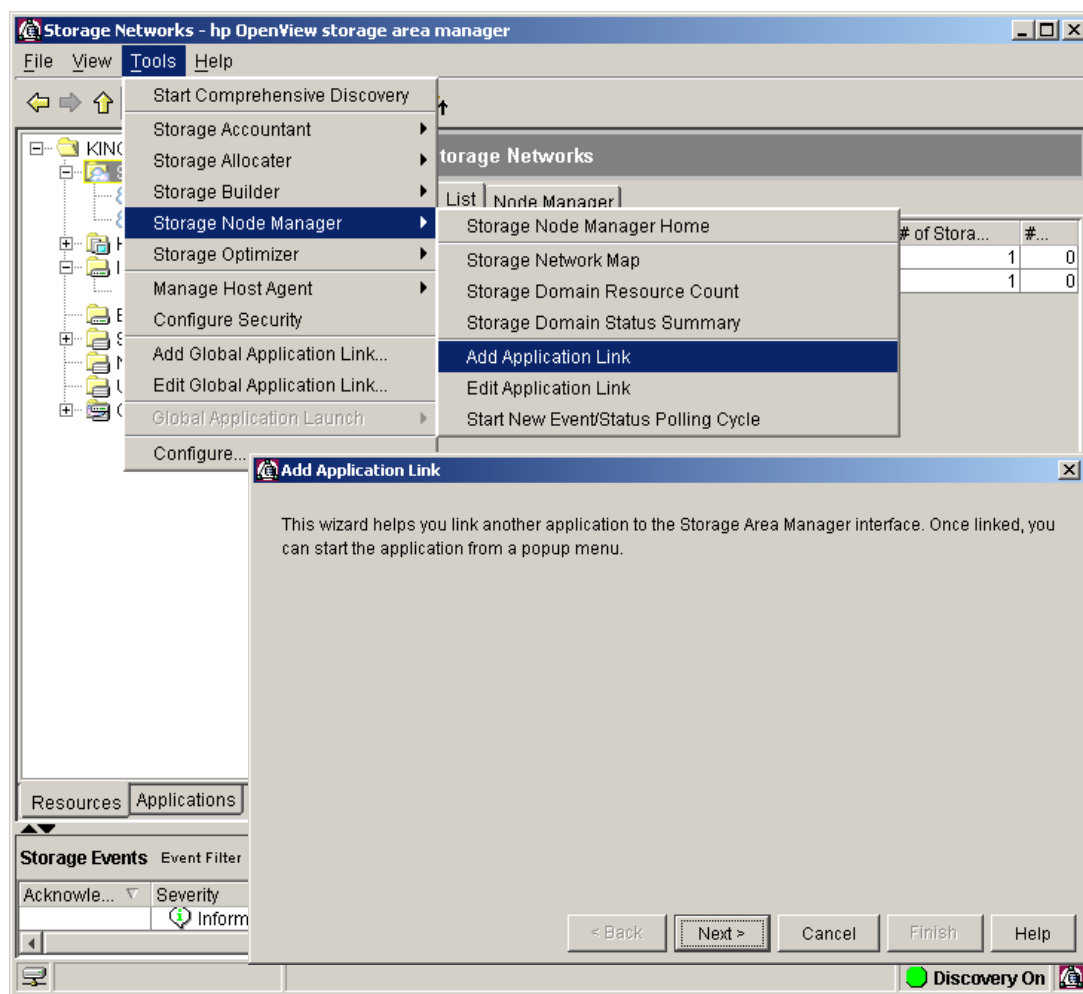


### Important

When available, Storage Node Manager also provides device manager release notes. These provide important tips on device configuration and troubleshooting.



## Linking applications to devices



The Add Application Link wizard guides you through the steps necessary to linking the application. Using this wizard is equivalent to updating the OnManage command in a device property file. However, using the wizard is recommended instead of editing the property file.

The Add Application Link wizard includes four steps:

1. Select Association Type From this screen, choose to link the application to a specific device or to a device model.

For example, you can link the application to a specific HP SureStore Hub S10 device in which case that device will have a link to start the application, or you can link the application to all HP SureStore Hub S10s in which case all devices of that model will have a link to start the application.

## 2. Associate a Device

From this screen, select the device to which you want to link the application. Once you complete the wizard, the application will appear in the drop-down menu when you right-click the device.

---

### **Note**

The application will be linked to the device you select in this window and not on a device you may have selected in the user interface when beginning this task.

---

3. Enter Application PropertiesFrom this screen, enter the application's name and type. The text you enter in the Application Name box window becomes the command you use to start the application. This command appears in a drop-down menu when you right-click the device to which you are linking the application.

The application type is based on where the application you are linking is installed. If it is installed on the management server, it is a local application, If not, it is a remote application.

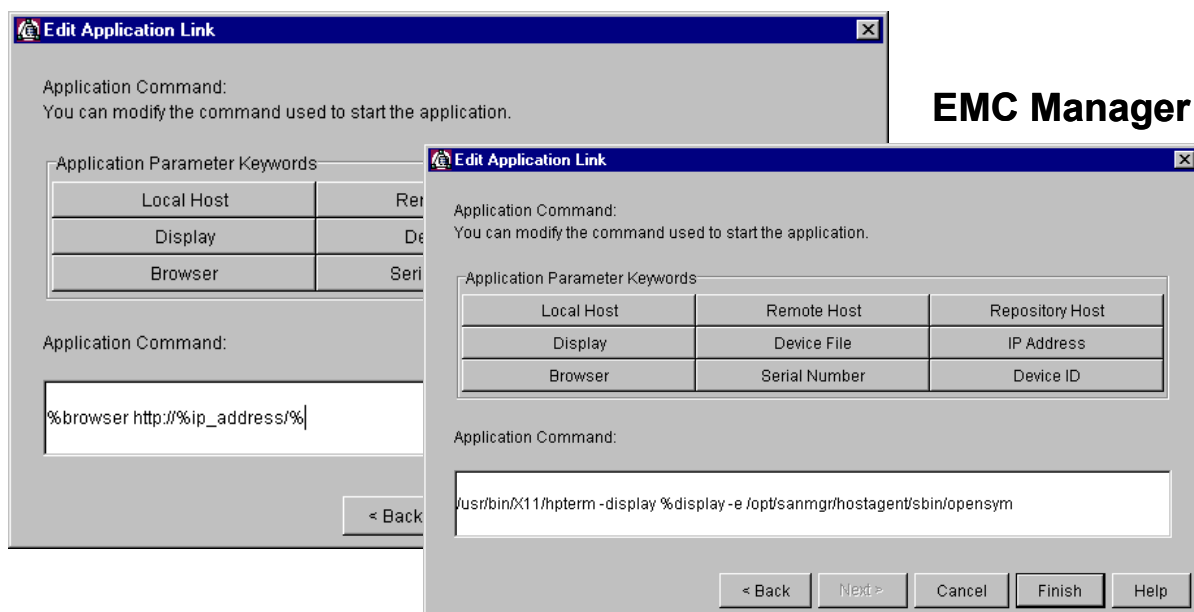
4. Enter the Application CommandFrom this screen, enter the command that starts the application you are linking. For example, the command to start the HP Brocade 2800 Gigabit Fibre Channel Switch's device management application is

`%browser http://%ip_address/.`

Also use the keyword buttons for variables that you want Storage Node Manager to pass with the command.

## Example application launch commands

### Brocade 2800



Above are example commands for launching the Brocade 2800 Web Tool and the EMC Manager. The Brocade Web Tool is accessed through a web server embedded in the switch itself. Therefore, the application command tells Storage Node Manager to launch a browser and pass it the IP address of the switch that has been selected in the navigation tree, device map, or event panel. The EMC Manager, on the other hand, is installed on the SAN host. The application command tells Storage Node Manager to launch a terminal emulation program on the connected SAN host, pass the display back to the management server, and then launch EMC manager which is installed on the SAN host. If an XP48, XP256, or XP512 CommandView web server has been converted to use SSL then you will need to edit the application link to modify the Application Command URL so that it points to the secure webserver

`%browser https://%ip_address.`

## Application parameter keywords

When creating a device-application link, the listed keywords can be used to pass device and environment information with the application command.

Keyword	Description
Display	Sends display to client
Local Host	System where the client is running
Browser	Launch a browser. Must be the first keyword
IP Address	IP address of the selected device
Remote Host *	Provides a list of available hosts
Device File *	Management path
Serial Number	Serial Number of selected device
Repository Host	Management Server
Device ID	Unique ID of the selected device

\* Including Remote Host AND Device File parameters will generate a list of hosts that the selected device is connected to

## Learning Check

1. List two types of application links.  
.....  
.....
2. Device-specific links are a feature of which Storage Area Manager application?
  - a. Storage Accountant
  - b. Storage Allocator
  - c. Storage Builder
  - d. Storage Node Manager
  - e. Storage Optimizer
3. Device management applications are pre-enabled for every device Storage Area Manager supports.  
☐ True  
☐ False
4. How are device-specific release notes accessed?  
.....
5. The Application Link wizard is used to link applications to the overall Storage Area Manager menu.  
☐ True  
☐ False
6. What application parameter keyword is used in commands for launching a web-based device manager?  
.....



### Objectives

After completing this module, you should be able to:

- List the four Storage Area Manager implementation phases.
- Describe the purpose of the SAN Verification Worksheet.
- Describe how the *Storage Area Manager Supported Components and Configuration Guide* is used to verify a customer's environment.
- List the key pre-installation tasks.
- Identify the installation tasks performed using the Setup Assistant.
- Identify key post-installation configuration tasks.
- Use the available documentation to ensure the customer environment is properly prepared for Storage Area Manager installation.

## Storage Area Manager implementation overview

The implementation of Storage Area Manager can be divided into four phases:

### 1. Verifying the SAN environment

The first step, verifying the SAN environment, is the focus of this training module. During this step, information about the customer's environment is gathered and verified against the configuration requirements.

### 2. Preparing for installation

In this second step, the implementer performs a series of tasks in preparation for the installation of Storage Area Manager. These tasks are typically performed upon arrival at the customer site before installation of the Storage Area Manager management server software or host agents.

### 3. Installing Storage Area Manager

The third step is the actual installation of Storage Area Manager on the management server. The Storage Area Manager Setup Assistant guides the implementer through the installation process, including deployment of the Host Agent software to the SAN hosts.

### 4. Setting up and configuring Storage Area Manager

In this last step, Storage Area Manager is configured for the customer environment. This process includes installing additional DPIs, configuring firewall support, configuring multi-homed systems, configuring SAN hosts and management clients that use DHCP, and so on.



## Step 1: verifying the SAN environment

During this step, information about the customer's environment is gathered and verified against:

- HP SAN configuration requirements
- HP device requirements
- Storage Area Manager configuration requirements

There are several key documents available to use in this important step:

- **SAN Verification Worksheet.** This series of Excel worksheets is used to collect information about the customer environment. When combined with a detailed SAN topology map, this provides the implementer with most of the information needed to verify compatibility and plan the implementation.
  - HP internal: <http://storage.inet.cpqcorp.net/application/view/prodcenter.asp?ProdCode=380> (under Sales Tools)
  - Americas channel partners: [https://www.partner.americas.hp.com/rrc/performance/html\\_src/channel/services/storage\\_delivery.html](https://www.partner.americas.hp.com/rrc/performance/html_src/channel/services/storage_delivery.html)
  - EMEA and AP channel partners: <http://www.hp.com/partners/csn>
- **HP OpenView Storage Area Manager Supported Components and Configuration Guide.** This guide details the operating systems, platforms, interconnect devices, software applications, and storage devices that are supported by HP OpenView Storage Area Manager. Its intent is not to provide end-to-end configuration information, but to show which devices, systems, and applications have been tested in conjunction with Storage Area Manager.
  - HP internal: <http://turbo.rose.hp.com/spock/index#OVSAM>
  - Americas channel partners: [https://www.partner.americas.hp.com/rrc/performance/html\\_src/channel/services/storage\\_delivery.html](https://www.partner.americas.hp.com/rrc/performance/html_src/channel/services/storage_delivery.html)
  - EMEA and AP channel partners: <http://www.hp.com/partners/csn>

- ***hp OpenView Storage Area Manager Installation Guide.*** Chapter one of this document covers system requirements for Storage Area Manager management servers and clients, as well as SAN host systems. This chapter also has information on the supported device types. Most of the information in this guide is duplicated in the *HP OpenView Storage Area Manager Supported Components and Configuration Guide*. Note that the installation guide is relatively static, while the *HP OpenView Storage Area Manager Supported Components and Configuration Guide* is updated on a regular basis. One requirement that is currently only addressed in the installation guide is the required operating system patches for SAN hosts.
  - HP internal and channel partners:  
**[http://ovweb.external.hp.com/lpe/doc\\_serv/](http://ovweb.external.hp.com/lpe/doc_serv/)**
- ***DPI readme files.*** New and updated DPIs are posted on the hp OpenView Device Plug-Ins website (**<http://www.openview.hp.com/products/SAM>**) after release of Storage Area Manager to provide updated features and device support. These DPI packages include a readme file with information concerning the device and its supportability. This information can be critical in determining support of a specific customer device.
- ***HP StorageWorks SAN Documentation.*** This is a group of documents that includes the SAN Design Reference Guide, SAN Fabric Interoperability information, support tables, and so on.
  - HP internal and channel partners:  
**<http://h18006.www1.hp.com/products/storageworks/san/documentation.html>**
- ***Streams Documents (Disk & Tape Devices):*** Use these documents to verify supported host specifications for storage devices. These support documents do not contain Storage Area Manager specific information.
  - HP internal:  
**[http://turbo.rose.hp.com/spock/index#Supported\\_Configurations](http://turbo.rose.hp.com/spock/index#Supported_Configurations)**
  - Americas channel partners:  
**[https://partner.americas.hp.com/rrc/performance/html\\_src/configurator/config.htm](https://partner.americas.hp.com/rrc/performance/html_src/configurator/config.htm)**
  - EMEA and AP channel partners: **<http://www.hp.com/partners/csn>**

## **SAN Verification Worksheet**

The SAN Verification Worksheet is used to collect information about the customer environment. When combined with a detailed SAN topology map, this provides the implementer with most of the information needed to verify compatibility and plan the implementation.

The SAN Verification worksheet is actually a Microsoft Excel spreadsheet that consists of the following six worksheets.

- OV SAM Hosts
- Hosts and Servers
- Attached Storage
- Fabric Devices
- Other Software
- Network
- An Additional SAN Diagram is required (Visio preferred)

**Verification worksheet: OV SAM Hosts**

The first worksheet, *OV SAM Hosts*, is used to gather information about the systems that will run the Storage Area Manager software.

Information is required for each:

- management server
- management client
- MoM client

Computer Name	OS	SP (W2K/NT)	RAM	Model
NIC 1 (yes or no)	NIC 2 (yes or no)	SAM Modules	SAM Bridge Active (Yes/No)	Disk 1, Size/Free
NIC Type (Ethernet/FC)	NIC Type (Ethernet/FC)		SAM Bridge Port	Disk 2, Size/Free
IP Address	IP Address		OV Integration Modules	Disk 3, Size/Free
FC HBA 1      PCI_x__ Other__	FC HBA 2      PCI_x__ Other__			Disk 4, Size/Free
HBA 1 Driver	HBA 2 Driver			
HBA 1 FW	HBA 2 FW			SAM IP Discovery Range
				root/admin User id & Password

The data gathered on this worksheet includes:

- Windows version & SP level
- Disk and memory configuration
- NIC and HBA (if used) information
- SAM modules to be implemented

During the inventory of hosts, the *red flag* items to look for are unsupported operating systems, minimum memory and disk requirements, and host bus adapter compatibility. During the verification step, a more detailed assessment of the support requirements will be done.

## Verification worksheet: Hosts and Servers

The *Host and Servers* worksheet is an inventory of all hosts in the SAN that Storage Area Manager will manage. Completing and verifying this sheet is usually the most time-consuming part of the planning and verification step.

Computer Name	OS	SP (V2K/NT)	RAM	Model
NIC 1 (yes or no)	NIC 2 (yes or no)	NIC 3 (yes or no)	Patches	OVPA / MVA Agent (yes/no)
NIC Type (Ethernet/FC)	NIC Type (Ethernet/FC)	NIC Type (Ethernet/FC)		OVPA / MVA Version
IP Address	IP Address	IP Address		OVPA / MVA Install Directory
FC HBA 1      PCI_X__ Other__	FC HBA 2      PCI_X__ Other__	FC HBA 3      PCI_X__ Other__		
HBA 1 Driver	HBA 2 Driver	HBA 3 Driver		
HBA 1 FW	HBA 2 FW	HBA 3 FW		root/admin User id & Password

The information on this worksheet includes:

- Computer model and memory configuration
- Operating system version and patches
- HBA make, model, driver version, and firmware revision
- OVPA agent installed and version

## Verification worksheet: Attached Storage

The *Attached Storage* worksheet is used to collect information on disk storage devices, both SAN-attached and direct-attached storage.

It includes five sections:

- SAN Attached Disk Storage
- Software
- SAN Attached Tape Storage
- Direct Attached Storage
- Total LUNs and Storage

<b>Section 5.0: SAN Attached Disk Storage</b> ***				
Instructions: Fill in the information for all Disk Storage Devices attached to the SAN being certified				
Disk Device Name	Vendor	Model	# LUNs & Mode:	Firmware
	IP Address / Usage	IP Address / Usage		

<b>Section 6.0: Software included with a Storage Device (CommandView, PerformanceAdvisor, SecureManager, etc)</b>				
Instructions: List the software associated with a particular Storage Device				
Associated with (Device Name):	Software Name	Revision	System	

<b>Section 7.0: SAN Attached Tape Storage</b>				
Instructions: Fill in the information for all Tape Storage Devices attached to the SAN being certified				
Disk Device Name	Vendor and Model	Library Firmware	SCSI Bridge Vendor & Model	SCSI Bridge Firmware

<b>Section 8.0: Direct Attached Devices (Not connected directly to the SAN)</b>				
Instructions: Fill in the Name and Model Number of any such devices				
Disk Device Name	Vendor	Model	Type	Firmware

<b>Section 9.0: Total LUNs and Storage</b>				
Instructions: Use the _____ to calculate the total number of LUNs. Also calculate total storage				
Total LUNs				
Total Storage				

The information collected in this worksheet includes device names, vendor, model, firmware revisions, and LUN counts.

Information concerning any software used to configure or manage the device (CommandView, and so on.) is collected here. This worksheet is also used to collect information on the SAN-attached tape storage, along with its firmware revisions, SCSI bridge adapter, and revision information.

## Verification worksheet: Fabric Devices

The *Fabric Devices* worksheet is used to capture information about fibre channel switches and port connections, including the switch zoning configuration.

It includes two sections:

- Switch Setup
- Switch Zoning

<b>Section 10.0: Switch Setup</b>				
Instructions: Provide info for what is connected to each port on the switch. Also advise what GBIC type and cable type is used.				
Switch #1 Name	Vendor	Model	Type	Firmware
Port 0	Port 1	Port 2	Port 3	Port 4
Port 5	Port 6	Port 7	Port 8	Port 9
Port 10	Port 11	Port 12	Port 13	Port 14
Port 15	Port 16	Port 17	Port 18	Port 19
Port 20	Port 21	Port 22	Port 23	Port 24
Port 25	Port 26	Port 27	Port 28	Port 29
Port 30	GBIC Type	Cable (fiber/copper/size)	Can a "SupportShow" log be provided to us for review? N/A	IP Address
<b>Section 11.0: Switch Zoning</b>				
Instructions: For each zone, indicate what elements are present in the zone.				
Zone Name	Zone Name	Zone Name	Zone Name	Zone Name
Elements in the zone:	Elements in the zone:	Elements in the zone:	Elements in the zone:	Elements in the zone:

Use this worksheet to ensure that there are enough ports available for all fibre channel HBA connections. The switch zoning information is critical to ensuring hosts will be able to access the LUNs configured for their use and to manage fibre channel network performance.

**Verification worksheet: Other Software**

The *Other Software* worksheet lists all other software that is being used to manage or gather information about the SAN. For example:

- OVPA / MeasureWare Agent
- OpenView Software
- Failover Software
- AutoPath

**Section 12.0: Other Software**

Instructions: List all other software that is being used to manage or gather information about the SAN

Software Name	Revision	Purpose	System

HP OpenView software products including OVPA/MeasureWare agents or any other management software (for example, HP-UX Logical Disk Manager), should be listed here.



## Verification worksheet: Network

The *Network* worksheet is used to gather basic network configuration information including:

- DNS server and domain information
- Windows domains and PDC
- DHCP use
- Firewall information

### Section 13.0: Network Information

Instructions: Provide the following information concerning the networks associated with your SAN and SAN Host systems

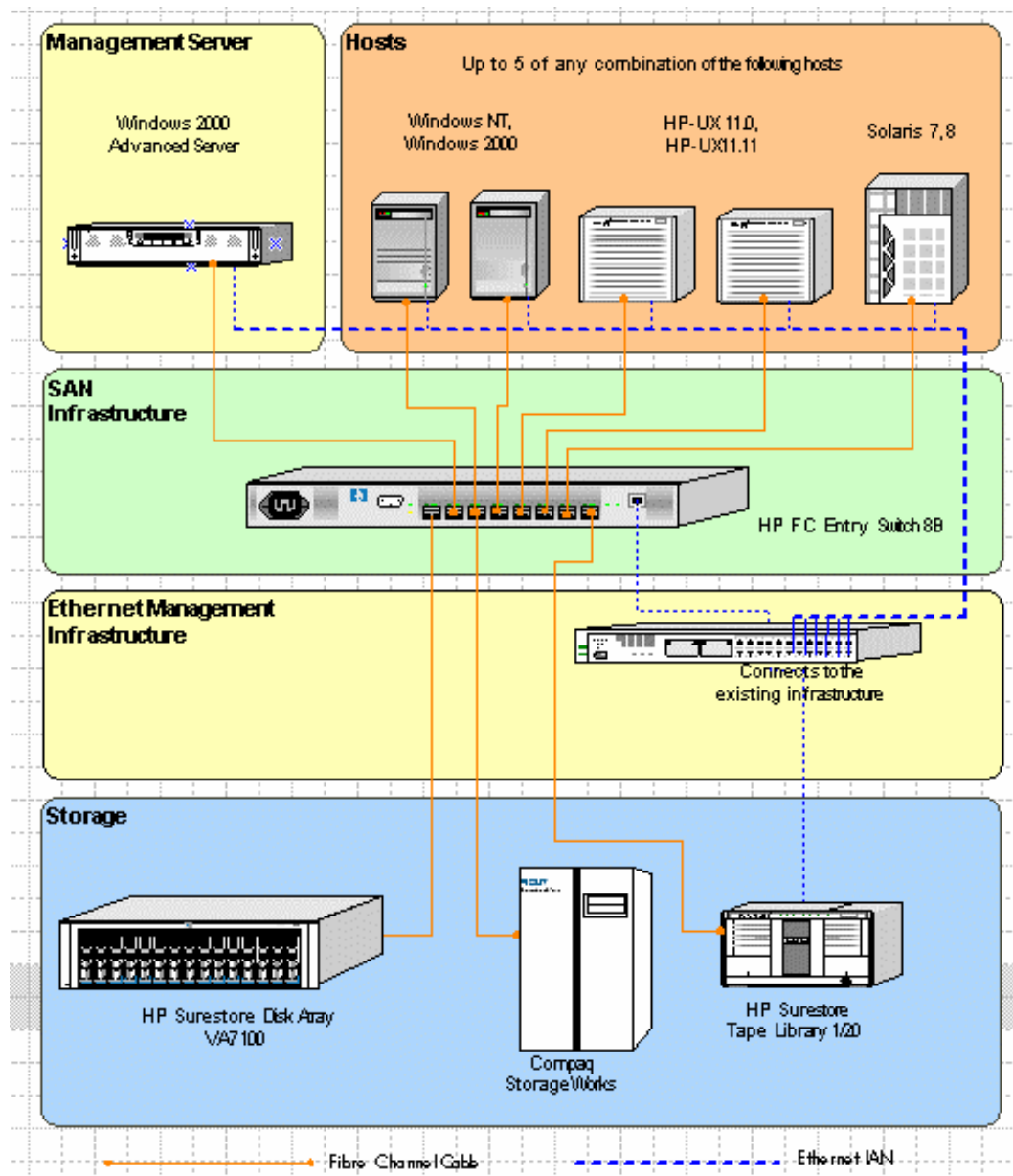
#1 DNS Server Name	#1 DNS Server IP Address	#1 IP Subnet Addr	#1 IP Subnet Mask	#1 IP Subnet Usage
#2 DNS Server Name	#2 DNS Server IP Address	#2 IP Subnet Addr	#2 IP Subnet Mask	#2 IP Subnet Usage
DHCP Server Name	DHCP Server IP Address	#3 IP Subnet Addr	#3 IP Subnet Mask	#3 IP Subnet Usage
#1 Windows Domain	#1 Windows Domain PDC	#1 Windows Domain Usage		
#2 Windows Domain	#2 Windows Domain PDC	#2 Windows Domain Usage		

### Section 14.0: Firewalls

Instructions: Provide information concerning firewalls that could affect communication within the SAN or between the SAN and host systems

Firewall #1 Name	Firewall #1 IP Addresses	Make / Model	Version	Type (Port Filtering / NAT)
Firewall #1 Role (Describe firewall role)				
Firewall #2 Name	Firewall #2 IP Addresses	Make / Model	Version	Type (Port Filtering / NAT)
Firewall #2 Role (Describe firewall role)				

## SAN diagram



The SAN Diagram shows all devices and connections that exist in the customer's SAN.

Use it in conjunction with the SAN Verification Worksheet to verify that Storage Area Manager supports the SAN environment.

## Supported Components and Configuration Guide

The *hp OpenView Storage Area Manager Supported Components and Configuration Guide* is intended to document the operating systems, platforms, fabric devices, software, and storage devices that are supported by Storage Area Manager. A version of this document exists for each release of Storage Area Manager. The document acts as a supplement to the installation guide.

This document works hand-in-hand with the SAN Verification Worksheet to help perform a complete survey of a customer's environment to ensure successful implementation of Storage Area Manager. A completed SAN Verification Worksheet should be compared with this document to determine Storage Area Manager's supportability and dependency requirements before installation.

Below is a description of some of the key contents included in the guide.

### **3 - Installation Platforms**

This section documents the specifications for management servers, management clients, MoM clients, and SAN hosts. This includes operating system support, service packs, and minimum hardware configuration. For SAN Hosts, it also documents supported hardware platforms, HBAs and driver versions, required system patches (currently missing from the 3.0 version of the guide), and whether Storage Allocator can be activated on each host type.

### **4 - Software Applications**

This section documents the software applications and versions on which Storage Area Manager is dependent. This includes device management applications (such as CommandView XP, CommandView SDM, SureStore AM60, and so on) as well as the OpenView Performance Agent and the OpenView products with which Storage Area Manager can be integrated (OVO/Unix, OVO/Windows, Reporter, and Service Desk).

It also documents the software applications whose co-existence with Storage Area Manager has been tested. This includes clustering/multi-path software (MS Cluster Server, HP HA/SG configurations, and Veritas), AutoPath software, and backup software.

## **5 - Fail-Over Support**

This section lists the fail-over configurations that have been verified to work with Storage Area Manager. Note that while Storage Area Manager can co-exist with the listed clustering and multi-path applications, it does not as a whole run as an application that can be configured to fail over in high-availability environments. The Storage Area Manager services that run on the management server can be configured to fail over in high-availability configurations, but Host Agents cannot.

## **6- Supported HBAs/Drivers**

This section lists the FC and SCSI HBAs and drivers supported by Storage Area Manager 3.1 in all supported OS (for example, HP-UX, and Solaris) and server IO backplane (for example, PCI, PCIx, CPCI, and S-bus) platforms.

## **7 - Supported Devices**

This section lists the supported interconnect devices (hubs, switches, and bridges) and storage devices (FC and SCSI disks and tapes). This information includes product names, version numbers, supported host operating systems, device management software, and a summary of the supported device-specific Storage Area Manager features.

## Step 2: preparing for installation

The *hp OpenView storage area manager installation guide* is the primary installation resource. A printed version ships with the product CD-ROM. Additionally, .pdf versions are available from the Help menu and in the \sanmgr\doc directory.

See the installation guide for more information on completing pre-installation tasks listed below.

### Pre-installation tasks

The following is a list of tasks that should be completed before installing Storage Area Manager:

- Apply patches/updates to host systems.
- Apply HBA and SNIA files to host systems.
- Apply patches and updates to devices.
- For Storage Optimizer installations only: Modify HP OpenView Performance Agent or HP OpenView VantagePoint for Windows on each SAN host from which you want to extract performance data.
- For Storage Allocator installations only: Ensure operating-specific requirements are met according to instructions in *Installation Guide*.
- Determine IP address discovery range and name resolution configuration.
- Ensure SAN host requirements are met.
- Read Release Notes to determine any special requirements.
  - For example, required install and uninstall sequence with CommandView SDM and CommandView XP

## Host Requirements

In addition to hardware requirements, Storage Area Manager requires the following criteria be met.

### HP-UX, Solaris, and AIX hosts

- root/superuser account access to system
- TCP/IP installed and operational
- /opt, /etc, /var directories exist (with adequate disk space)
  - Additionally, for AIX, / and /usr directories must also exist (with adequate disk space)
- /etc/hosts file and/or DNS have correct entries for the SAN host and management server
- For remote Host Agent deployment
  - rexec and ftp enabled with root access (/etc/inetd.conf)

### Tru64 hosts

- root/superuser account access to system
- TCP/IP installed and operational
- /opt, /etc, /var directories exist (with adequate disk space)
- /etc/hosts file and/or DNS have correct entries for the SAN host and management server
- For remote Host Agent deployment
  - rexec and ftp enabled with root access (/etc/inetd.conf)telnet enabled

### Linux hosts

- root/superuser account access to system
- TCP/IP installed and operational
- /opt, /etc, /var directories exist (with adequate disk space)
- /etc/hosts file and/or DNS have correct entries for the SAN host and management server
- For remote Host Agent deployment
  - rexec, wu-ftpd, and rlogin services enabled with root access

**Netware hosts**

- /sys directory exists (with adequate disk space)
- For remote Host Agent deployment
  - Netware client must be installed on the management server
- /system device directory exists (with adequate disk space)
- Administrator account access to the system
- TCP/IP installed and operational
- Adequate disk space on installation drive
- For remote Host Agent deployment:
  - Shareable system drive
  - WINS configured
    - ◆ Set WINS servers
    - ◆ Enable DNS for Windows Resolution
- Enable LMHOST lookup

**OpenVMS****Windows hosts**

## Pre-installation tips

Before visiting the customer site to install Storage Area Manager, create a CD with the following additional software that will be required for the installation:

- Storage Area Manager and host system patches
  - HP OpenView patch website:  
**<http://support.openview.hp.com/patches>**
  - Check with the host system vendor
- New DPIs
  - HP OpenView DPI website:  
**<http://www.openview.hp.com/products/SAM>**
- The latest Storage Area Manager approved HBA and SNIA files
  - Check the HBA vendor website.

Additionally, consider the following regarding Storage Area Manager licenses:

- Licenses are tied to specific machines. Make sure that the customer does not intend to move Storage Area Manager to another system.
- Calculate the customer's storage to make sure that they have purchased enough licenses to support their environment.



## Step 3: Installing Storage Area Manager

The Storage Area Manager installation process includes installing the software on the management server, using the Database Control wizard to create a new database, adding permanent licenses (optional), and then using the Setup Assistant to complete the following tasks:

- Set the storage domain name
- Set the device discovery range(s)
- Set the Storage Accountant currency type (if applicable)
- Install the Host Agent software on all SAN hosts
- Activate Storage Allocator on all SAN hosts (if applicable)
- Start the device discovery process

The installation process is described in detail in module 8.

## Step 4: Setting up and configuring Storage Area Manager

The setup and configuration steps that need to be performed after installation of Storage Area Manager depend on the customer's environment. Possible tasks include:

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**Note**

See the installation guide and installation module for detailed information on the configuration tasks listed below.

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- Installing additional DPIs
- Adding undiscovered hosts
- Activating Storage Allocator using the Activation Wizard
- Associating unknown devices
- Associating inferred hubs
- Renaming discovered devices
- Customizing the device maps
- Customizing event handling (filters, triggers, and automatic deletion)
- Configuring device and global application links
- Setting up management clients
- Installing and configuring Storage Area Manager MoM
- Configuring SAN hosts and management clients for DHCP
- Configuring firewall support
- Configuring multi-homed systems
- Integrating Storage Area Manager with other HP OpenView applications
- Integrating Storage Area Manager with other framework applications (SNMP trap forwarding, application launching and so forth)
- Configuring Storage Allocator, Storage Accountant, Storage Builder, and Storage Optimizer

## Learning check

1. List the name of the document that is the primary source of information regarding devices supported by Storage Area Manager.  
.....
2. What is the purpose of the SAN Verification Worksheet and who is the intended audience?  
.....  
.....
3. List three tasks that need to be performed before installing Storage Area Manager.  
.....  
.....  
.....
4. List three tasks that might need to be performed (depending on the customer environment) after installing Storage Area Manager on the management server and deploying the Host Agent software.  
.....  
.....  
.....

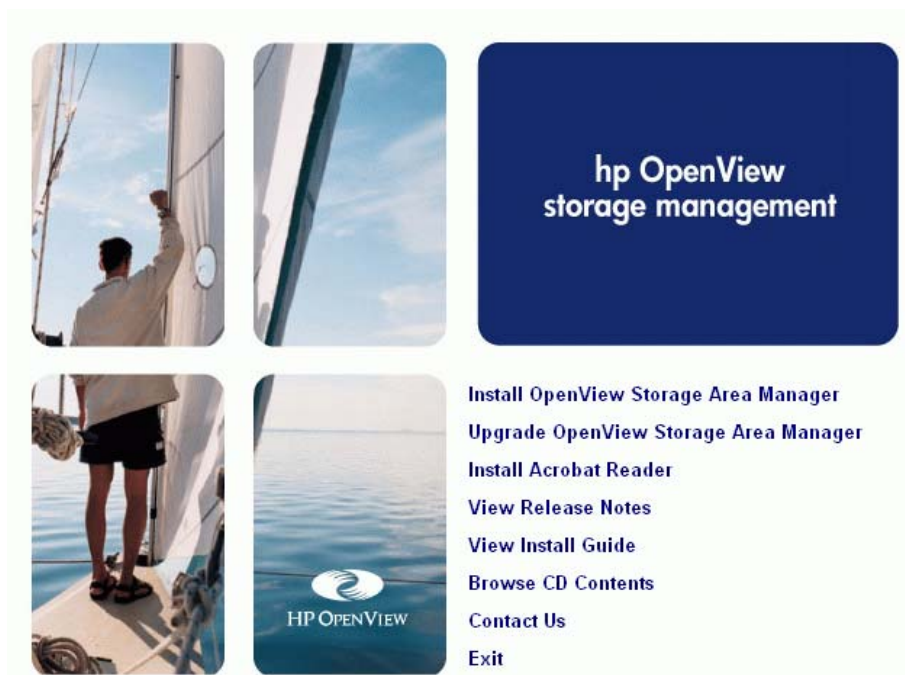


### Objectives

After completing this module, you should be able to:

- Use the Setup Assistant to install Storage Area Manager.
- Identify post-installation tasks.
- Identify the authorization files that reside on the management server and SAN host.
- Configure SAN hosts and management clients that use DHCP.
- Configure passphrases.
- Configure multi-homed systems.
- Identify firewall configurations supported by Storage Area Manager.
- Configure Storage Area Manager to communicate across firewalls.
- Install Storage Area Manager licenses.

## Installing Storage Area Manager



To install Storage Area Manager on the management server:

1. Log onto the system (the management server) on which Storage Area Manager will be installed.
2. Close all Windows applications and disable any antivirus programs before continuing with the Storage Area Manager installation.
3. Insert the hp OpenView storage area manager CD-ROM in the CD-ROM drive.
  - If autorun is enabled, the Installation wizard automatically starts and the Introduction window displays.
  - If autorun is disabled, run `Setup.exe` from the CD-ROM. This file is located in the root directory of the CD-ROM. The Introduction window displays.

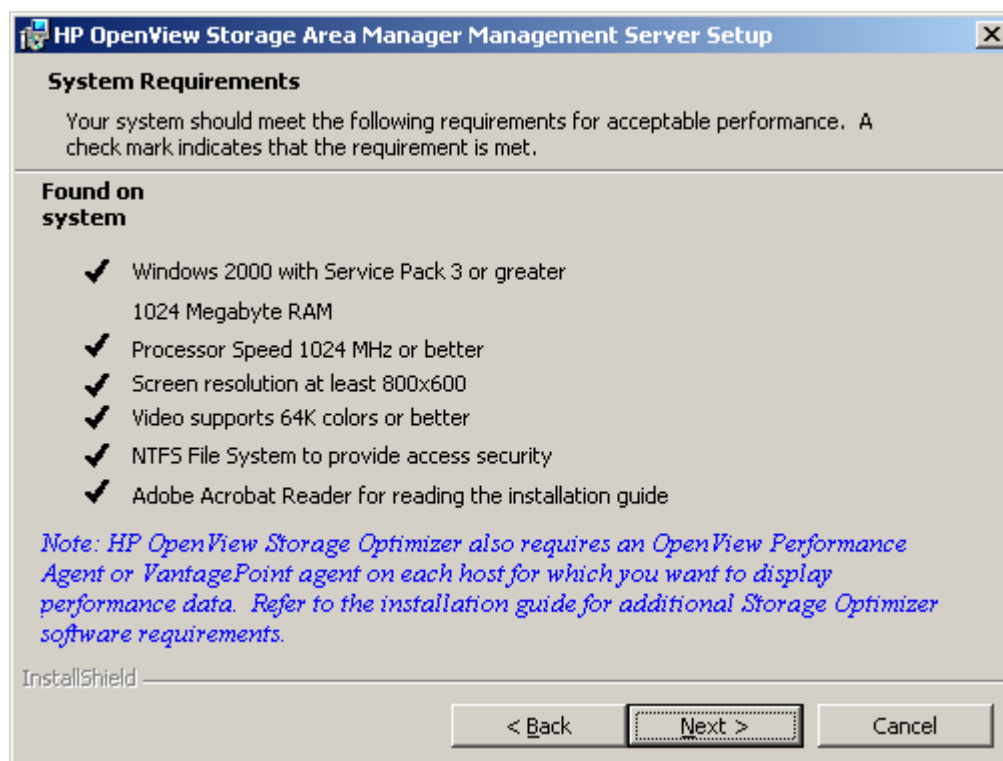
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### Note

You must have administrator privileges for this system to be able to install and start Storage Area Manager.

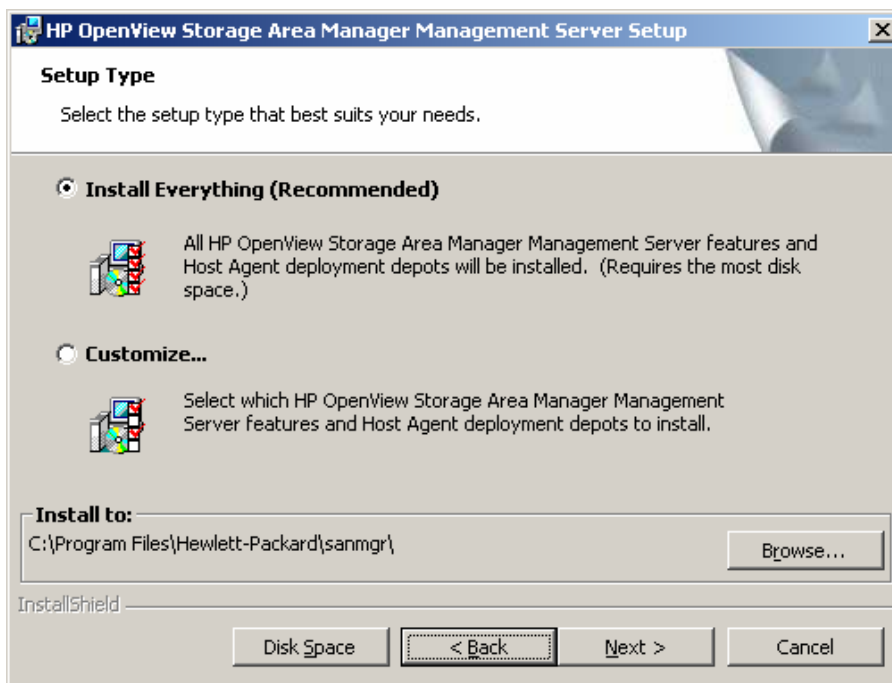
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## Meeting system requirements



Before installation takes place, Storage Area Manager verifies that this system meets or exceeds minimum requirements for the management server. Installation may continue if these requirements are not met. However, Storage Area Manager may not perform optimally.

## Recommended setup



The recommended setup type, *Install Everything*, installs all Storage Area Manager applications to the default location C:\Program Files\Hewlett-Packard\sanmgr\.

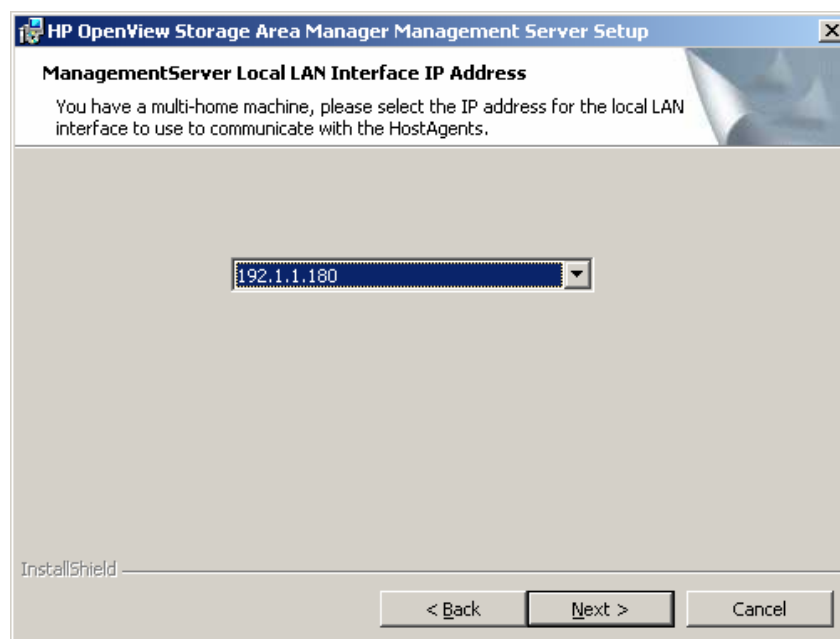
To customize the Storage Area Manager installation, select *Customize...*

To change Storage Area Manager's installation directory, click the *Browse* button.

To display the disk space of the management server's drives, click the *Disk Space* button.

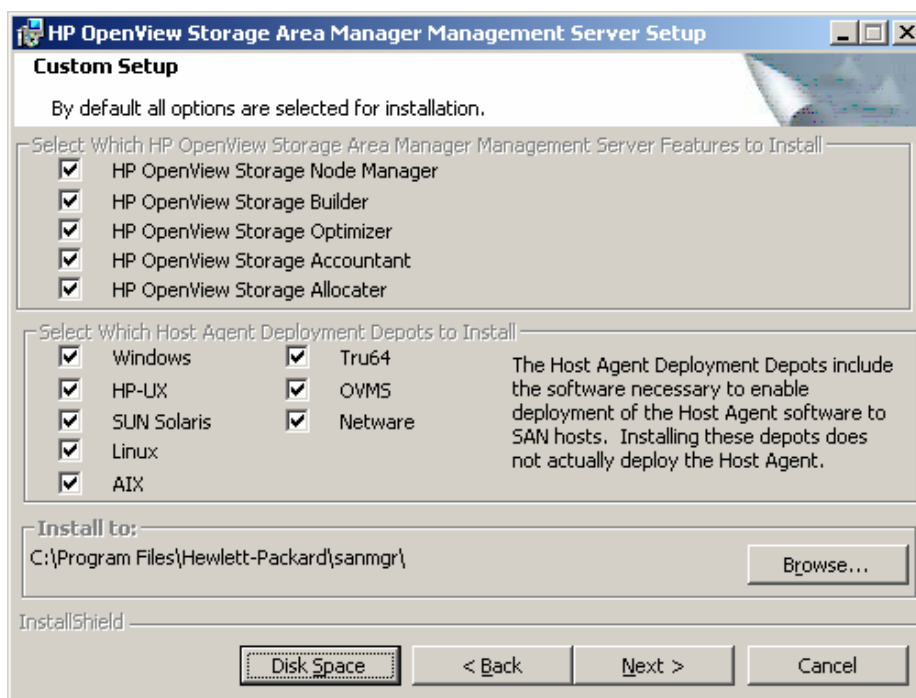


## Multi-homed management servers



If the machine on which you are installing Storage Area Manager is multi-homed, the Local LAN Interface IP address window displays.

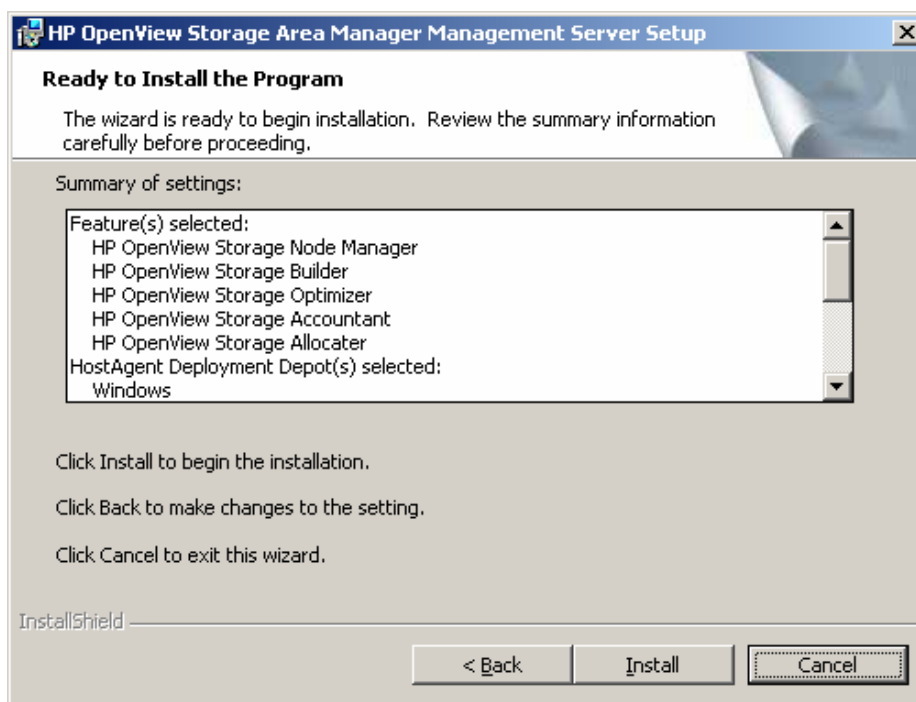
## Custom Setup window



To customize a Storage Area Manager installation, use the Custom Setup window to specify which Storage Area Manager applications and which Host Agent deployment depots to install.

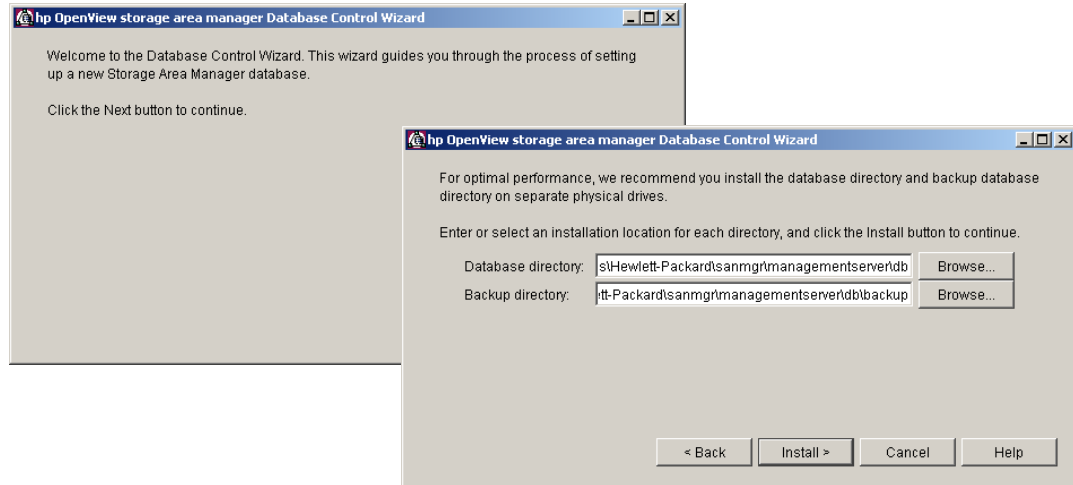
The Host Agent deployment depots include the software necessary to enable deployment of the Host Agent software to SAN hosts. Installing these depots does not actually deploy the Host Agent. If you choose not to install a Host Agent deployment depot for a specific operating system, but intend to manage hosts of that type, you must install the Host Agent software locally (using the product CD) on those machines.

## Ready to Install the Program window



The Ready to Install the Program window displays a summary of Storage Area Manager applications and Host Agent Deployment Depots that are selected for installation. Click the *Back* button to make any changes. Click the *Install* button to begin installation.

## Database Control Wizard



At the end of the Storage Area Manager installation process, the Database Control wizard Welcome window displays. Use the Database Control wizard to create a new database and change the database and backup directory locations from the default location to a preferred location.

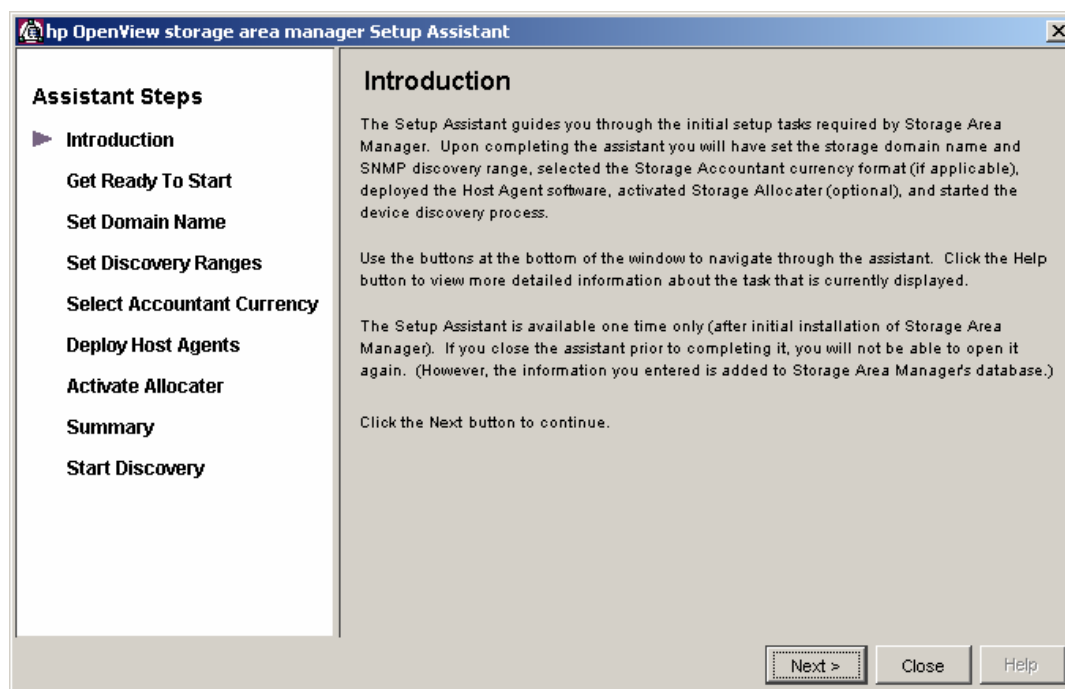


### Important

HP recommends installing the database and backup directories on separate physical drives.

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## Setup Assistant



After installing Storage Area Manager, running the Database Control wizard to create a new database, and adding permanent licenses (optional), the user interface automatically starts and the Setup Assistant Introduction window displays.

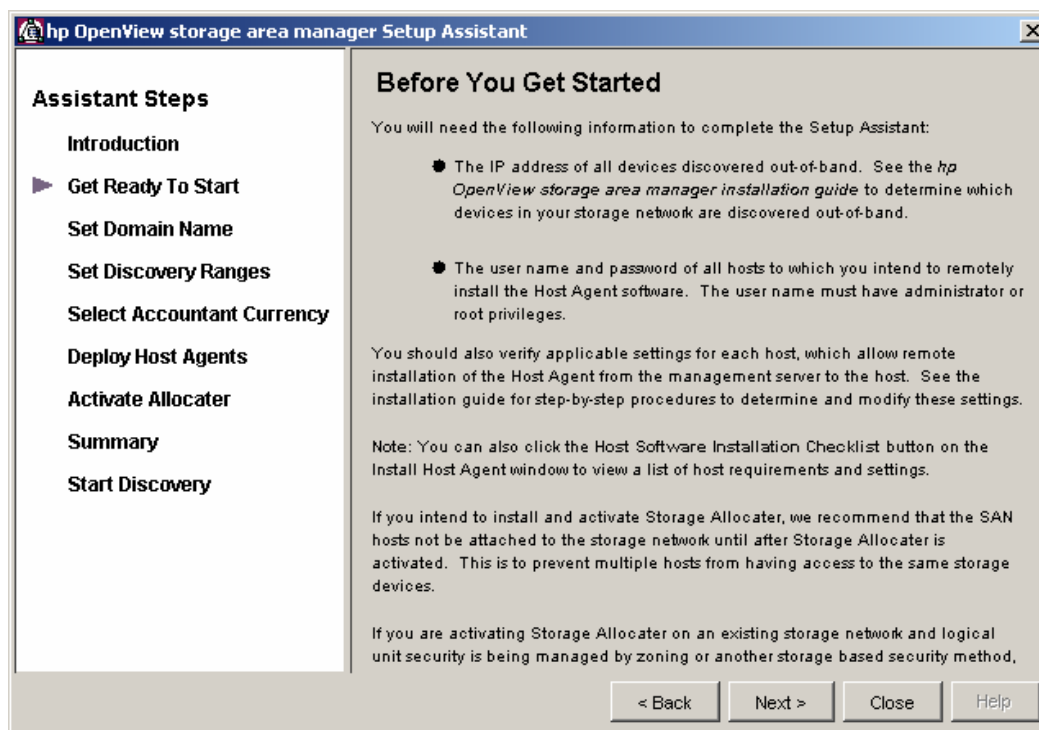
Use the Setup Assistant, to complete the following tasks:

- Set the storage domain name
- Set the device discovery range(s)
- Set the Storage Accountant currency type (if applicable)
- Install the Host Agent software on all SAN hosts
- Activate Storage Allocator on all SAN hosts (if applicable)
- Start the device discovery process

Depending on the environment, additional setup tasks may be required, for example:

- Adding undiscovered hosts
- Associating unknown devices
- Associating inferred hubs
- Renaming devices

## Getting ready to start



To use the Setup Assistant, you will need the following information:

- The IP address of all SNMP devices (discovered out-of-band). See the *hp OpenView storage area manager installation guide* for a list of supported devices that are discovered out-of-band.
- The user name and password of all hosts to which you intend to remotely install the Host Agent software. The user name must have administrator privileges.

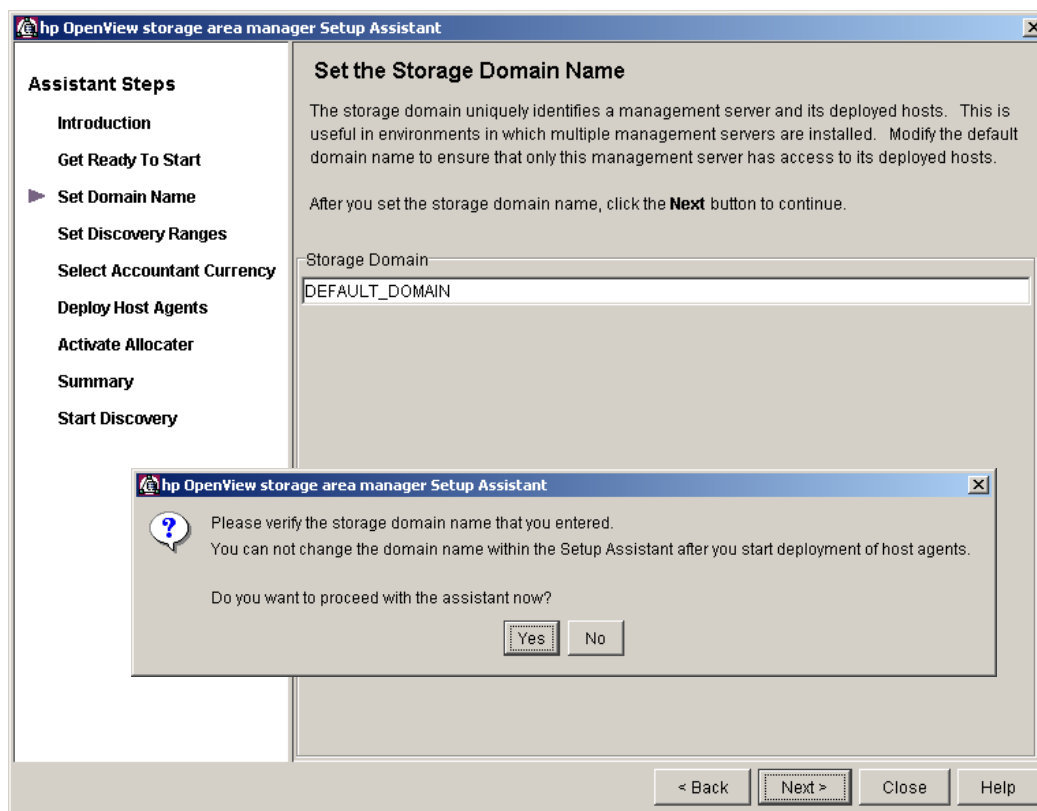
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### Note

Verify applicable settings for each host, which allow remote installation of the Host Agent from the management server to the host. See the *hp Openview storage area manager installation guide* for step-by-step procedures to determine and modify these settings. Alternatively, click the *Host Software Installation Checklist* button on the Install Host Agent window to view a list of host requirements and settings.

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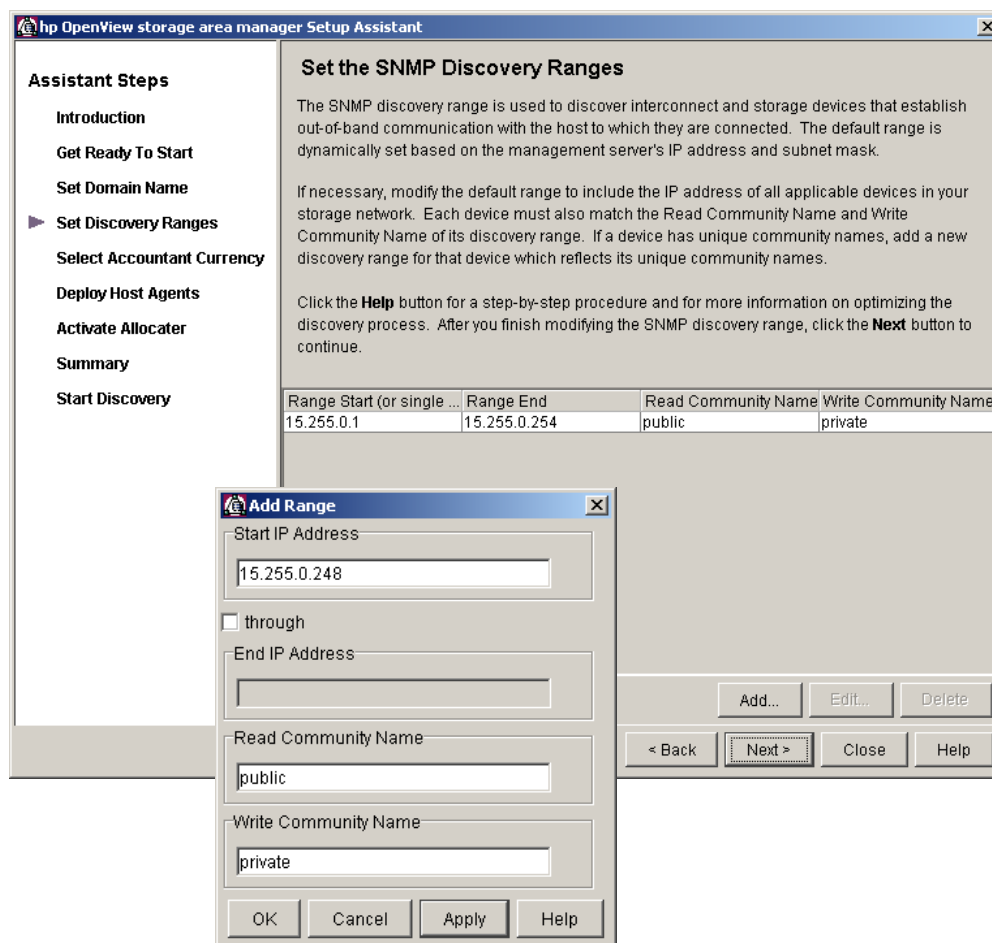
## Setting the storage domain name



Storage Area Manager's storage domain uniquely identifies a management server and its deployed hosts. This is highly recommended in environments in which multiple management servers are installed.

When you remotely install the Host Agent software on a SAN host, that host is uniquely identified by the management server's storage domain name. The host is not available to any other management server. However, if you accept the default storage domain name, `DEFAULT_DOMAIN`, then deployed hosts may be available to other management servers that are also using the default name.

## Setting the SNMP discovery range



The SNMP discovery range represents a range of IP addresses within which Storage Area Manager attempts to discover devices it supports through out-of-band communication. *Out-of-band communication* refers to devices that communicate with the management server using a protocol other than fibre channel (for example, the SNMP protocol).

The Storage Area Manager discovery process searches the storage network for each IP address within the discovery range and successfully discovers devices that meet the following criteria:

- The device is supported by Storage Area Manager
- The device's IP address is within the discovery range
- The device's read community and write community names exactly match those represented by the applicable discovery range (the community names are case sensitive)



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**Note**

The SNMP discovery range is used to discover interconnect and storage devices that establish out-of-band communication with the management server. You do not need to include SAN host IP addresses in the discovery range because SAN hosts are discovered through the Host Agent software.

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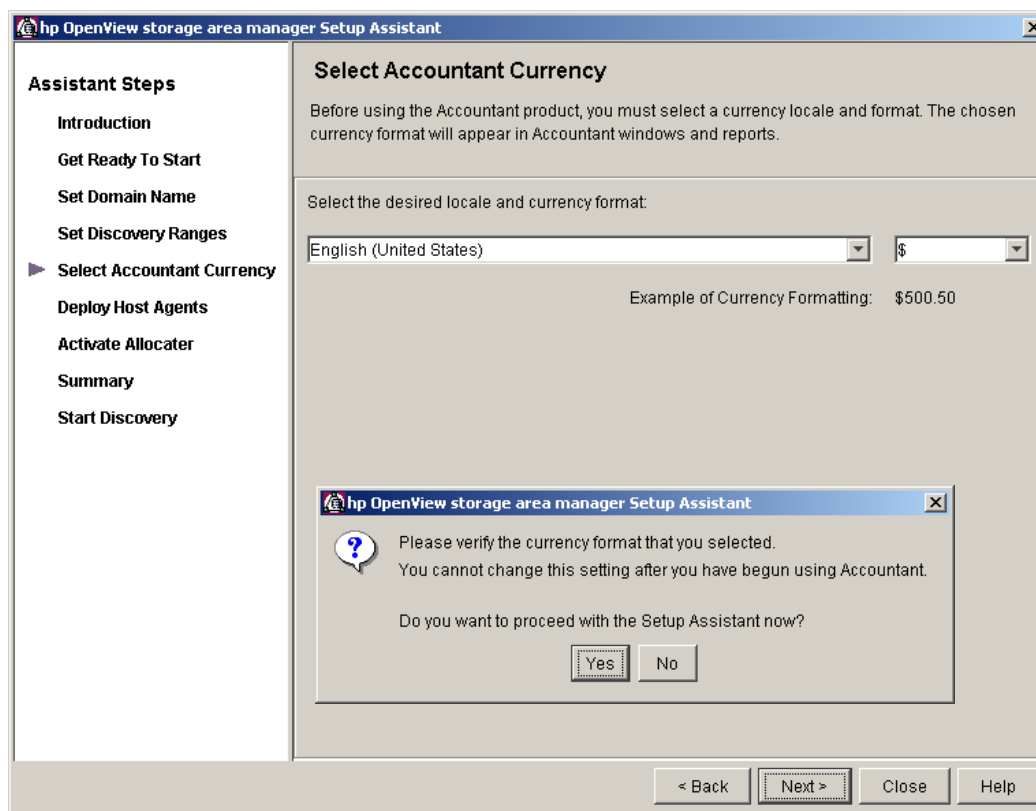
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**Important**

To reduce the amount of time it takes to discover devices, minimize the number of non-applicable IP addresses you include in a discovery range. For example, if you have two devices with IP addresses of 15.83.3.1 and 15.83.3.75, consider adding two separate entries rather than one entry with a range that covers both IP addresses.

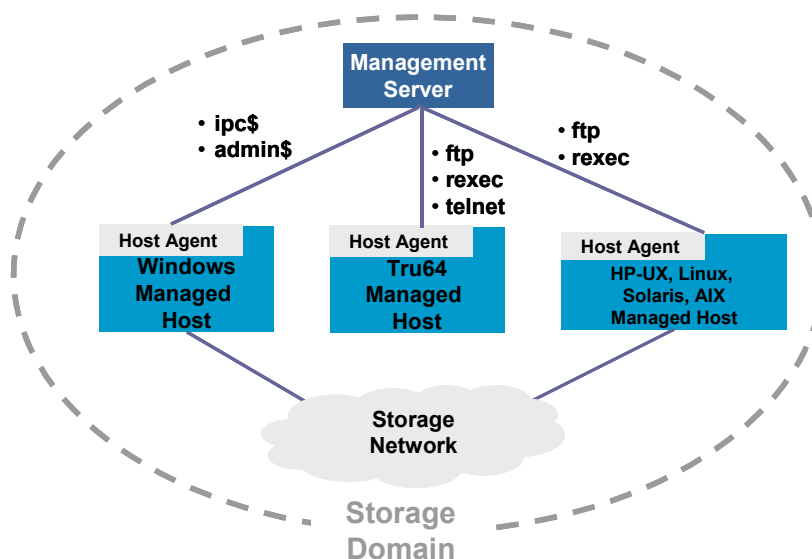
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## Selecting Accountant currency



Storage Accountant is able to display its financial data in many different locales and currency formats. However, you must select the currency setting before Storage Accountant can store information in the database. You cannot modify the currency format setting after completing the Setup Assistant. The default settings are based on the management server's locale setting.

## Deployment process



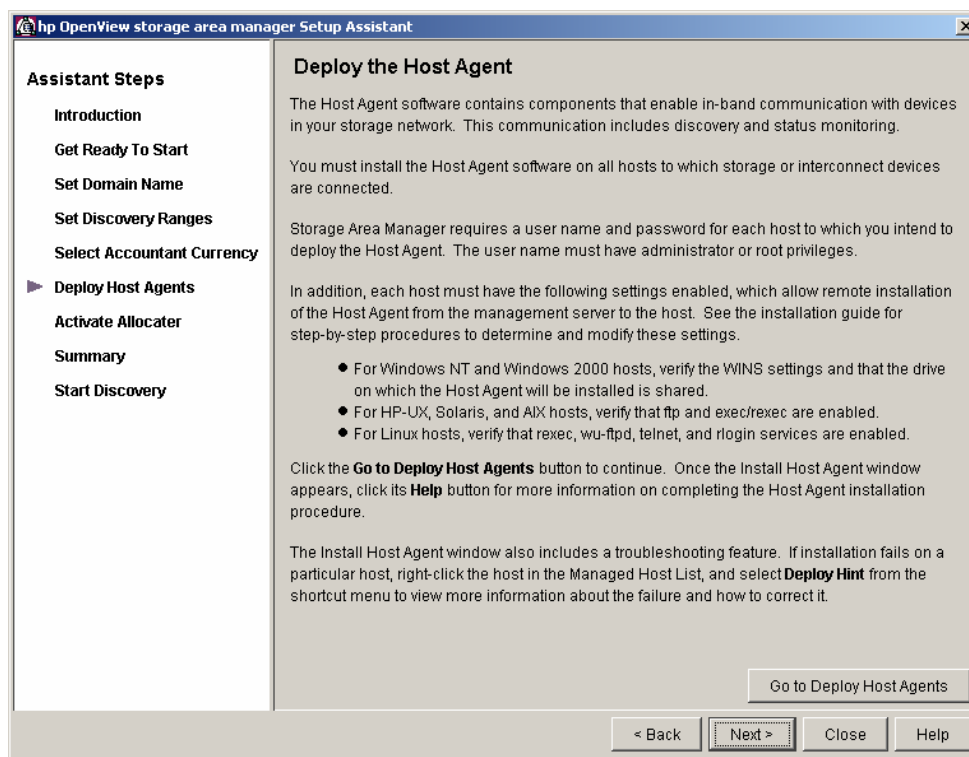
Deployment of the Host Agent is performed using ftp and rexec to Unix hosts and using admin\$ and ipc\$ for Windows hosts.

First time deployment requires Administrator access on Windows systems and root access on Unix systems. Starting with the 3.1 release, the Administrator/root user IDs are not required to perform the following deployment functions:

- update the host agent framework
- install and remove packages
- send the Host Agent configuration information

Instead, these deployment functions are performed via the management server/host agent JCORE/RMI communication path.

## Deploying Host Agent software



Host Agent software contains components that enable in-band communication with devices in the storage network.

The Host Agent software also contains components that enable performance and capacity data collection for the Storage Optimizer and Storage Builder applications

Install the Host Agent software on all hosts to which storage or interconnect devices are connected. Storage Area Manager offers two methods for installing the Host Agent:

- **Remotely** from the management server to each SAN host.
- **Locally** from the Storage Area Manager product CD.

To remotely install the Host Agent software to a particular operating system, you must have installed that platform's deployment depot when you installed Storage Area Manager.

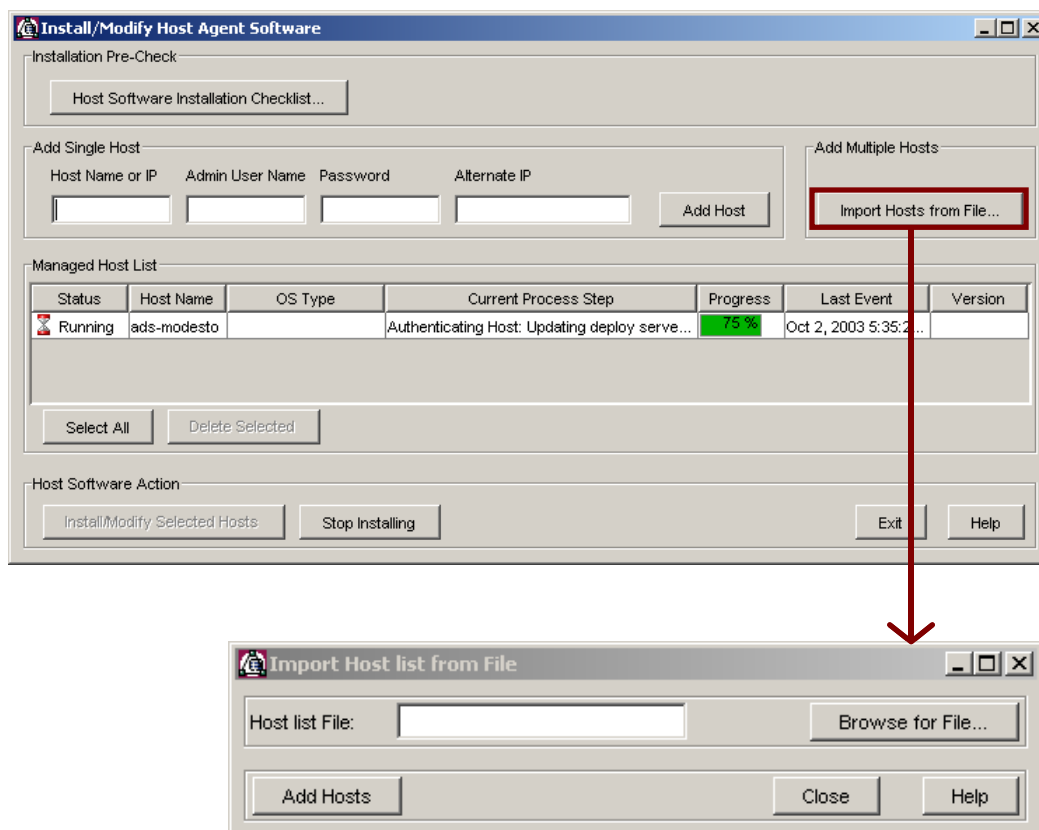


### Important

The Setup Assistant is able to activate Storage Allocator only on hosts on which the Host Agent is installed remotely by the Setup Assistant.

---

## Adding SAN hosts to the deploy list



The Install Host Agent window offers three methods for building the list of hosts on which Storage Area Manager attempts to remotely install the Host Agent:

- Add one host at a time to the list
- Add multiple hosts to the list at one time
- Import a list of hosts from a file

By default, the Managed Host List table contains a list of hosts that are in the NT domain of the management server. These are usually only NT systems.

---

### Note

Click the *Host Software Installation Checklist* button to view the system requirements and required settings for each supported operating system.

---

### Note

Hostnames are limited to eight characters for HP-UX, Solaris, and AIX hosts. If you enter a hostname that has more than eight characters, any characters beyond eight will be ignored.

---

To add one host at a time:

1. Enter the hostname or the IP address of the host to which you want to install the Host Agent software in the Host Name or IP box. If this host is not within the management server's network domain, enter its fully qualified DNS name.
2. Enter a user name for this host in the Admin User Name box. The user name must have administrator, root, or superuser privileges for the host.
3. Enter the password for this user name in the Password box.
4. Click the *Add Host* button. Storage Area Manager confirms the hostname, user name, and password and adds the host to the managed host list if all are valid.
5. Repeat steps 2 through 4 for each host to which you want to remotely install the Host Agent software.

To import a .txt file of hosts along with their usernames and passwords, click the *Import Hosts from File* button.

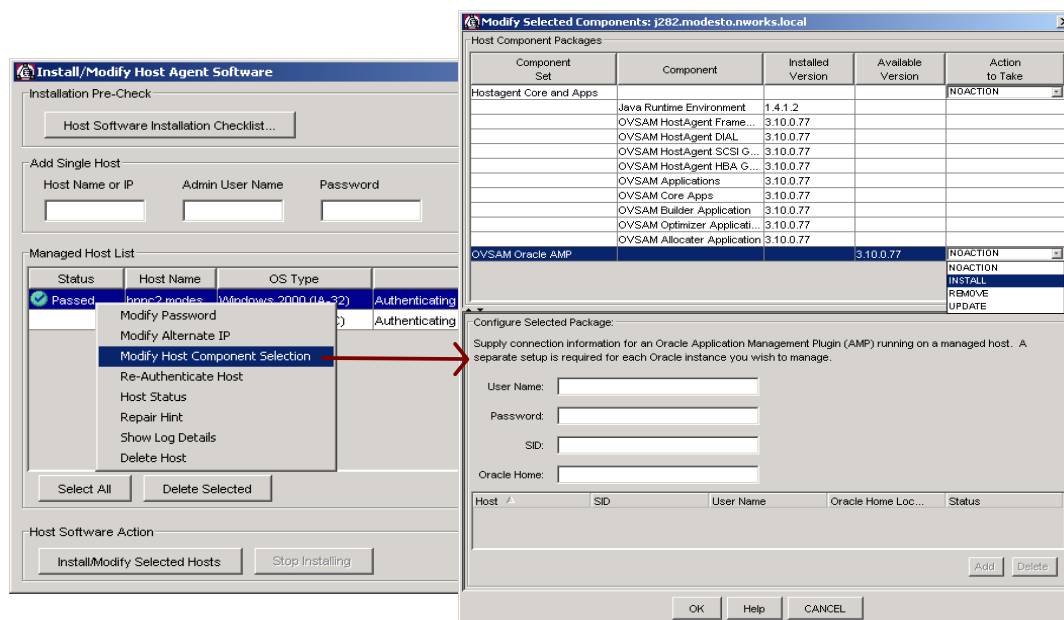
The following restriction apply to this file:

- It must be a .txt file.
- The first line must contain the tag "hotlist".
- Each host must occupy a separate line.
- The format for each host must be <hostname>, <username>, <password>. Hostname is required. Username and password are optional.
- Valid delimiters include commas, a black space, and a tabbed space.

For example:

```
<hostlist>
winhost1, user1, pass1
winhost2, user2, pass2
uxhost1, user1, pass1
uxhost2, user2, pass2
```

## Selecting which Host Agent packages to install

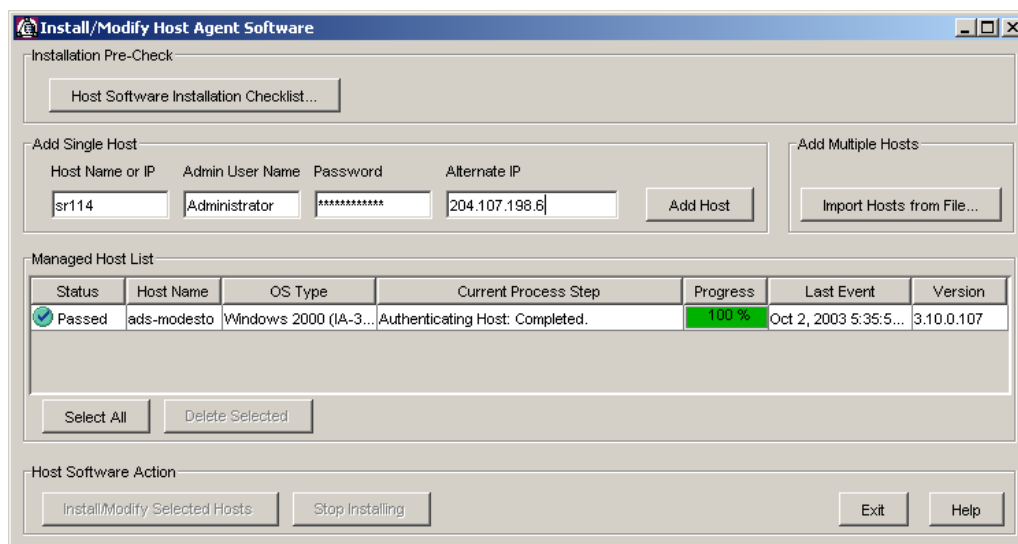


The Host Agent software includes two packages:

- **Hostagent Core and Apps:** This is the Host Agent software's framework package and enables Storage area Manager's device monitoring and device collection activities. This package is required for all Host Agent software installations.
- **Application Management Plugins (AMPs):** This is a managed application framework and enables Storage Area Manager to monitor and collect capacity data from specific applications that reside on the SAN host. The Host Agent software includes an AMP for each application it supports. These package(s) are optional.

If you do not intend to use this package, you can save disk space by not installing it. The Oracle AMP requires additional connection steps. AMPs will be covered in more detail in the Storage Builder module.

## Status of Host Agent software deployment



To initiate Host Agent installation, select the hosts in the Managed Host List where you want to remotely install the Host Agent. Then click the *Install on Selected Hosts* button to begin the installation process.

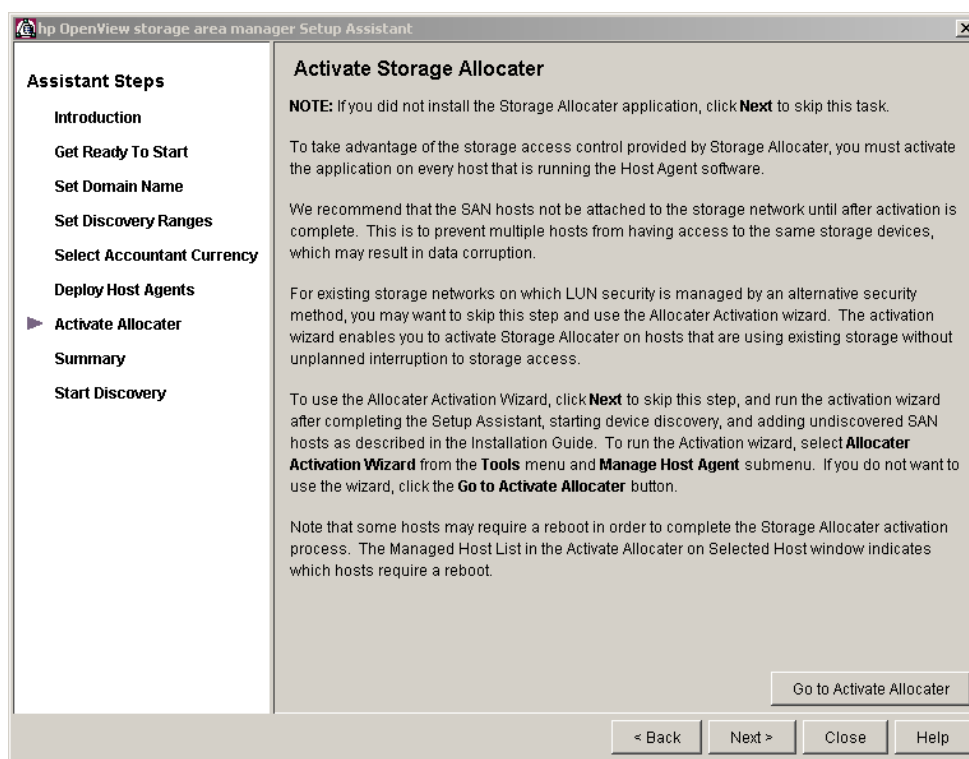
Storage Area Manager deploys Host Agent software to one host at a time, working down the table. There is a progress indicator for each host in the table. Additionally, there is an overall status indicator at the bottom left of the screen.

If a host fails installation, right-click the error message displayed in the Current Process Step column, and select *Repair Hint* from the shortcut menu to display troubleshooting information.

After installation is complete, click the *Exit* button to return to the Setup Assistant. The Activate Storage Allocator window displays.



## Activating Storage Allocator



To take advantage of the storage access control provided by Storage Allocator, it must first be activated on every SAN host within a storage network fabric.

Click the *Go to Activate Allocator* button to activate Storage Allocator within the Setup wizard.



### Important

Only activate Allocator from within the Setup wizard if installing Storage Area Manager onto a new SAN.

For existing SANs with LUN security managed by zoning or another storage-based security method, use the Storage Allocator Activation wizard after completing the Setup Assistant, starting the discovery process, and adding undiscovered SAN hosts.

For hosts that are behind a firewall, activate Storage Allocator locally after configuring the firewall.



### WARNING

Hosts that have fibre channel HBAs and do not have Storage Allocator activated will be able to access all the fibre channel SAN storage, which could cause a multiple writer situation and data corruption.



### Caution

If using an instant on license to evaluate Storage Allocator, be sure to enter a permanent Storage Allocator license or deactivate Storage Allocator before the instant on license expires. Failure to do so will compromise functionality within the storage network.

## Activate Allocator on selected hosts window

**Installation Pre-Check**

Host Software Installation Checklist...

**Add Single Host**

Host Name or IP:  Admin User Name:  Password:

**Add Multiple Hosts**

**Managed Host List**

Status	Host Name	OS Type	Current Process Step	Progress	Last Event	Activated?	Reboot?
	localhost	WINDOWS 5.0	HostAgent installation succeeded on host localh...	0 %	Sep 1, 2002 4:25:06 PM	no	no

**Host Software Action**

0% **STATUS:**

If choosing to activate Allocator from within the Setup Assistant, build the list of managed hosts using the same techniques described for Host Agent deployment. When done, select the hosts on which you want to activate Storage Allocator, and click the *Activate Allocator on Selected Hosts* button.

### Note

If a host fails activation, right-click the error message displayed in the Current Process step column, and select *Repair Hint* from the shortcut menu.

Reboot all hosts that indicate *Yes* in the managed host list's Reboot column. Windows and Solaris hosts require a reboot to complete the activation process.



### Caution

If you activated Storage Allocator on the management server (localhost), do not reboot the management server until you have completed the Setup Assistant procedure and the host is listed in the Storage Area Manager Resources tree. If you do not reboot a host that requires a reboot to finish the activation procedure, LUN security will not be active on that host.

When you activate Storage Allocator on a Solaris host, do the following before rebooting:

- Back up the `/kernel/drv/<driver_name.conf>` file for the HBA driver.
- Edit the `max_luns_per_target` value in the `sd_fcst.conf` file. This value controls the number of LUNs that Storage Allocator will look for on each SAN target. The default value is 256, but for improved performance, HP recommends setting `max_luns_per_target` to the largest number of LUNs that is configured on any disk array in your storage network.

**Caution**

Due to possible problems when scanning all the possible LUNs in an array's address space, setting this variable is particularly important for Emulex HBAs.

---

**Important**

If activating Storage Allocator on a Solaris or Linux host, see the *hp OpenView storage area manager installation guide* for additional steps that must be completed after activating Storage Allocator.

---

## Reviewing the Setup Assistant summary

The screenshot shows the 'hp OpenView storage area manager Setup Assistant' window. On the left is a sidebar titled 'Assistant Steps' with a list of steps: Introduction, Get Ready To Start, Set Domain Name, Set Discovery Ranges, Select Accountant Currency, Deploy Host Agents, Activate Allocator, Summary (highlighted with a purple arrow), and Start Discovery. The main area is titled 'Summary' and contains the following text: 'This screen summarizes the activity completed by the Setup Assistant thus far. Review the information below, then click the Next button to continue.' Below this text are three summary sections, each with a label and a text box: 'Domain name' with 'KingvaleSAN2', 'SNMP discovery range' with '15.255.0.248', and 'Hosts with the host agent deployed' with '15.255.0.171' and 'localhost'. A fourth section, 'Hosts with the allocator activated', has an empty text box. At the bottom right are four buttons: '< Back', 'Next >' (highlighted with a dashed border), 'Close', and 'Help'.

Section	Value
Domain name	KingvaleSAN2
SNMP discovery range	15.255.0.248
Hosts with the host agent deployed	15.255.0.171 localhost
Hosts with the allocator activated	

Review the summary information provided by the Setup Assistant. To make changes, click the *Back* button to return to previous windows.

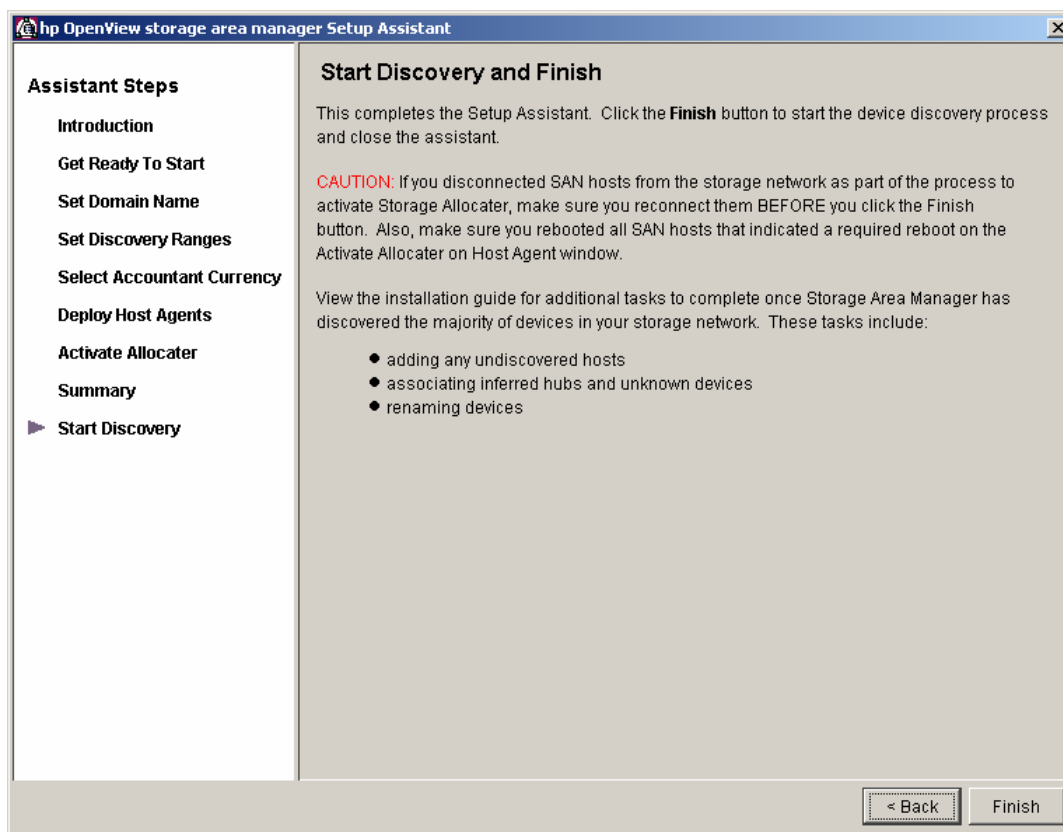
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### Note

If you deployed the Host Agent software to any hosts earlier in this assistant, you cannot return past the Set the SNMP Discovery window.

---

## Starting device discovery



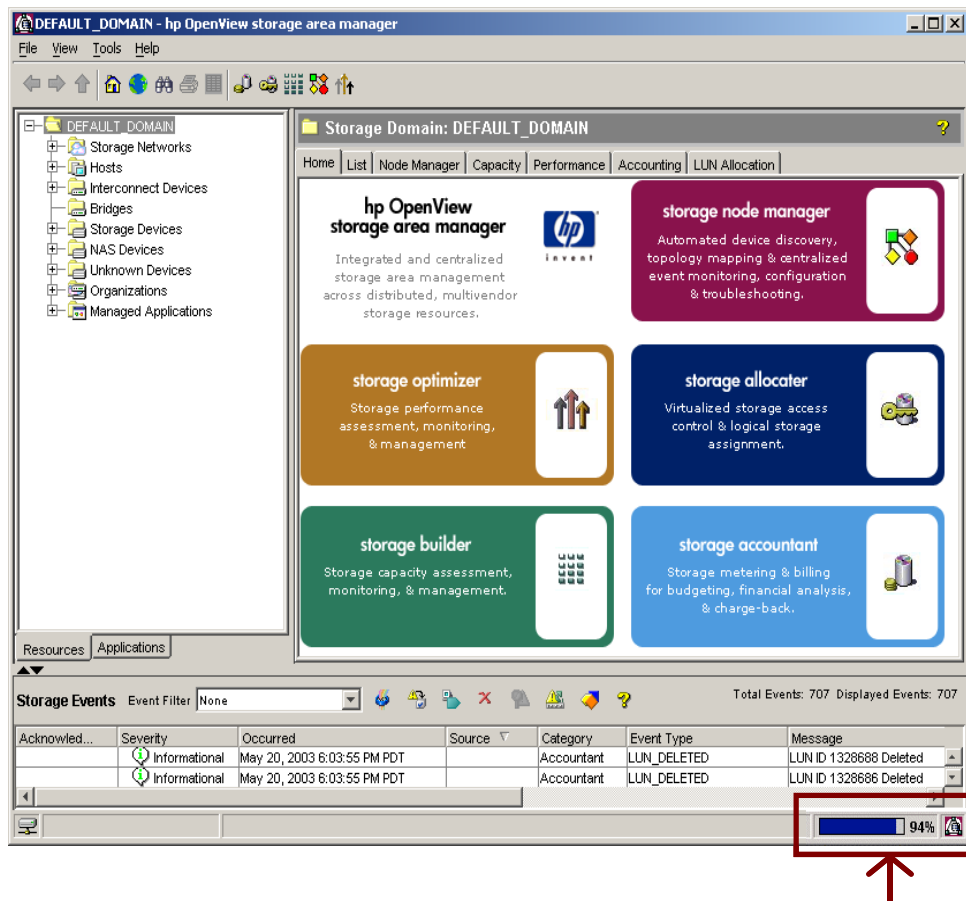
Initiating the discovery process is the last installation step. Once initiated, Storage Area Manager begins discovering devices based on the information entered in the SNMP Discovery Ranges and Install Host Agent windows.

Before clicking the *Finish* button to initiate the discovery process, be sure to verify that all hosts requiring a reboot were rebooted, and that any hosts disconnected from the storage network as part of the Allocator activation process have been reconnected.

After clicking the *Finish* button, click *Yes* to confirm the initiation of the discovery process.

If the environment uses firewalls, click *No*. Configure firewalls, as described later in this module, before initiating the discovery process.

## About discovery cycles

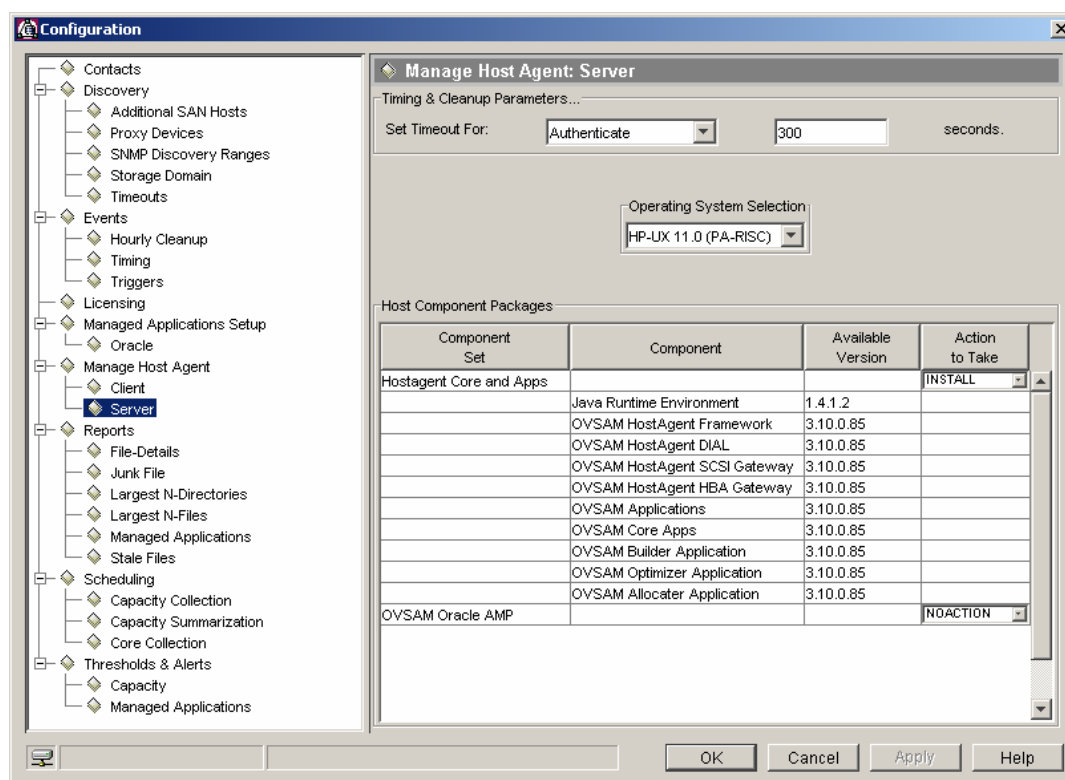


The discovery indicator near the bottom right of the window changes to a progress bar, which shows that the discovery is in progress. Devices are added to the user interface as they are discovered. When the progress bar reaches 100%, the message changes to Discovery On, indicating that the ongoing discovery process is enabled.

Depending on the size of the SAN and the speed of the devices, the initial discovery cycle may be lengthy. Storage Area Manager may require two discovery cycles to report all devices.

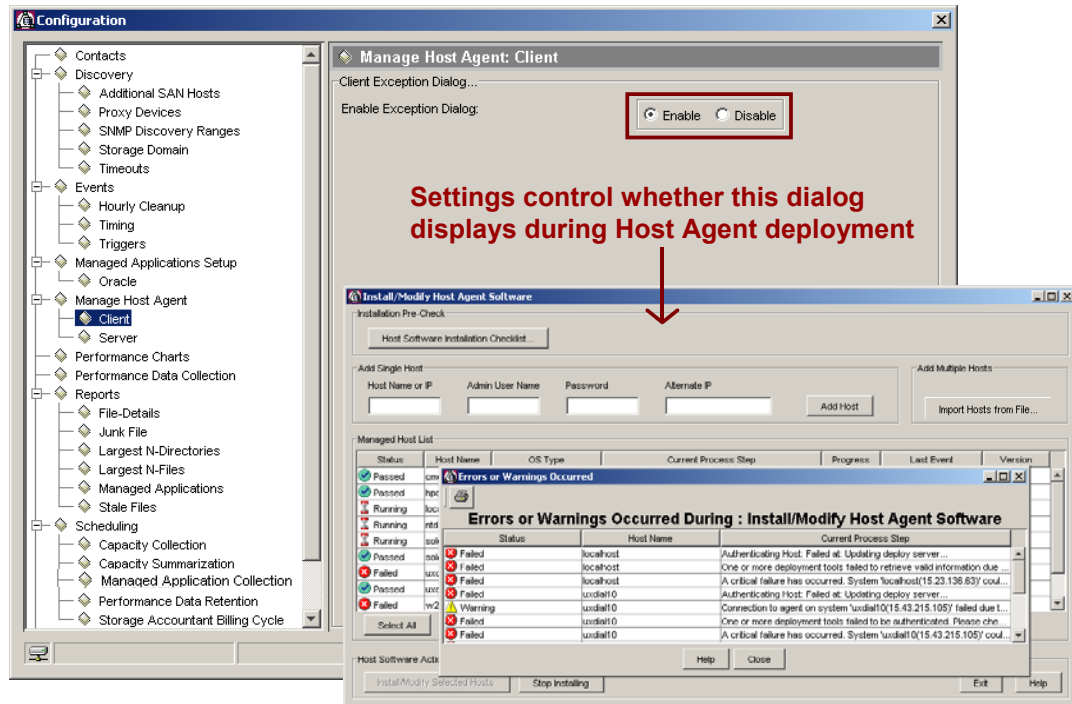
Device discovery runs continuously. SAN Host LUN collection runs every 15 minutes and is user configurable. To manually start a comprehensive discovery, select *Start Comprehensive Discovery* from the Tools menu.

## Setting default deployment options



The Manage Host Agent: Server window enables you to configure timeout settings for each Host Agent action. This window also enables you to set the default Host Agent package installation settings for each SAN host operating system. For example, you can set as a default to install the Storage Area Manager Oracle AMP on HP-UX hosts.

## Enabling/disabling the client exception dialog



The Manage Host Agent: Client window enables you to enable or disable the Exceptions window, which identifies any failed hosts after a Host Agent action (installation, modification, uninstallation, update, or add access) completes.

Selecting Enable will display the Error or Warnings Occurred window upon completion of the action if one or more of the selected hosts failed the action. The default selection is Enable.

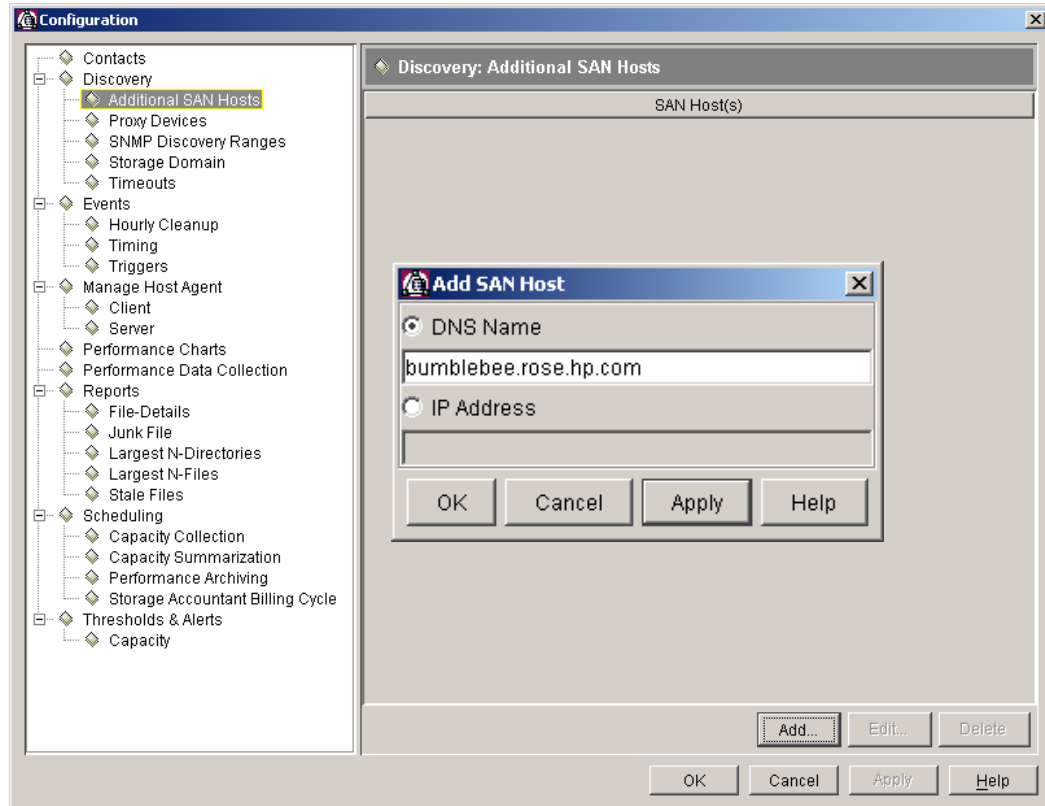


## Post installation tasks

After installing Storage Area Manager on the management sever, deploying the Host Agent software, and starting the initial discovery cycle, it may be necessary, depending on the environment, to perform the following additional tasks:

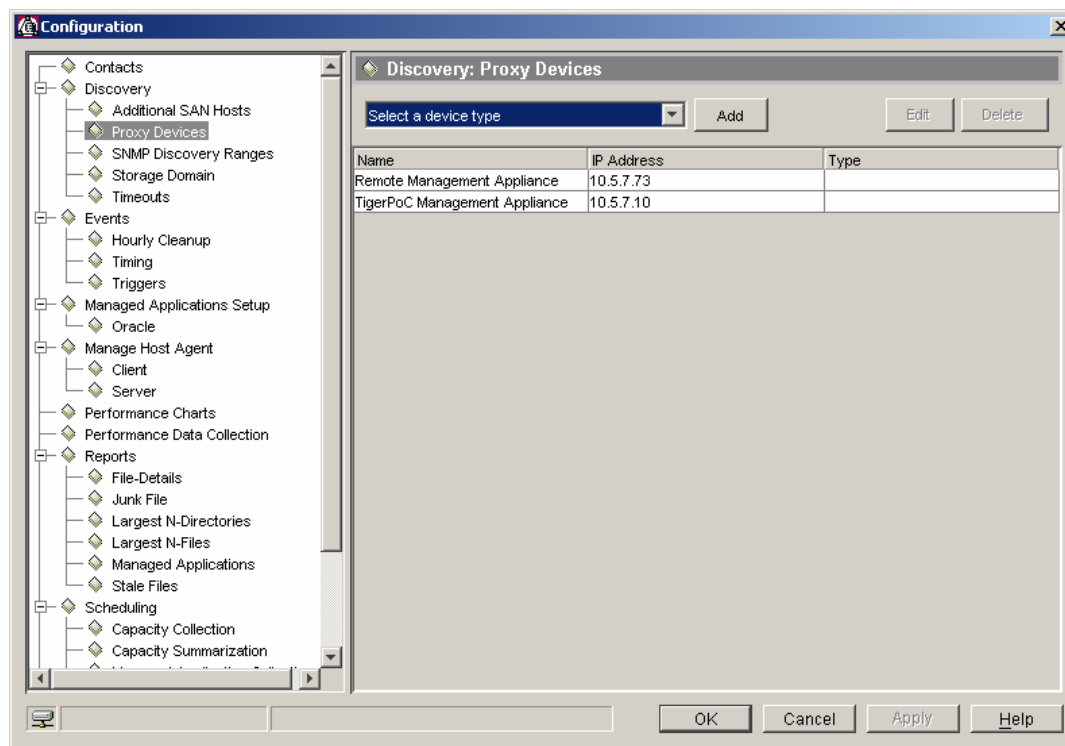
- Customize discovery
  - Add additional SAN hosts
  - Configure proxy devices
- Install and configure management clients
- Update host access (if local installs performed)
- Add licensing information
- Customize Storage Area Manager configuration:
  - DHCP
  - Passphrases
  - Firewalls
- Install and configure MoM stations (discussed later)
- Integrate with other OpenView applications (discussed later)

## Adding undiscovered SAN hosts



In some cases, Storage Area Manager is unable to discover a SAN host on which Host Agent software was installed. Add these hosts as Additional SAN Hosts in the Configuration window and Storage Area Manager will contact the host directly.

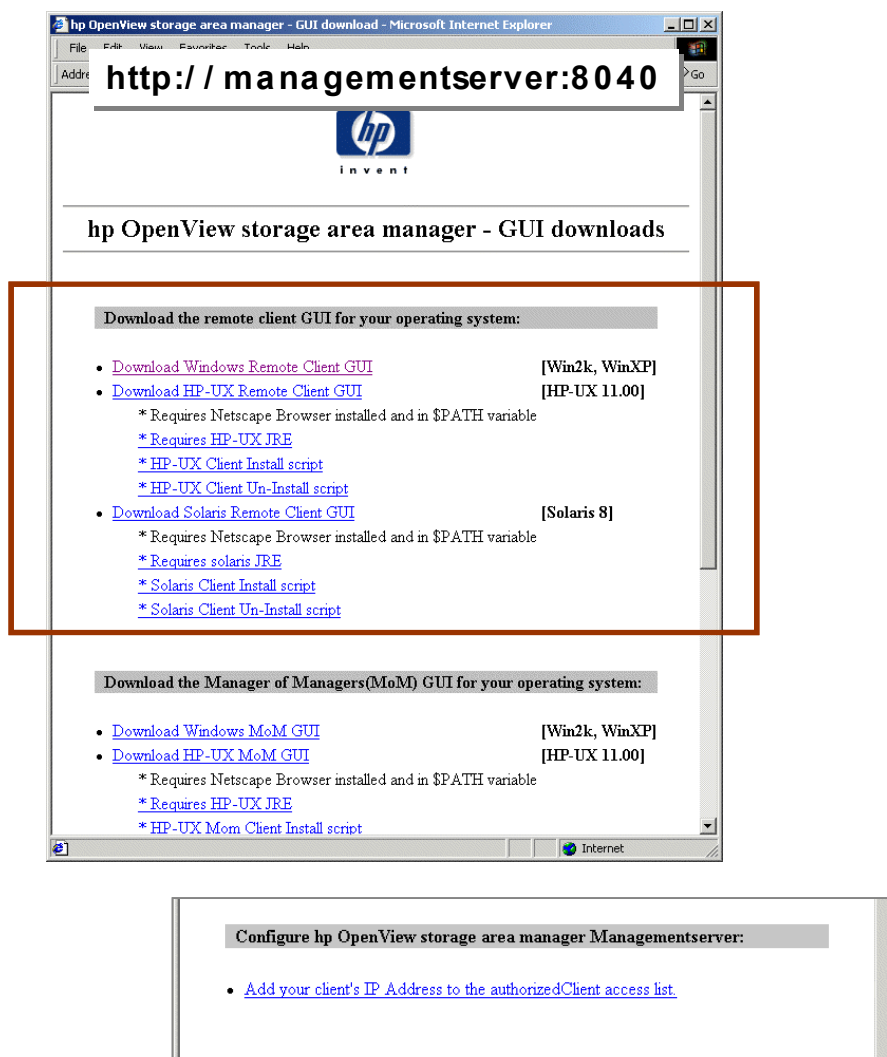
## Configuring proxy devices



In some cases, a storage resource serves as a proxy for another storage device. In these cases, Storage Area Manager must discover and interact with the proxy device to manage the storage device that it supports. For example, the hp StorageWorks management appliance is a proxy device for the hp StorageWorks EVA Arrays.

Add proxy devices in the Configuration window.

## Setting up management clients



To start Storage Area Manager and perform management server tasks remotely, set up management clients. To install management clients for each supported operating system, access the GUI download page available on each management server by opening a browser and entering the following address:  
**http://<hostname>:8040.**

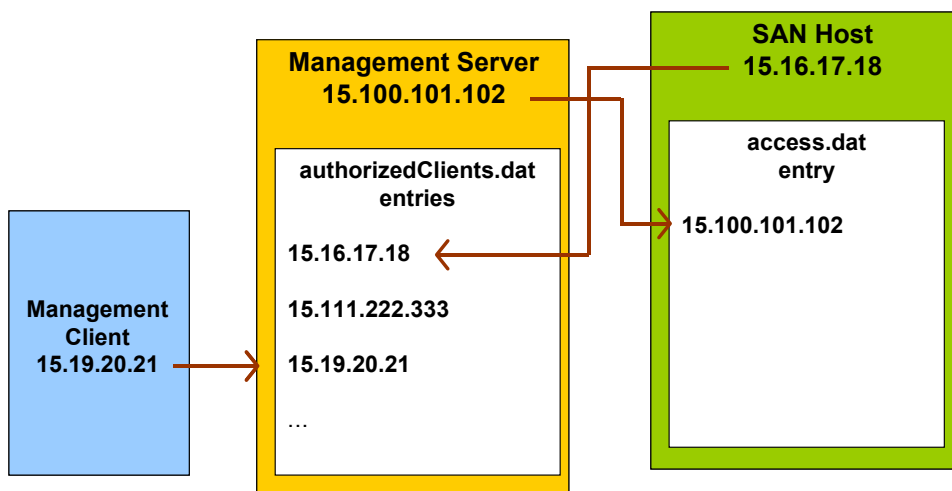
### Note

Also use this GUI download page to remotely install MoM clients.

After installing the user interface on the management client, authorize the client to access the management server. Click the *Add your client's IP Address to the authorizedclient.dat* link at the bottom of the download page.

This procedure writes the client's IP address to a file on the management server called /config/authorizedclients.dat, which lists the IP addresses of all hosts that have permission to access the management server.

## Access control files



Access control files reside on both the management server and each SAN host.

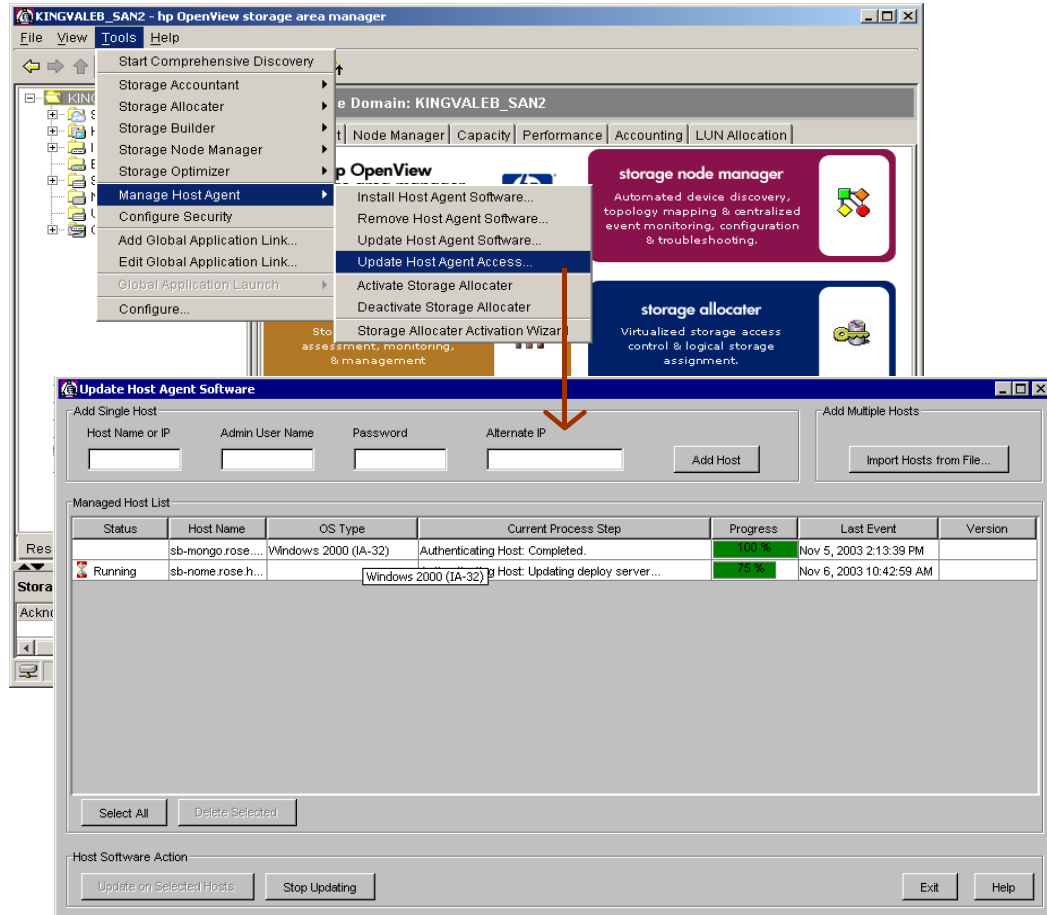
- Management server: `sanmgr\managementserver\config\authorizedClients.dat`
- SAN host: `access.dat`
  - Windows: `sanmgr\hostagent\config`
  - Unix: `opt/sanmgr/hostagent/config`

The management server access control file contains entries for each SAN host to which it has successfully deployed Host Agent software. It must also contain entries for any management clients that require access. Entries for management clients are made manually or through the management server GUI download page (recommended).

Likewise, the SAN host access control file contains an entry for the management server from which the Host Agent software was successfully deployed.

If a local install of Host Agent software was performed, use the Update Host Access feature to ensure access control files are properly synchronized.

## Updating host access



As with IP addresses in the access control files, the storage domain is set during the remote Host Agent deployment process. If a local installation of the Host Agent was performed or the storage domain name was modified after remotely deploying the Host Agent from the management server, use the Update HostAgent Access feature to synchronize the management server and SAN host.

## Using DHCP with SAN hosts and management clients

Dynamic Host Configuration Protocol (DHCP) is supported for both management clients and SAN hosts. However, special configuration is required for management clients to enable support. Configuration depends on how tightly coupled DNS and DHCP are in the storage environment.

DHCP leases for SAN host must be long-term. A *long-term* lease means the IP address is assigned and does not change as long as the SAN host is up and running.

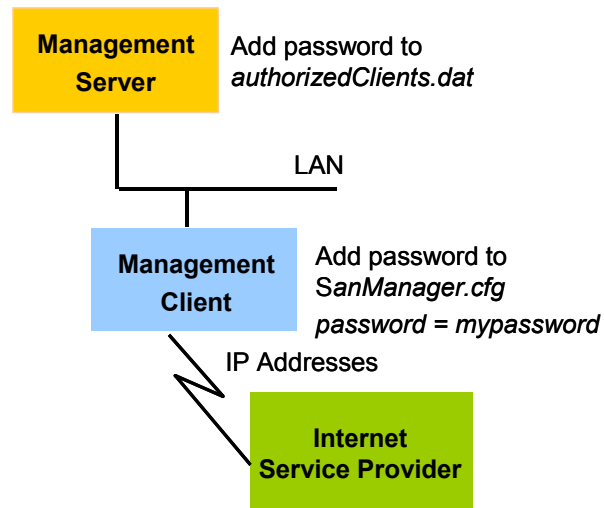
Short-term leases (or anything that causes the IP address to change while the SAN host is up and running) result in multiple copies of the same host being discovered and mapped.

### Configuring management clients in tightly coupled environments

If DNS and DHCP are tightly coupled in the environment (for example, if the management server and management client are part of a corporate intranet), complete the following steps to enable DHCP support:

1. Open a web browser.
2. Enter the following address: `http://<hostname>:8040`, where `<hostname>` is the hostname or IP address of the management server.
3. Press the *Enter* key.
4. Click the Add your client's IP address to the authorized Client access list link.
5. Enter the fully qualified hostname of the management client in the IPAddress field.
6. Enter a Storage Area Manager user name in the User Name field.
7. Enter a Storage Area Manager password in the Password field.
8. Click the *Submit* button.

## Configuring management clients in loosely coupled environments



If DNS and DHCP are not tightly coupled in your environment (for example, if the management client is using an Internet Service Provider (ISP) to connect to the management server), complete the following steps to enable DHCP support:

1. At the management server, go to the <install directory>\sanmgr\managementserver\config directory.
2. Open the *authorizedClients.dat* file in a text-editing application.
3. Go to the end of the file, and enter a password for the management client on a new line.  
  
The password can use alphanumeric characters, must not have embedded spaces, and is case-sensitive.
4. Save and close the file.
5. At the management client, go to the <install directory>\sanmgr\client\config directory.
6. Open the *SanManager.cfg* file in a text-editing application.
7. Go to the end of the file, and enter the password on a new line, as follows:  
  
PASSWORD=<password>  
  
For example, enter PASSWORD=mypassword
8. Save and close the file.

---

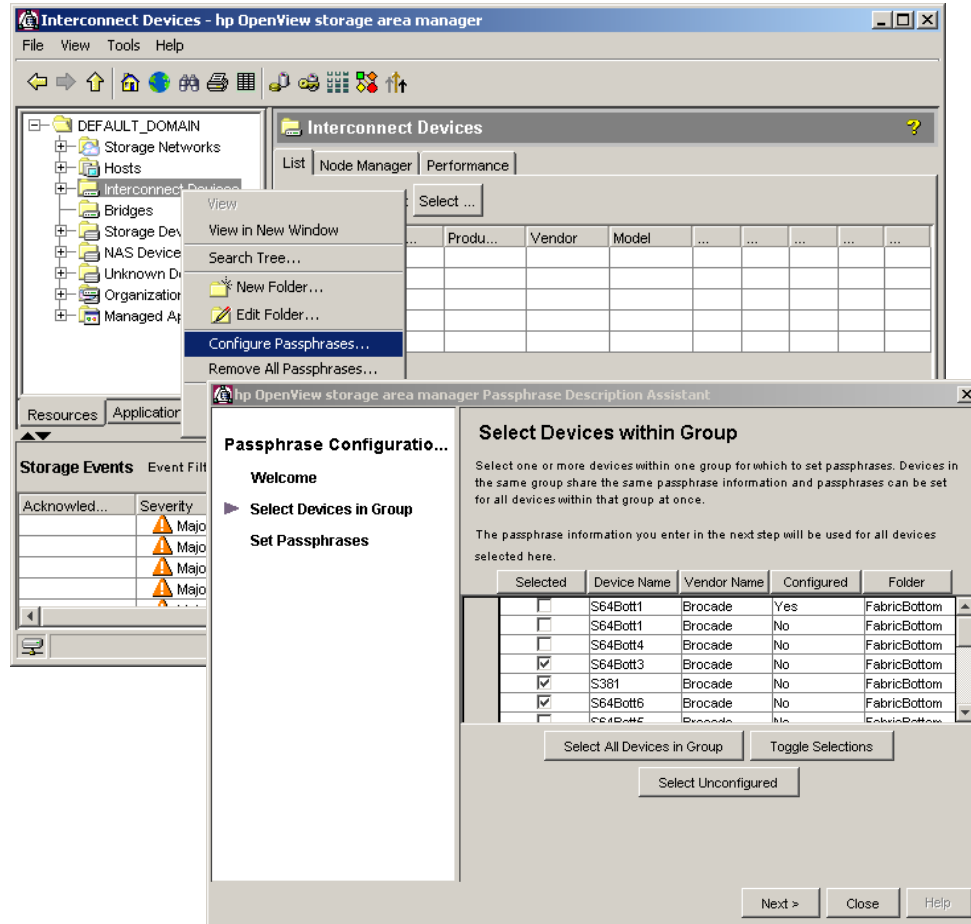
**Note**

The password is protected by encryption when the management client attempts to log onto the management server.

---



## Configuring passphrases



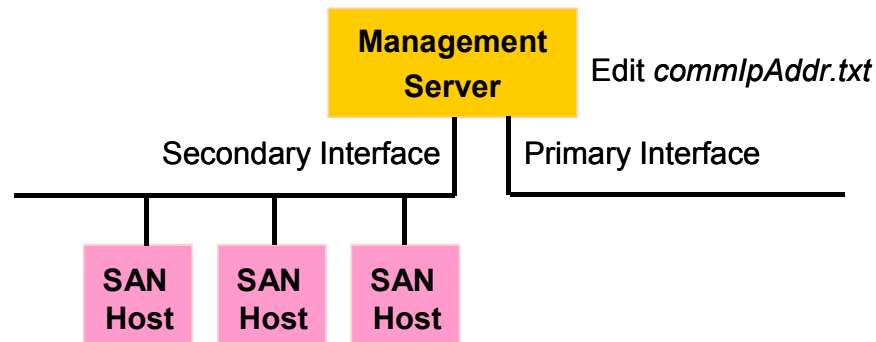
Brocade switches, configured through DPIs, require a username and password for data collection. Currently, Brocade devices are the only devices that support passphrases. To enter the appropriate username and password for a device, right-click the device and select *Configure Passphrases...* from the shortcut menu. The procedure launches a dynamically generated dialog that matches the particular needs of the selected device. If the device does not need or does not support passphrases, then the shortcut menu option is disabled.

To set passphrases for multiple devices at a time, right-click the Interconnect Devices node and select *Configure Passphrases...* from the shortcut menu. The procedure launches the Passphrase Configuration wizard.

If a passphrase has not been entered and Storage Area Manager has difficulty collecting data from the device, an event will be generated.

To remove passphrases, right-click the device and select *Remove All Passphrases* from the shortcut menu.

## Configuring multi-homed systems



A *multi-homed system* is a system that houses multiple network interface cards. Extra configuration steps are necessary if the management server is multi-homed and the interface through which the management server communicates with the storage network is not its primary interface the SAN host is multi-homed and the interface through which it communicates with the storage network is not its primary interface AND the host agent software was installed locally

### Configuring multi-homed management servers

You may enter the alternate IP address for the management server during initial installation using the Setup Assistant. Alternatively, you may use the following procedure:

1. Close Storage Area Manager if it is open.
2. Stop the HP OpenView SAM Management Server service.
3. Go to the C:\Program Files\Hewlett-Packard\sanmgr\managementserver\config directory.
4. Open the commIpAddr.txt file in a text-editing application.
5. Add the IP address of the interface that the management server uses to communicate with hosts and devices in the storage network.
6. Save and close the file.
7. Go to the C:\Program Files\Hewlett-Packard\sanmgr\client\config directory.
8. Open the commIpAddr.txt file in a text-editing application.
9. Add the IP address of the interface that the management server uses to communicate with the storage network.
10. Save and close the file.
11. Go to the C:\Program Files\Hewlett-Packard\sanmgr\mom\config directory.
12. Open the commIpAddr.txt file in a text-editing application.
13. Add the IP address of the interface that the management server uses to communicate with the storage network.

14. Save and close the file.
15. Start the HP OpenView SAM Management Server service.
16. Update the host's access.dat file, as follows:
  - a. Start Storage Area Manager.
  - b. From the Tools menu, select *Update Host Agent Access*
  - c. In the Managed Host List, select the host(s) to update, and click the *Update Access on Selected Hosts* button.




---

**Caution**

Do not update host agent access on the localhost (management server).

---

- d. Click *Exit* to close the Update Host Agent Access window.

---

**Note**

If the procedure in step 16 fails, open the access.dat file in sanmgr\hostagent\config (Windows) or opt/sanmgr/hostagent/config (Unix), enter the IP address of the management server, and save and close the file. Stop and restart the HP OpenView SAM Host Agent service.

---

## Configuring multi-homed management clients

Perform the following procedure at each multi-homed management client:

1. Close Storage Area Manager, if it is open on the management client.
2. Go to the C:\Program Files\Hewlett-Packard\sanmgr\client\config directory.
3. Open the commIpAddr.txt file in a text-editing application.
4. Add the IP address of the interface that the management client uses to communicate with the management server.
5. Save and close the file.
6. Open a web browser, and enter the following URL:  
**http://<management server hostname or IP address>:8040**
7. Click the Add your client's IP Address (of Fully Qualified Hostname) to the authorizedClient access list link at the bottom of the page.
8. Enter your Storage Area Manager user name and password in the User Name and Password boxes.
9. Click the *Submit* button.
10. Start Storage Area Manager.

## Configuring multi-homed SAN hosts

Perform this procedure for multi-homed SAN hosts on which you performed a local installation of the Host Agent software from the Storage Area Manager CD. This procedure is necessary only if *both* conditions (multi-homed and local installation) exist.

1. Stop the appropriate service or processes at the SAN host.
  - For Windows-based SAN hosts, stop the HostAgent service.
  - For Unix-based SAN hosts, stop the HostAgent process.
2. Go to the <install directory>\sanmgr\hostagent\config directory.
3. Use a text-editing application to open or create the commIpAddr.txt file.
4. Add the IP address of the interface that the SAN host uses to communicate with the management server.
5. This file must contain one IP address entry only. The entry must be a valid, configured IP address.
6. Save and close the file.
7. Open a web browser, and enter the following URL:  
**http://<management server hostname or IP address>:8040**
8. Click the Add your client's IP Address (of Fully Qualified Hostname) to the authorizedClient access list link at the bottom of the page.
9. Enter your Storage Area Manager user name and password in the User Name and Password boxes.
10. Click the *Submit* button.
11. Start the service or processes stopped in step 1.

## About Storage Area Manager firewall support

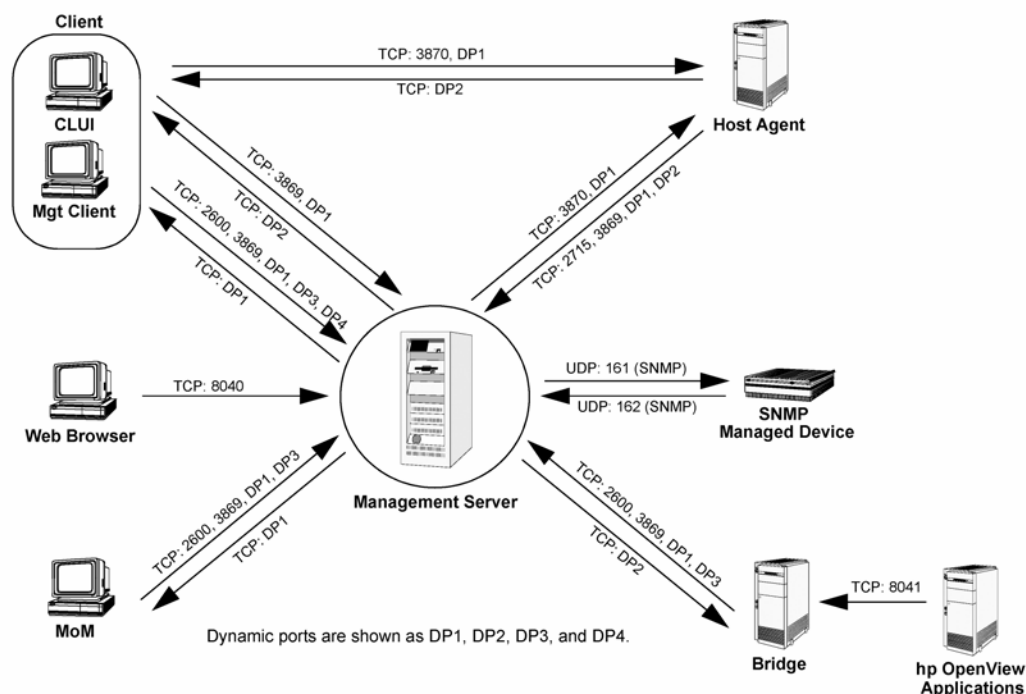
When Storage Area Manager components are separated by a firewall, ports on either side of the firewall need to be configured to allow communication. Storage Area Manager's components include:

- Storage Area Manager management server
- Storage Area Manager management client
- Storage Area Manager Host Agent software
- Storage Area Manager bridge
- Storage Area Manager command line user interface (CLUI)
- Storage Area Manager MoM (Manager of Managers)

The following restrictions apply when configuring Storage Area Manager to support firewalls.

- Firewall implementations that use network address translation (NAT) are not supported.
- Firewall implementations must support and use TCP state tracking (also called connection tracking).
- When Storage Area Manager management client, CLUI, and MoM are configured for firewall usage, you can run only instance of a configured component per machine. For example, you cannot run two firewall configured management clients at the same time on the same machine.

## Configuring firewall support



The following summarizes the tasks required to configure firewall support for Storage Area Manager.

1. Determine where firewalls will separate Storage Area Manager components.
2. Determine the port numbers to be used for communications between the Storage Area Manager components separated by firewalls.
3. Configure the firewall to allow communication between Storage Area Manager components.
4. Install the Storage Area Manager components. Host Agents separated from the management server by a firewall need to be installed locally.
5. Stop the Storage Area Manager components that require configuration to communicate through the firewall.
6. Configure the Storage Area Manager components on either side of the firewall where inbound traffic is being blocked or filtered.
7. Start Storage Area Manager Services and Discovery.

### Determine where firewalls separate components

The network communications between Storage Area Manager components is shown in the picture above. The figure shows the default ports and protocols used for network communication where the port numbers represent the listening TCP or UDP ports used by the Storage Area Manager component. The arrows show the direction of the communication through the firewall.

## Determine the ports used for communication

Storage Area Manager components use fixed and dynamically allocated port numbers (represented by DP1, DP2, and so on). Dynamically allocated ports need to be changed to fixed ports when a Storage Area Manager component is on the side of a firewall where ports are blocked in the direction in which communication travels to a component.

For example:

- If a management server and Host Agent are separated by a firewall that blocks most traffic from the management server to the Host Agent, but allows all traffic in the direction from the Host Agent to the management server, then the dynamic ports on the Host Agent must be configured as fixed, while the dynamic ports on the management server may remain dynamic.
- If a management server and Host Agent are separated by a firewall that blocks most traffic in both directions, then the dynamic ports on both the management server and the Host Agent must be configured as fixed.

The listening ports used by Storage Area Manager components are summarized in the table below.

### Storage Area Manager Firewall Ports

Component	Listening TCP Ports	Listening UDP Ports
Management Server	2715, 2600, 3869, 8040, DP1, DP3, DP4	162
Host Agent	3870, DP1	
Management Client	DP1	
Management Client (CLUI)	DP2	
MoM	DP1	
Bridge	8041, DP1	
SNMP Devices		161

For each Storage Area Manager component separated by a firewall, determine which dynamic port numbers need to be changed to fixed port numbers. When deciding upon which fixed port number to use, the following rules apply:

- Port numbers must be valid TCP or UDP port numbers between 1 and 65535. A value of zero results in a dynamic (or random) available port number, which is not valid for firewall configurations.
- Port numbers must be available ports on the machine on which the component is running.
- Port numbers cannot be duplicated for components running on the same machine (for example, if the management server and management client are running on the same machine, they must specify different ports). However, different components running on different machines may overlap port numbers to minimize the amount of ports to open on the firewall.

When deciding on what ports to use, you may need to consider the following situations:

- The management server discovers SNMP managed devices via the SNMP protocol. This protocol uses UDP ports 161 and 162. The management server receives SNMP traps on UDP 162 and the SNMP managed devices receive SNMP requests on UDP 161. SNMP managed devices may be separated from the management server by a firewall. In this case, the firewall must allow traffic from the management server side to the SNMP managed device(s) side on UDP 161. Additionally, the firewall must allow responses from the SNMP managed device to arbitrary UDP ports on the management server.
- Telnet on TCP port 23 needs to be opened on the firewall if you want to perform the right-click Telnet operation from the management client to hosts (where the hosts are separated from the management client by a firewall). If this functionality is not desired, the port does not need to be opened.
- HTTP is used to access certain device managers. The ports used depend on the individual device managers. See your device manager documentation for more information.

## Configure the firewall

The firewall needs to be configured to allow communication between the Storage Area Manager components separated by the firewall. The firewall must be configured to open the TCP and UDP ports as determined in previous sections.

---

**Note**

For specific instructions on configuring your firewall, see your firewall documentation.

---

## Install the Storage Area Manager components

After configuring the firewall, install the Storage Area Manager components. If Storage Area Manager has already been installed, begin with step 7.

1. Install Storage Area Manager.
2. Create a database.
3. Optionally, install licenses.
4. Run the Storage Area Manager Setup Assistant. Skip the Host Agent installation and Storage Allocator activation procedure for hosts that are separated from the management server by a firewall.
5. At the end of the Setup Assistant procedure, click the *No* button to prevent discovery from starting.
6. Use the local Host Agent installation procedure to install the Host Agent software on all the hosts that are separated from the management server by a firewall.



**Note**

The Host Agent software cannot be deployed through a firewall.

After performing the local installation, do not perform the necessary steps to synchronize the management server and hosts. This step will be performed later.

7. Exit the Storage Area Manager management client.
8. Stop the services that need to be configured to communicate through the firewall. The services can include:
  - Management server services: HP OpenView SAM ManagementServer; HP OpenView SAM Embedded DB
  - Host Agent software: HP OpenView SAM Host Agent; HP OpenView SAM OpenDial
  - Bridge service: HP OpenView SAM Bridge

## Configure the Storage Area Manager components

Configure the dynamic ports of the Storage Area Manager components on either side of the firewall where inbound traffic is being blocked to use fixed port numbers.

1. Open the file(s) shown in the table below for each Storage Area Manager component where a port needs to be changed from a dynamic port to a fixed port number. The file can be opened in any text editor.
2. Assign a valid, fixed port number for the RMI\_PORT setting. Dynamically assigned ports appear as RMI\_PORT=0.
3. Save and close the file(s).

### Storage Area Manager component port setting files

Component	Port	File Name
Management Server	DP1	<install directory>\managementserver\config\ServiceManager.cfg
	DP3	<install directory>\managementserver\config\AAServerComponent.scp
	DP4	<install directory>\managementserver\config\PassphraseCacheComponent.scp
Host Agent	DP1	<install directory>\hostagent\config\ServiceManager.cfg
Management Client	DP1	<install directory>\client\config\ServiceManager.cfg
Client (CLUI)	DP2	<install directory>\client\config\ServiceManager.clui.cfg
MoM	DP1	<install directory>\mom\config\ServiceManager.cfg
Bridge	DP1	<install directory>\bridge\config\ServiceManager.cfg

## Start Storage Area Manager

1. Start the services that you stopped. Be sure to start the management server first.
2. If Host Agents were configured, now perform the steps that were skipped earlier to synchronize the management server and SAN hosts. Do this for each of the Host Agents that were configured.
3. Use the local Storage Allocator activation procedure (see the *Installation Guide* for full details) to activate Storage Allocator on all of the hosts that are separated from the management server by a firewall.
4. Start the Storage Area Manager application.
5. Start Discovery:
6. Select Tools → Configure.
7. Select Discovery.
8. Select *Yes, run discovery*, and click *OK*.

## Licensing Storage Area Manager using AutoPass

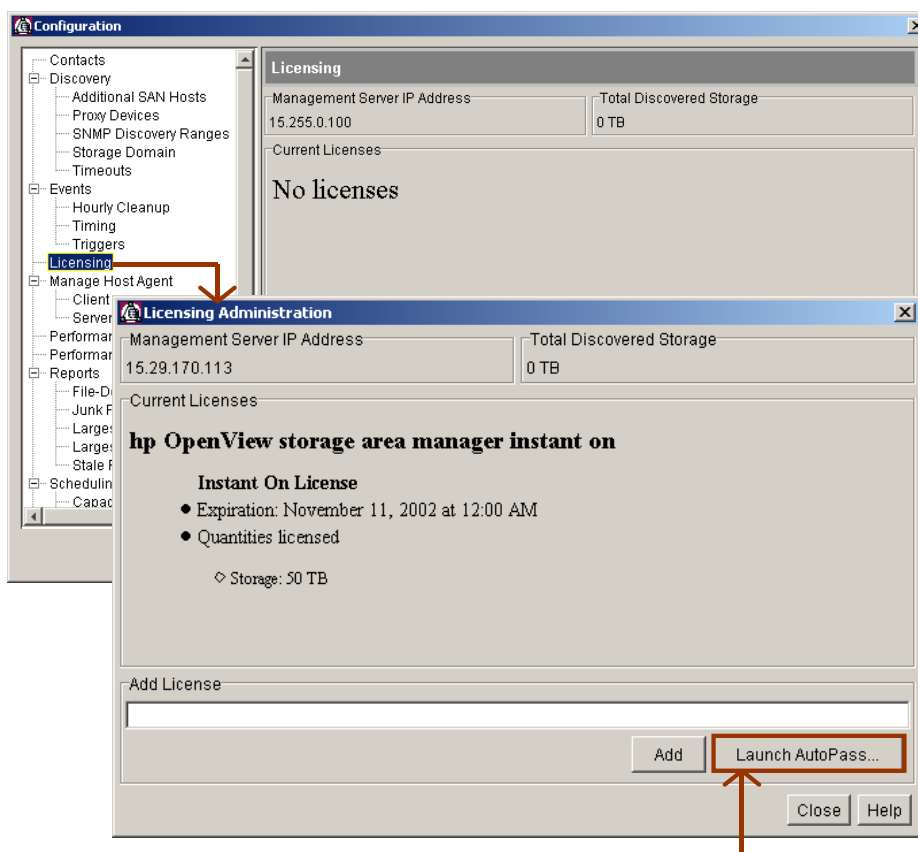
Storage Area Manager uses a standard OpenView application called AutoPass to handle product licensing. Use AutoPass to install passwords that control the Storage Area Manager functionality available on the storage network. In this context, *password* refers to a package of one or more licenses.

The HP OpenView AutoPass application is installed on the management server as part of the Storage Area Manager installation. It can only be run from the management server.

Ensure you have the following available before running AutoPass:

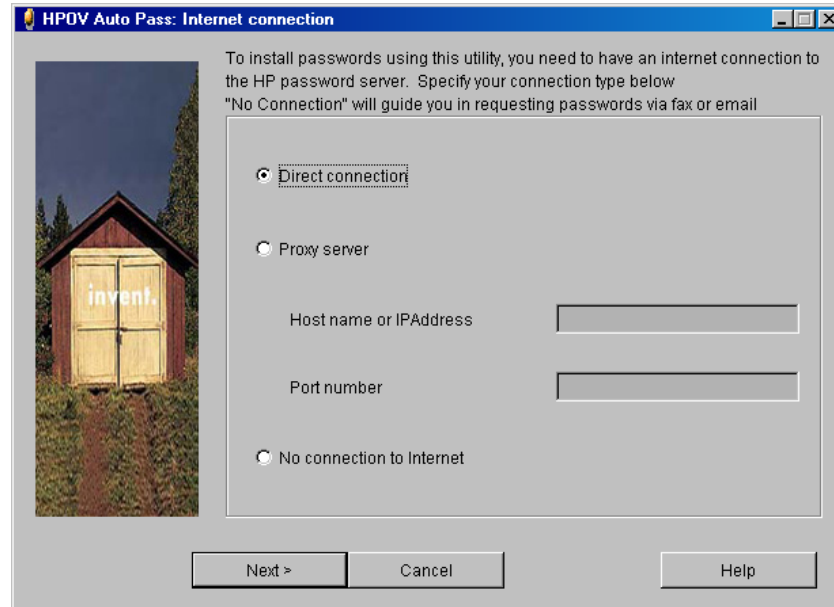
- Purchase order with entitlement document
- If using a proxy server, the proxy server's host name or IP address and port number
- The amount of storage (TB) that will be licensed

### Launching AutoPass



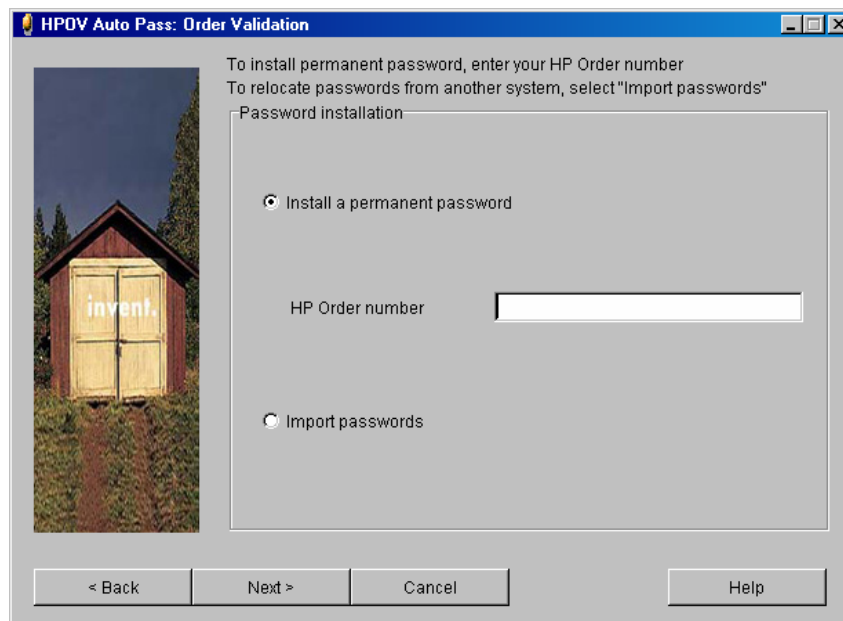
To begin entering license information, select *Licensing* from the Configuration window. Next, click the *Launch AutoPass...* button.

## Internet connection



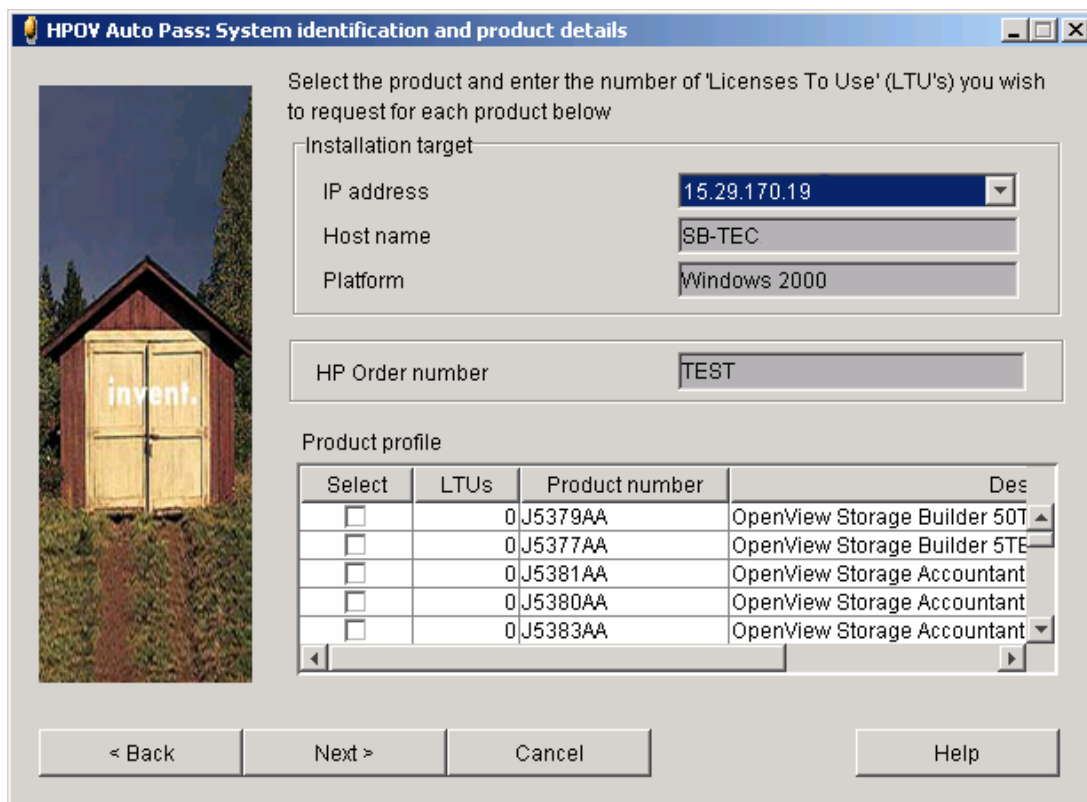
To obtain a password for the product(s), either connect to the Internet or request that the password information be sent by fax or email.

## Validating license orders



Choose to install a new, permanent license or relocate a license from another system. The HP Order number is required for new licenses.

## Installing permanent licenses: System Identification window



**HPDV Auto Pass: System identification and product details**

Select the product and enter the number of 'Licenses To Use' (LTU's) you wish to request for each product below

Installation target

IP address: 15.29.170.19

Host name: SB-TEC

Platform: Windows 2000

HP Order number: TEST

Product profile

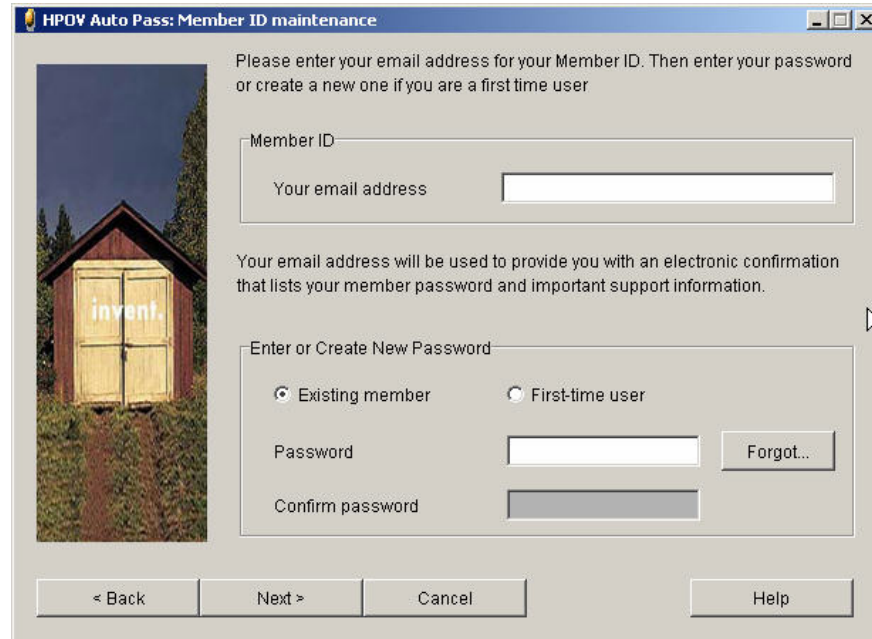
Select	LTUs	Product number	Des
<input type="checkbox"/>	0	J5379AA	OpenView Storage Builder 50T
<input type="checkbox"/>	0	J5377AA	OpenView Storage Builder 5TE
<input type="checkbox"/>	0	J5381AA	OpenView Storage Accountant
<input type="checkbox"/>	0	J5380AA	OpenView Storage Accountant
<input type="checkbox"/>	0	J5383AA	OpenView Storage Accountant

< Back    Next >    Cancel    Help

The Password Center server first checks the HP order number. If the order number is valid, the System Identification and Product Details window displays. This window displays the management server on which the licenses will be installed.

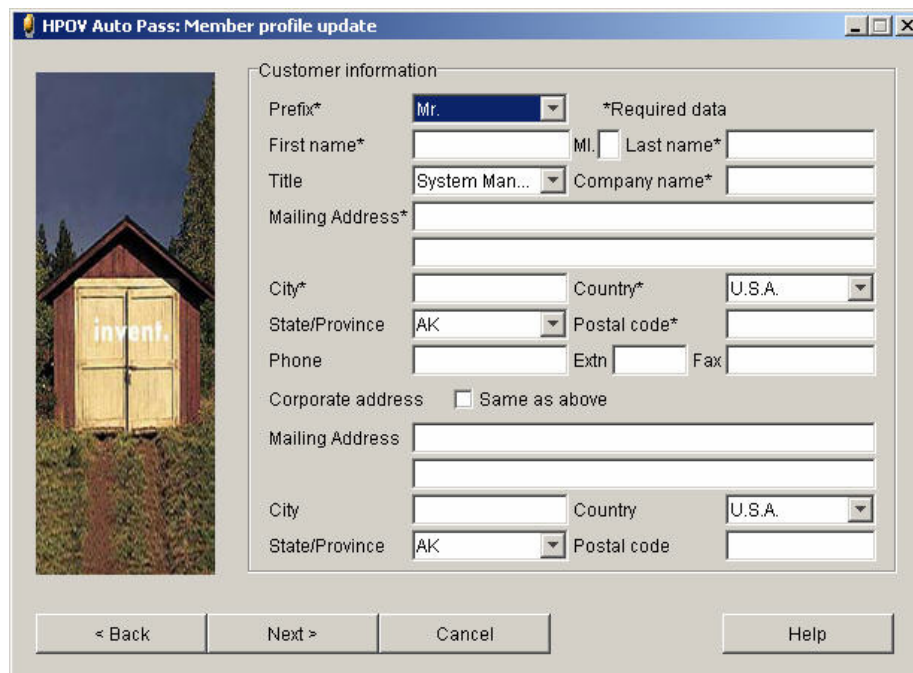
In the Product profile area, select the product(s) to install. You must select at least one product to continue. Next, select the number of Licenses-to-Use (LTUs) to install. Install some or all of the LTUs listed on the entitlement certificate.

## Creating a member ID password



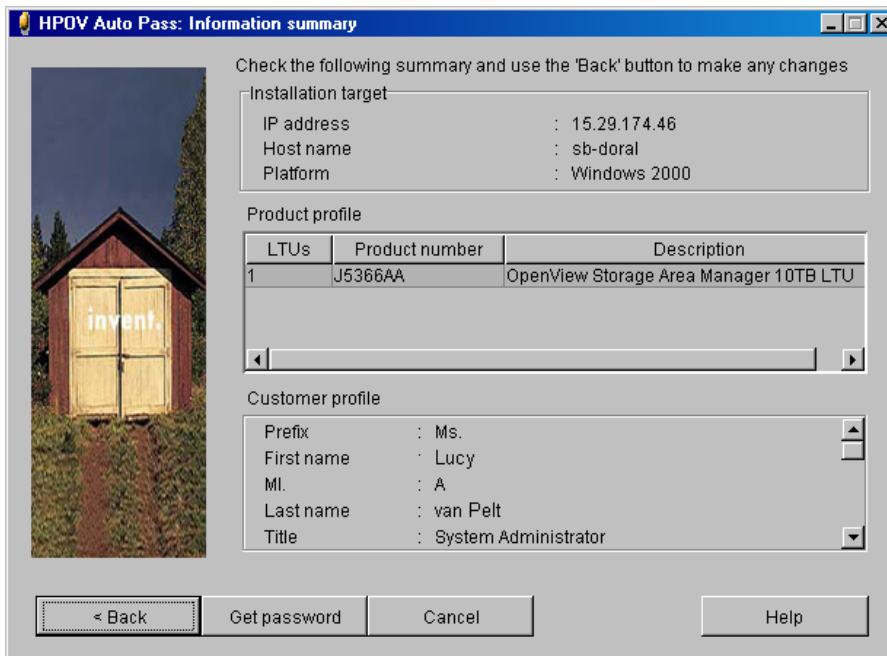
Create a Member ID to receive electronic confirmation and important support information.

## Entering member profile information



Enter member profile information. This is required for new members. Fields are pre-populated for existing members.

## Installation summary



Check the following summary and use the 'Back' button to make any changes

Installation target

IP address : 15.29.174.46  
Host name : sb-doral  
Platform : Windows 2000

Product profile

LTUs	Product number	Description
1	J5366AA	OpenView Storage Area Manager 10TB LTU

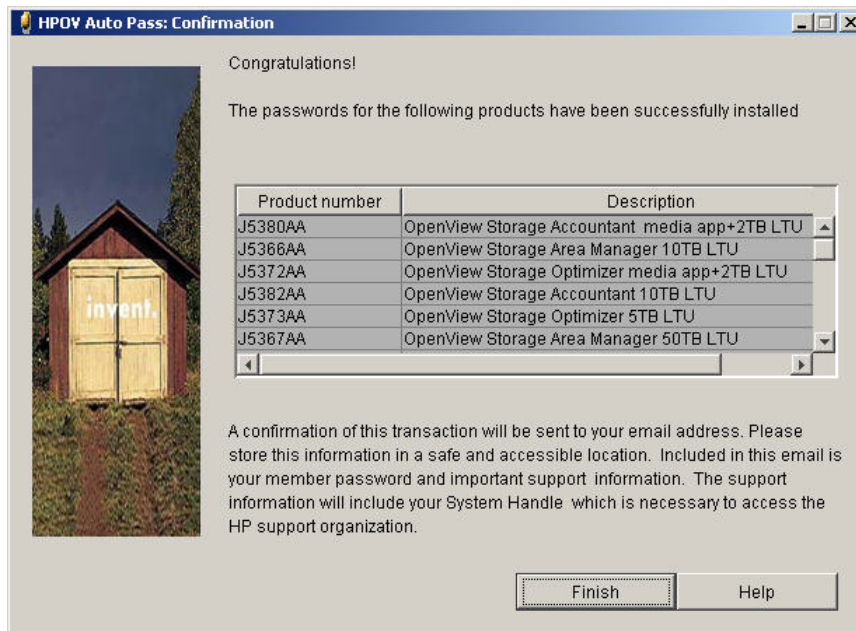
Customer profile

Prefix : Ms.  
First name : Lucy  
MI. : A  
Last name : van Pelt  
Title : System Administrator

< Back    Get password    Cancel    Help

Review a summary of the licensing information entered. Click the *Back* button to make any necessary changes, or click the *Get password* button to continue.

## Installation confirmation



Congratulations!

The passwords for the following products have been successfully installed

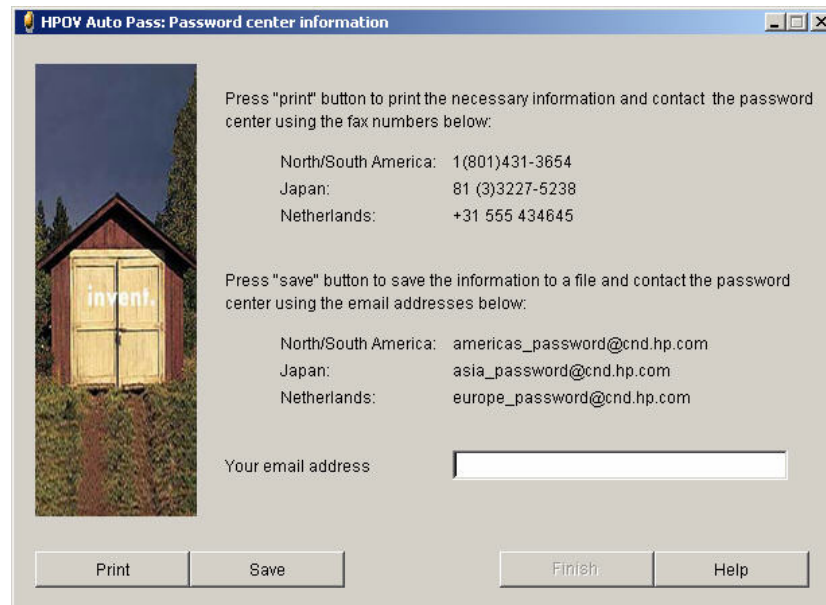
Product number	Description
J5380AA	OpenView Storage Accountant media app+2TB LTU
J5366AA	OpenView Storage Area Manager 10TB LTU
J5372AA	OpenView Storage Optimizer media app+2TB LTU
J5382AA	OpenView Storage Accountant 10TB LTU
J5373AA	OpenView Storage Optimizer 5TB LTU
J5367AA	OpenView Storage Area Manager 50TB LTU

A confirmation of this transaction will be sent to your email address. Please store this information in a safe and accessible location. Included in this email is your member password and important support information. The support information will include your System Handle which is necessary to access the HP support organization.

Finish    Help

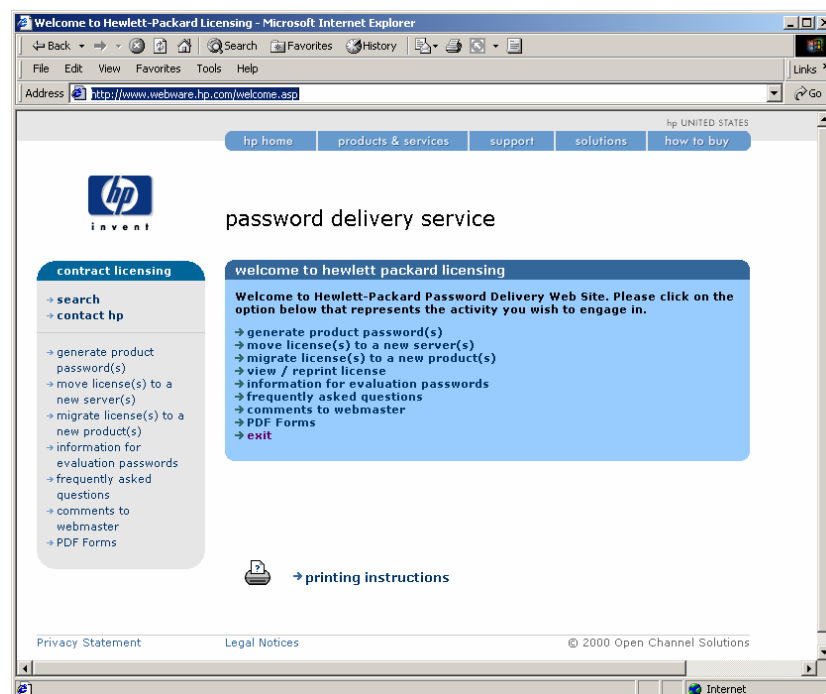
Licenses are automatically installed on the management server. Confirmation is sent to the member profile email address, along with other support information.

## Installing licenses without an Internet connection



To install licenses without an Internet connection, enter email address and click the *Save* button. The password center will email or fax license strings within 24 hours.

## Where to get more information on AutoPass

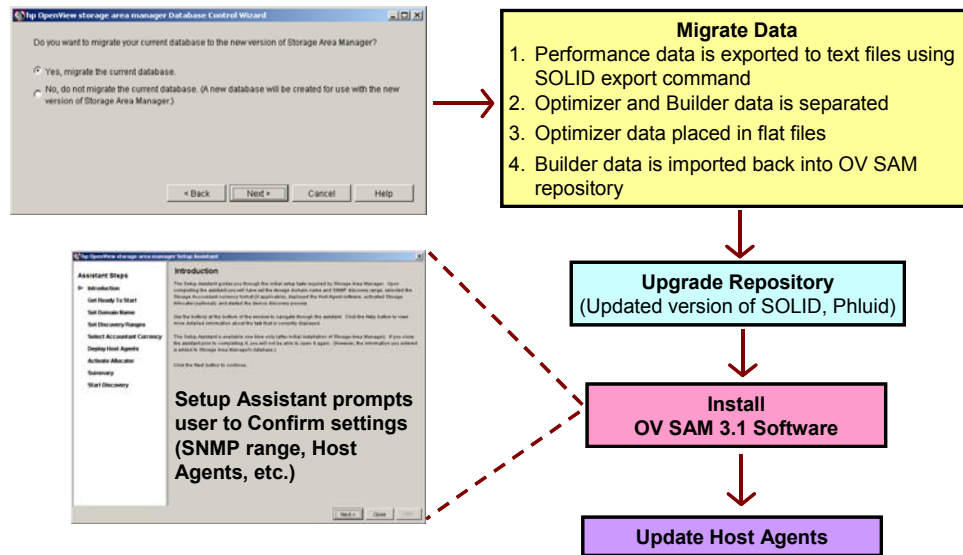


For more information on Auto Pass, refer to <http://www.webware.hp.com/welcome.asp>



# Migrating to Storage Area Manager 3.1

If a previous version of OV SAM is detected, the Database Control wizard is automatically launched

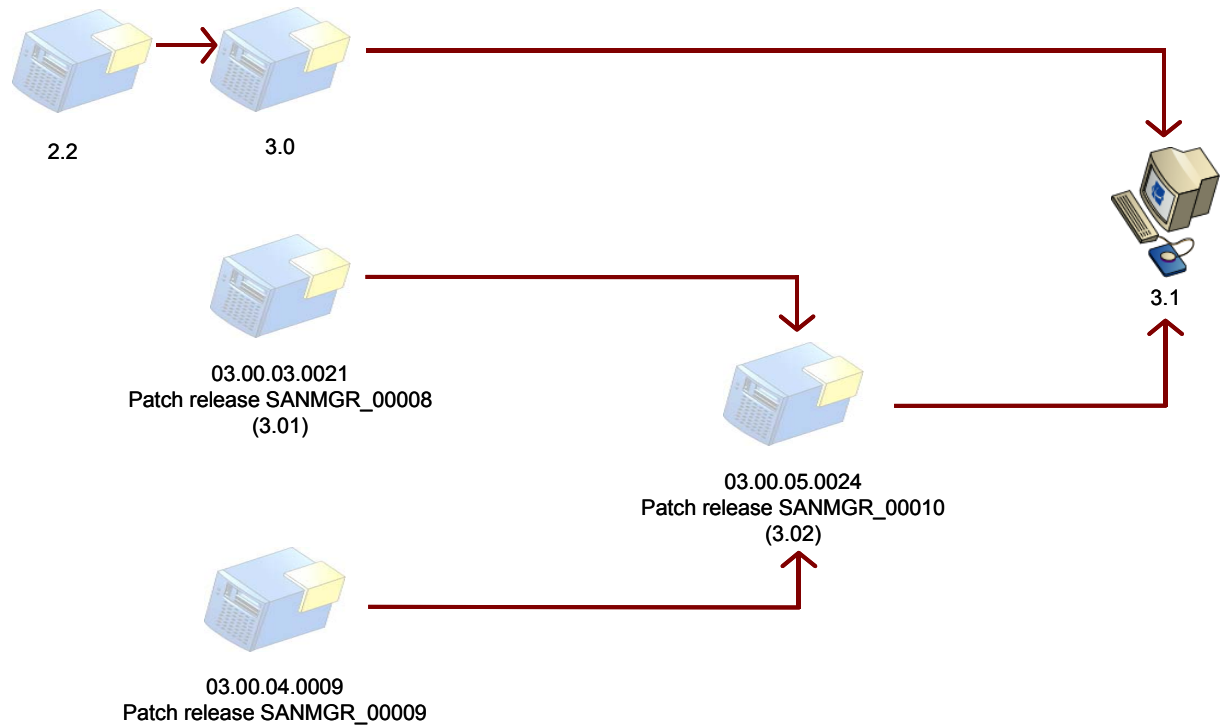


The picture above demonstrates a basic Storage Area Manager migration scenario.

1. If a previous version of Storage Area Manager is detected, the database control wizard is automatically launched. You have the option to migrate the current database or create a new database.
2. If you choose to migrate the database, Storage Area Manager performs a series of steps to migrate Storage Optimizer data to flat files.
  - a. Performance data is exported to text files using the SOLID export command
  - b. Storage Optimizer and Storage Builder data is separated
  - c. Storage Optimizer data is placed in flat files
  - d. Storage Builder data is imported back into the Storage Area Manager repository
3. The Storage Area Manager repository is upgraded to use updated versions of SOLID and Phluid.
4. The Setup Assistant is launched and prompts you to confirm original settings (for example, SNMP range, Host Agents, and so on).
5. The Storage Area Manager 3.1 management software is installed.
6. The SAN hosts are updated with Host Agent software.

You do not need to uninstall 3.0 Host Agents prior to upgrading to 3.1. Installing the Host Agent software using the Setup Assistant will automatically uninstall the 3.0 Host Agent and install the 3.1 Host Agent.

## Supported Storage Area Manager 3.1 migration paths



Storage Area Manager 3.1 will automatically convert databases directly from Storage Area Manager 3.0 systems and 3.0 systems with the SANMGR\_00010 patch. Systems with SANMGR\_00008 or SANMGR\_00009 patches, you must apply the SANMGR\_00010 patch prior to installing Storage Area Manager 3.1.

## Supported migration scenarios

- **New customers installing Storage Area Manager for the first time**

The Database Control Wizard will be launched as part of the product installation. Customers can select to have the Storage Area Manager 3.1 database created in the default location or a user-defined location.

- **Customers in the process of upgrading to Storage Area Manager 3.1 have two options**

- Migrate legacy database into the Storage Area Manager 3.1 schema. The migrated database will be located in a user-defined location. The legacy database will not be modified. After the data is migrated, the customer has the option of discontinuing installation. This allows ‘test’ migrations to be performed.
- Don’t migrate the legacy database but save it in a user-defined location and start Storage Area Manager 3.1 with an empty database. The legacy database can be migrated to the Storage Area Manager 3.1 schema later on but customers need to be aware that the migrated legacy data will overwrite the current data.

- **Customers who have uninstalled the previous version of Storage Area Manager, but want to migrate their legacy database when upgrading to Storage Area Manager 3.1.**

- When they choose to upgrade, they will be given the option of ‘browsing’ to the location of their legacy database (since the install process can’t detect where the database is located).

- **Storage Area Manager 3.1 customers who only want to relocate the Storage Area Manager 3.1 database and backup directory to different (most likely, bigger) locations.**

This activity can be accomplished by launching the Database Control Wizard as a stand-alone utility

- **HP Support team, can copy the Database Control Wizard from the Storage Area Manager CD and run it as a standalone utility (alleviates the need to install Storage Area Manager).**

The stand-alone Database Control Wizard utility can be used to

- Migrate the saved legacy database into the Storage Area Manager 3.1 schema  
(Note: Customers need to be aware that by doing so, their new database will be overwritten by the migrated legacy database)
- Relocate the database and backup directories to different locations
- Recreate the Storage Area Manager database

## Using Storage Area Manager on the Storage Management Appliance

It is now possible to employ the powerful storage management features of Storage Area Manager on the HP OpenView Storage Management Appliance (SMA). The purpose of this section is to illustrate the details that should be considered when positioning Storage Area Manager on the SMA platform, as well as the SMA as a Storage Area Manager Proxy Device, used to supplement the information that it collected in-band from HSV controller-based arrays.

### About the Storage Management Appliance

The SMA is a centralized, appliance-based monitoring and management solution for the SAN. The SMA software is accessible from anywhere in the SAN through a supported Web browser (Internet Explorer or Netscape). The SMA software lets you organize, configure, and monitor storage components from a single web-based navigation point. The SMA also provides a launch site for a variety of core and optional, value-added HP storage management applications, including:

- Command View EVA (previously named HSV Element Manager) for managing and configuring RAID array systems that are based on HSV controllers
- HSG Element Manager for managing and configuring RAID array systems that are based on HSG controllers
- Enterprise Volume Manager or Business Copy EVA for managing controller-based clone and snapshot operations
- Continuous Access EVA for real-time replication between HP StorageWorks enterprise virtual arrays
- Secure Path Manager for protecting and managing paths between hosts and storage systems
- Storage Provisioner for automated provisioning and monitoring of storage usage
- In addition, the Storage Management Appliance supports a large number of industry-standard applications from HP and third-party vendors, which can optionally be installed on the SMA.

For more information about supported antivirus and backup products, see *HP OpenView Storage Management Appliance Software v2.0 Installing Antivirus and Backup Software* application notes available from

**<http://h18006.www1.hp.com/products/sanworks/managementappliance/documentation.html>**

## Network View, Storage Resource Manager, and Storage Allocation Reporter migration

Network View (NV) and Storage Allocation Reporter (SAR) are value-add applications that run on the SMA. Storage Resource Manager (SRM) runs on a separate host system. HP is transitioning its Network View, SRM, and SAR customers to the Storage Area Manager suite. The following table lists HP SANWorks software and their equivalent HP OpenView software products

### HP SANWorks Applications and HP OpenView Replacements

HP SANWorks	HP OpenView
Storage Allocation Reporter	Storage Accountant
Network View	Storage Node Manager and Storage Optimizer

## Running Storage Area Manager on the Storage Management Appliance

The following is required to successfully install and run Storage Area Manager on the SMA.

### Hardware and software requirements

- Storage Management Appliance II, with an additional 1GB of memory or Storage Management Appliance III
- Storage Area Manager 3.0 or 3.1
- Storage Management Appliance software v2.0, with Service Pack 4 or Storage Management Appliance software v2.1
- Requires monitor, keyboard, and mouse to be attached to the SMA during the installation of Storage Area Manager, or access to the SMA using Terminal Services or Window Remote Desktop
- Prior to installation of Storage Area Manager on the SMA, Network View and Storage Allocation Reporter must be uninstalled

### Known issues and limitations

- The SMA has limited scalability compared to a dedicated Storage Area Manager management server. When installing Storage Area Manager on the SMA, the maximum recommended configuration is 50 hosts and 10,000 host-LUN presentations.
- The Storage Area Manager comprehensive discovery cycle in a large configuration has been found to negatively affect the SMA system response time.
- The recommendation to run the Storage Area Manager client GUI on separate host, in keeping with the appliance based deployment model.
- Storage Allocator and Storage Provisioner cannot manage the same host and storage resources. Data corruption could occur.

## Event notification

Storage Area Manager and the SMA both have functionality for notifying users when an event occurs within the SAN. Both can distinguish the severity of SAN events, and both provide various methods for notifying a designated individual. When Storage Area Manager is installed on the SMA, these notification systems work independently of each other and without conflicts. SMA core events (for example, an SMA shutdown) and audit events (for example, users logging on to the SMA) are not received by Storage Area Manager. Refer to the Storage Area Manager or the SMA documentation for instructions on setting up event notification.

## Licensing

Storage Area Manager and the SMA use different licensing models that function independently of each other. When you install Storage Area Manager, you get a 60-day instant on license for the entire Storage Area Manager suite. After the 60-day instant on license expires, only those applications that have permanent licenses will continue to operate. You must acquire permanent licenses if you want to use any of the remaining applications in the Storage Area Manager suite. When you need to add licenses, use the Storage Area Manager software, not the SMA software.

## Databases

Storage Area Manager and the SMA store data in separate databases. Data cannot be migrated between the SMA and Storage Area Manager databases. The SMA can be configured to save backed-up Storage Area Manager data to a network share.

## Security

Storage Area Manager and the SMA software have their own independent security infrastructures. The SMA has three levels: Administrators, Operators, and Users. Storage Area Manager offers the same three user levels. To access both Storage Area Manager and SMA, you need to log on to each application separately.

## Discovery

Both Storage Area Manager and the SMA software can be used to perform discoveries. The discovery operations and end results are independent of each other. Therefore, to utilize the features of either Storage Area Manager or the SMA, you need to perform separate discoveries.

## Compatibility between Storage Area Manager and Storage Management Appliance components

The applications in the Storage Area Manager suite—Storage Node Manager, Storage Builder, Storage Optimizer, Storage Accountant, and Storage Allocator—are compatible with all of the SMA core components, as well as products listed in

the *Using Storage Area Manager on the Storage Management Appliance* application note.

Network View and Storage Allocation Reporter are not supported when Storage Area Manager is installed on the SMA.

## Compatibility between Storage Allocator and Storage Provisioner

HP OpenView Storage Allocator is an allocation product in the Storage Area Manager suite. Storage Allocator's main focus is to provide host-based, logical unit security management for the SAN. It provides the ability to allocate and de-allocate storage to or from a host.

HP OpenView Storage Provisioner is a provisioning application that can optionally be installed on the SMA. This software manages both HSG80- and HSV110-based storage subsystems. Storage Provisioner allows storage providers to manage storage as a utility, customize service levels, and grant consumers self-service access to storage via quotas. Storage Provisioner also creates usage reports to support billing for both storage providers and consumers.

It is possible to have both of these products installed on the SMA with no technical problems. However, if you use both products simultaneously, conflicts and data corruption can occur if they attempt to allocate the same storage.

For example, you can assign a LUN to a host using Storage Allocator. However, if you then use Storage Provisioner, the LUN appears to be available and Storage Provisioner could reassign the same LUN, causing information to be overwritten.



### Caution

HP recommends, as a best practice, that you use either Storage Allocator or Storage Provisioner, but not both, for storage provisioning. If you choose to use both, ensure that the two applications do not attempt to manage the same host and storage resource. Otherwise, data corruption can occur.

## Accessing Storage Area Manager

hp OpenView  
storage management appliance

Status: Informational Appliance Name: sd-appl01

Home Tools Devices Status Settings Help ?

storage area manager business copy continuous access storage provisioner

**Tools**  
The HP OpenView Storage Management Appliance offers a comprehensive suite of monitoring and management tools. Use the following links to help you manage your storage environment.

**storage area manager**  
Access the Storage Area Manager GUI downloads page to download software and specify authentication information.

**business copy**  
Manage controller-based clone and snapshot operations.

**continuous access**  
Manage movement, replication, and recovery of online StorageWorks arrays.

**storage provisioner**  
Monitor storage usage and provide automated provisioning for better quality of service.



After Storage Area Manager is installed on the SMA, and client and hosts are configured, you access and use Storage Area Manager in the usual way by connecting to the management server from a client. You do not use the SMA software to start Storage Area Manager. However, the SMA interface provides access to some Storage Area Manager features.

For example, when Storage Area Manager is installed, an application icon and description appear on the SMA Tools page. Clicking the Storage Area Manager icon connects you to the Storage Area Manager GUI downloads page.

You can also connect to this page by clicking the Configure button on the SMA Manage Tools page.

## Starting and stopping Storage Area Manager services

The screenshot shows the HP OpenView Storage Area Manager interface. The top navigation bar includes links for Home, Tools, Devices, Status, Settings, Help, and ?. Below this, a secondary bar contains Maintenance, Users, Discovery, Groups, Manage Tools (highlighted), Network, Licensing, Notification, and Automation. The main content area is titled 'Manage Tools' and includes a search bar and a table of applications. The 'Storage Area Manager' application is selected, and the 'Start...' task is highlighted in the 'Tasks' column.

hp OpenView  
storage management appliance

Status: Informational Appliance Name: sd-appl01

Home Tools Devices Status Settings Help ?

Maintenance Users Discovery Groups **Manage Tools** Network Licensing Notification Automation

### Manage Tools

View, start, and stop services and applications.

Search: Application [ ] Go

Application	Version	State	Tasks
<input type="checkbox"/> Automation Manager	2.00	Running	<div>Start... Stop... Properties... Configure...</div>
<input type="checkbox"/> Bridge:HP	Unknown	Running	
<input type="checkbox"/> Business Copy	2.20.051.0	Running	
<input type="checkbox"/> command view eva	3.1.0.21	Running	
<input type="checkbox"/> Compaq Management Agents	6.30	Running	
<input type="checkbox"/> continuous access	1.1.0.0	Running	
<input type="checkbox"/> HSG Element Manager	1.0.4.0	Running	
<input type="checkbox"/> License Manager	1.02	Running	
<input type="checkbox"/> Management Appliance	2.1	Running	
<input checked="" type="checkbox"/> <b>Storage Area Manager</b>	<b>03.10.00.0120</b>	<b>Running</b>	

Additionally, you can use the Manage Tools page to stop and start Storage Area Manager management server services.

## Pre-installation steps

The following are the high-level pre-installation steps. Refer to the *Using Storage Area Manager on the Storage Management Appliance* application note for full details on each step.

1. Log on to the Storage Management Appliance.  
Refer to the HP OpenView Storage Management Appliance Software User Guide for complete instructions.
2. Verify that the Storage Management Appliance has SMA software v2.0 SP4 or later installed on it.  
This information is available by clicking *Help* on the SMA navigation bar.  
You can order the latest version of the SMA software from  
**<http://h18006.www1.hp.com/products/sanworks/softwaredrivers/managementappliance/index.html>**.
3. Use the SMA software to back up the SMA to a network share. Refer to the SMA online help for complete backup instructions.
4. Verify the SAN environment and perform other pre-installation steps that are required prior to a Storage Area Manager implementation, as documented by HP Services.

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**Note**

Storage Area Manager normally recommends two disk drives for acceptable performance. However, when installing Storage Area Manager on a Storage Management Appliance, these are not required.

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5. If Network View and/or Storage Allocation Reporter are installed on the SMA, uninstall these applications. If using the SMA II, perform upgrade to add additional 1 GB of memory.

## Installation and post-installation steps

The following are the high-level installation and post-installation steps. Refer to the *Using Storage Area Manager on the Storage Management Appliance* application note for full details on each step.

1. Attach a monitor, keyboard, and optional mouse to the SMA.
2. Insert the Storage Area Manager installation CD into the SMA DVD or CD-ROM drive.
3. Install Storage Area Manager as described in the documentation.

---

**Note**

You can install the Storage Area Manager Host Agent software on an SMA running software version 2.1. The Host Agent on the SMA does not monitor and manage storage because the SMA is not directly attached to storage devices. However, installing the Host Agent on the SMA allows Storage Area Manager to recognize the SMA as a known system in the SAN.

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4. Install any required Storage Area Manager patches.
5. Install appropriate DPIs for the environment.
  - HSV Controller DPI
  - Modular Data Router DPI
  - MSA1000 and RA4100 Controller DPI
6. Disconnect the monitor, keyboard, and/or mouse.

---

**Note**

HP recommends that you install the Storage Area Manager client software on a system separate from the SMA and that you manage the Storage Area Manager server from that client system.

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7. Register the Storage Area Manager Service with the SMA.

## Registering the Storage Area Manager service with the SMA

The last step in completing installation is to register the Storage Area Manager service with the SMA. This procedure allows you to start and stop services for the Storage area Manager server by using the SMA Manage Tools page.

### Storage Area Manager service registration with SMA software v2.0

This procedure allows you to start and stop services for Storage Area Manager by using the SMA Manage Tools page.

1. Connect to the SMA, either through Terminal Services or by attaching a monitor, keyboard, and mouse.
2. Create a new text file named `sam.ini` in the `C:\Filestore` directory on the SMA and enter the following lines:
 

```
[Storage Area Manager]
HP OpenView SAM Bridge
HP OpenView SAM Embedded DB
HP OpenView SAM ManagementServer
```
2. Execute the command:
 

```
C:\Filestore\fixupservice.exe "c:\Filestore\sam.ini"
```
3. Disconnect the monitor, keyboard, and/or mouse, if used.

### Storage Area Manager service registration with SMA software v2.1

1. To register the Storage Area Manager v3.0 or v3.1 service with Storage Management Appliance software v2.1:
2. Connect to the SMA, either through Terminal Services or by attaching a monitor, keyboard, and mouse.
3. Execute the command:
 

```
C:\Program Files\Compaq\SANworks\Appliance
Manager\bin\configservices" service.ini "[Storage Area
Manager]
```
4. You can ignore the following statement that appears after completion of this command: **Deleting application: Storage Area Manager.**
5. If you have *not* installed the host agent on the SMA, execute the following command:
 

```
C:\Program Files\Compaq\SANworks\Appliance
Manager\bin\configservices" service.ini "[Storage Area
Manager]:HP OpenView SAM Bridge:HP OpenView SAM Embedded DB:HP
OpenView SAM ManagementServer
```
6. The service is registered.

7. If you *have* installed the host agent on the SMA, execute the following command:  

```
C:\Program Files\Compaq\SANworks\Appliance  
Manager\bin\configservices" service.ini "[Storage Area  
Manager]:HP OpenView SAM Bridge:HP OpenView SAM Embedded DB:HP  
OpenView SAM ManagementServer:HP OpenView SAM HostAgent:HP  
OpenView SAM OpenDial
```
8. The service is registered.
9. Disconnect the monitor, keyboard, and/or mouse, if used.

## Configuring a fixed IP address

To use Storage Area Manager, you must configure the Storage Management Appliance to use a fixed IP address.

1. On the Storage Area Manager client, open a supported browser and connect to the SMA by entering **http://appliance name** or **http://appliance ip address**.
2. Click *Settings* on the primary navigation bar, and then click *Network*. The Network page displays.
3. Click *Interfaces*, choose the Local Area Connection, and then click *IP*. The IP Address Configuration page displays.
4. Choose *Use the following IP settings* and enter the IP address, Subnet mask, and Default gateway.
5. Click *OK*.

Be sure to click *OK* before changing settings on the Advanced tab. If you click the Advanced tab before you click *OK* on the General tab and then +return to the General tab, the fixed IP address you entered reverts back to the DHCP-supplied address.

The fixed IP address is set and is reflected correctly on the General tab. You can now return to the IP Address Configuration page and set the Advanced tab settings.

6. Reboot the Storage Management Appliance.

## Configuring the SMA to back up Storage Area Manager

To configure the SMA to include Storage Area Manager v3.1 backups:

1. Connect to the SMA, either through Terminal Services or by attaching a monitor, keyboard, and mouse.
2. Use Notepad or another text editor to open the SMA configuration file, *osmbackup.conf* (for example, *C:\Program Files\Compaq\SANworks\OSM\osmbackup.conf*)

This file begins with the following notation:

```
# backup configuration file #  
# app <appname>
```

3. Go to the end of *osmbackup.conf* and change the following line:

Storage Area Manager dirtree SAM Backup

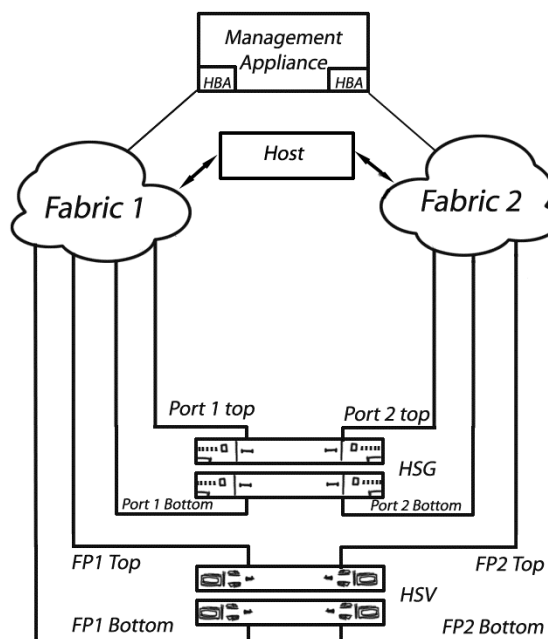
so that it reads as follows:

“Storage Area Manager” dirtree “C:\program files\ Hewlett-Packard\sanmgr\managementserver\db\backup”

4. Save the *osmbackup.conf* file.
5. Disconnect the monitor, keyboard, and/or mouse, if used.

After you update *osmbackup.conf* with the Storage Area Manager backup path information, HP recommends that you back up the file to a network share. Provide the location of the backed-up file to an SMA Administrator, to be used, if necessary, to recover a failed SMA.

## Using Storage Area Manager in a dual-redundant fabric configuration



SMA is often deployed in dual-redundant Fibre Channel environments. The Storage Area Manager software is compatible with dual redundancy.

Using dual-redundant Fibre Channel paths for storage management enables the SMA to have redundant control over the SAN, creating an environment with no single point of failure. In such a configuration, the SMA has two host bus adapters (HBAs), allowing greater ability to provide nonstop management control and monitoring of critical SAN devices.

The example above shows two fabrics with fiber connections between the SMA, a host, switches, and storage devices, including:

- The SMA with two host bus adapters
- A storage host system on which you install the Storage Area Manager host agent software
- An HSG controller pair connected to the fabric through Ports 1 and 2 (top controller) and Ports 1 and 2 (bottom controller)
- An HSV controller pair connected to the fabric through Fabric Ports 1 and 2 (top controller) and Fabric Ports 1 and 2 (bottom controller)

For more information, refer to the *HP OpenView Storage Management Appliance Software High Availability Application Notes*, available at <http://h18006.www1.hp.com/products/sanworks/managementappliance/documentation.html>.



Storage Area Manager can be successfully installed on the SMA in a dual-redundant environment. However, the Storage Area Manager discovery process might show dual-redundant configurations as two separate SANs, even though there is only one. Storage Area Manager incorrectly displays duplicate SAN maps with discovered devices in one SAN, but not the other. You can resolve this error using the following procedure:

1. Delete the devices under the Unknown Devices tree in the second SAN map displayed by Storage Area Manager.
2. Run another discovery operation.

After performing the second discovery, Storage Area Manager will correctly display a single SAN.

## Using Modular Data Routers with the Storage Management Appliance

If you have Modular Data Routers (MDRs) in your SAN, you need to install the Modular Data Router DPI to communicate with Storage Area Manager. You also need to install the HP StorageWorks Command Console for Tape Controller Management Element Manager on the Storage Area Manager server. However, Tape Controller Management (TCM) is not compatible with other software on the SMA and should not be installed on the SMA. Instead, it must be installed on some other Windows 2000 or Windows NT system. This Windows system does not need to be in the SAN, but needs to have IP connectivity to the SMA and MDRs in the SAN.

After installing the TCM Element Manager on the Windows host, use the Storage Area Manager application link feature (*Tools* → *Storage Node Manager* → *Edit Application Link*) to change the URL that launches TCM.

Refer to the HP StorageWorks Modular Data Router Device Plug-In Installation Instructions and the release notes included with the Modular Data Router DPI for complete details.

To enable the MDR page to launch from Storage Area Manager after you install TCM on the Windows host, you must allow anonymous access to unsecured pages in the System Management Home Page. Use the following procedure:

1. Log on using the administrator account on the System Management Home Page (**[http://ip\\_addr:2301/](http://ip_addr:2301/)**), where ip\_addr is the IP address of the Windows system where TCM is installed. The default password is administrator.
2. Click the *Options* link. (On some versions of the System Management Home Page, click the *Settings* tab and then click *Options*.)
3. Select *Anonymous Access* and save the settings.

The Modular Data Router DPI and supporting documentation are available at **<http://www.openview.hp.com/products/dpi/index.html>**.

## **Troubleshooting Storage Area Manager on the Storage Management Appliance**

Connect via Terminal Services to access the SMA to obtain the following Storage Area Manager information

- Get diagnostic information
- Apply Storage Area Manager patches
- Refer to the event viewer under system tools for any SMA related errors

## Learning check

1. List the authorization files that reside on the management server and SAN host.  
.....  
.....
2. Which of the following is a post-installation task that needs to be performed AFTER using the Setup Assistant.
  - a. Set the SNMP discovery range
  - b. Set the storage domain name.
  - c. Set the Storage Accountant currency type
  - d. Configure proxy devices.
3. Storage Area Manager supports firewall configurations that use NAT.  
☐ True  
☐ False
4. The only devices that currently support passphrases are
  - a. JBODs
  - b. XP Disk Arrays
  - c. Brocade switches
  - d. Inferred hubs
5. Describe the two criteria that must be met for a SAN host to be considered multi-homed.  
.....  
.....
6. DHCP is supported on which Storage Area Manager systems?
  - a. Management server only
  - b. Management clients and SAN hosts
  - c. Management server and MoM clients
  - d. DHCP is not supported by Storage Area Manager

7. HP's Storage Allocation Reporter customers are being migrated to which Storage Area Manager application?
  - a. Storage Builder
  - b. Storage Optimizer
  - c. Storage Node Manager
  - d. Storage Accountant
  
8. Installing Storage Area Manager on the SMA involves upgrading the Appliance with an extra 1 GB of memory.  
☐ True  
☐ False
  
9. Which two Storage Area Manager tasks can be performed using the SMA software?
  - a. Stop/start management server services
  - b. Modify Storage Area Manager maps
  - c. Access the Storage Area Manager GUI Download page
  - d. Stop/start Host Agent services
  
10. Installation of Storage Area Manager in dual-redundant fabric configuration may result in
  - a. The inability to launch the TCM Element Manager from the Storage Area Manager GUI
  - b. Dual-redundant configurations appearing on Storage Area Manager map as two separate SANs
  - c. Duplicate events appearing on the SMA
  - d. Unpredictable performance as Storage Area Manager is not supported in dual-redundant fabric configurations

### Objectives

After completing this module, you should be able to:

- Describe key families of disk arrays supported by Storage Area Manager.
- Describe how specific DPIs interface with devices and management applications in order to
  - Discover the device
  - Collect performance data
  - Obtain device status
  - Obtain device events
- Describe Storage Area Manager configuration requirements
- Describe device and management application configuration requirements

## DPI review

DPIs are internal Storage Area Manager code that is used to retrieve detailed information from an interconnect or storage device.

DPI components include

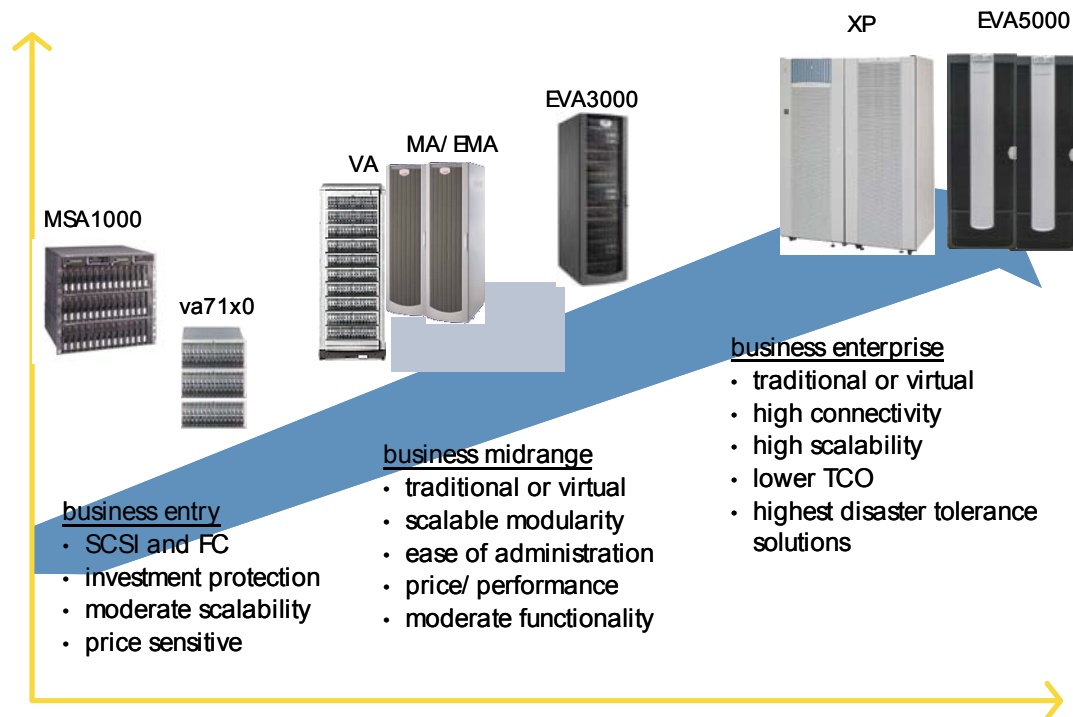
- **Property File** — enables Storage Area Manager to recognize devices, place them in the directory tree, display icons, launch management applications, and so on.
- **Discovery Code** — tells Storage Area Manager how to uniquely recognize a device
- **DPI Core Class** — defines the level of information that Storage Area Manager can provide about a device

DPIs are included with the Storage Area Manager product. Additionally, they can be downloaded asynchronously to product releases from

**[http://managementsoftware.hp.com/products/dpi/prod\\_0032.html](http://managementsoftware.hp.com/products/dpi/prod_0032.html)** DPIs are stored in a directory on the management server in one of two places:

- sanmgr\managementserver\devices\Deviceobjects
- sanmgr\managementserver\devices\dpi

## HP StorageWorks online storage systems



The HP StorageWorks disk array portfolio can be divided into three tiers:

- Enterprise class storage
- Mid-range storage
- Entry-level storage

### Enterprise class storage

Ideal for enterprise-wide deployment and mission-critical applications, these solutions are the most extensible, resilient, and controllable storage solutions available. They offer maximum scalability, industry-leading performance, a fully integrated suite of centralized management tools, and unmatched data protection and disaster tolerant features. Enterprise-class storage products include

- HP StorageWorks Disk Array XP1024
- HP StorageWorks Disk Array XP128
- HP StorageWorks Enterprise Virtual Array 5000 (EVA5000)

For more information on these products, see

<http://h18006.www1.hp.com/storage/enterprisestorage.html>

We will also cover the EMC disk arrays in this module.

## Mid-range storage

Ideal for moderate to large size data centers running key business applications, these solutions offer scalability to multiple terabytes of capacity, high-performance, many enterprise-class data protection features, and a fully integrated suite of centralized management tools for greater administrative control. Mid-range storage products include

- HP StorageWorks Enterprise Modular Array 16000 (EMA16000)
- HP StorageWorks Enterprise Virtual Array 3000 (EVA3000)
- HP StorageWorks MA8000/EMA12000 Fibre Channel
- HP StorageWorks Virtual Array (VA) 7410

For more information on these products, see

**<http://h18006.www1.hp.com/storage/midrangestorage.html>**

## Entry-level storage

Ideal for smaller deployments, including smaller data centers and remote office locations, these solutions are typically deployed in a direct-attach configuration, and are scalable to terabytes of capacity. They offer the capability of moving to a networked storage environment and the most affordable data protection and performance features in their class. Entry-level storage products include

- HP StorageWorks Modular SAN Array 1000 (MSA1000)
- HP StorageWorks Virtual Array 7x10

For more information on these products, see

**<http://h18006.www1.hp.com/storage/entrystorage.html>**



## HP StorageWorks XP1024/128, XP512/48, XP256 DPI



The HP StorageWorks XP1024/128, XP512/48, XP256 DPI supports

- HP StorageWorks XP128, 1024, 48, 512, 256
- HDS Freedom 7700e
- HDS Lightning 9910, 9960, 9970V, 9980V
- Hitachi Sanrise 2200, 2800

This section covers

- Management software/hardware, including Storage Area Manager dependencies
- DPI communication
- Storage Area Manager configuration requirements
- SVP configuration requirements
- XPPA configuration requirements

### XP disk arrays: management software/hardware

The following XP-related management software is used or required by Storage Area Manager:

- **Command View XP** — Provides the common user interface for all XP disk array management applications. Customers only need to learn a single user interface, reducing the learning curve and increasing usage of the tool. Command View XP uses a simple, browser-based interface.

A clear differentiator for Command View XP is its Path Connectivity module. This module provides customers with a series of reports detailing and configurations, connections, and paths being used by hosts and switches to the XP array.

Path Connectivity also provides diagnostic capabilities for the fibre channel connection between hosts and the XP array. This feature identifies if a particular connection has begun to degrade and then provides diagnostic information to assist with the troubleshooting process.

Storage Area Manager does not require Command View XP; however, an application link can be created to invoke the Command View XP web interface.

- **Service Processor (SVP)** — Acts as an embedded Windows 2000 laptop computer inside of the XP disk array. The SVP is on a private LAN that is used for management purposes. Customers do not directly use the SVP but interact with it through the Command View XP software.

Storage Area Manager uses the SVP to discover the XP disk array. The SVP provides device information and sends SNMP traps to Storage Area Manager.

- **Performance Advisor XP** — Collects and monitors the real-time performance of the HP SureStore XP family of disk arrays.

Performance Advisor uses a simple, browser-based interface and provides real-time and historical data on:

- LDEV, CHIP, ACP, RAID group, array, and host I/O per second
- Front-end and back-end port utilization
- Internal bus utilization
- Cache usage

The software also provides alarm and event notification through email, SNMP, and VPO console.

Storage Area Manager uses Performance Advisor XP to gather performance metrics.

- **Remote Control XP** — Manages the XP512, XP48, and XP256 disk arrays. Remote Control XP the HP name for the original Hitachi management application.

Storage Area Manager provides an application link to Remote Control XP and discovers the specific XP disk arrays by means of the SNMP agent implemented on the Remote Control XP system.

For the XP128 and XP1024 disk arrays, Remote Control XP is not required or supported.

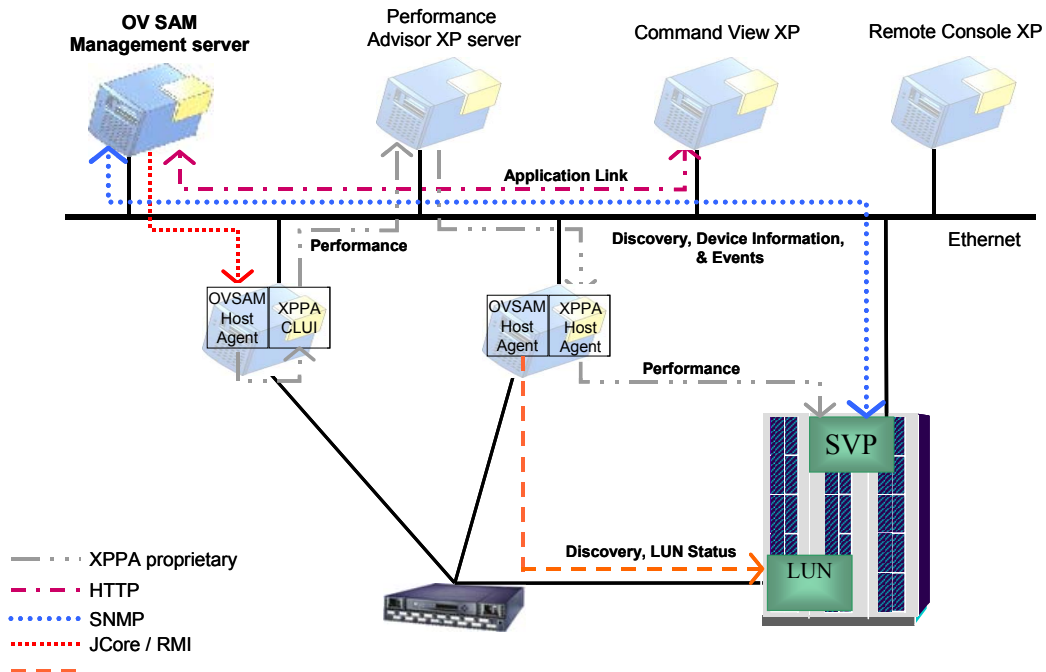
The following XP-related management software is used or required by Storage Area Manager:

- **Application Policy Manager XP** — Provides the ability to borrow, fence, and limit storage resources that directly affect application and user performance.
- **Auto Path XP for HP-UX** — Adds HP-UX support to Auto Path.
- **Cluster Extension XP** — Provides long-distance data replication capabilities. It extends leading high-availability server clustering solutions over geographically dispersed data centers up to 10 km. It integrates XP remote mirroring with cluster monitoring and failover operations.
- **Secure Manager XP** — Provides continuous, real-time, I/O-level data access control of the XP array. It allows restriction of a single LUN or group of LUNs to a specified host or group of hosts.
- **Business Copy XP** — Maintains one or several copies of critical data through a split-mirror process. Asynchronous copy volume updates ensure that the I/O response time for primary applications is not adversely affected.

Each copy of the data can be used for various purposes—backup, new application testing, or data warehouse loading—without disrupting the primary application and primary data, and most importantly, without disrupting business operations.

- **Continuous Access XP** — Provides a high-availability data and disaster recovery solution that delivers host-independent, real-time, remote data mirroring between XP disk arrays.

## XP disk arrays: DPI communication



This graphic shows the specific interfaces that the Storage Area Manager XP DPI uses to gather information from the XP family of disk arrays.

### Device discovery

XP arrays are discovered by two methods:

- **SNMP-based discovery of the SVP** — The storage Area Manager server queries the SNMP sysObjectID.
- **SCSI inquiry of host LUNs** — On hosts with the Storage Area Manager Host Agent installed, Storage Area Manager performs a standard SCSI Inquiry of each host LUN.

### Device information

The DPI gathers most of the non-performance-related device information from the XP array SNMP MIB. The device information includes storage unit information, the number of LUNs, LUN sizes, internal disks and ports, and device status.

SNMP is implemented in different ways depending on the model of XP array.

- **XP48, XP128, XP512, and XP1024** — The SNMP agent resides within the SVP.
- **XP 256** — The SNMP agent is implemented by the Remote Console XP application.

## Device status

The Host Agent periodically issues a SCSI request to determine if the host can communicate with the LUN. If connectivity to the LUN has been lost, the Host Agent will generate an event and change the status of the device.

## Events

Events are received by the management server in the form of SNMP traps sent by the SNMP agent of the SVP.

## Performance data collection

Storage Optimizer relies on Performance Advisor XP (XPPA) to obtain performance data for the XP family of disk arrays.

Performance Advisor XP includes the following components:

- XPPA Server
- XPPA Host Agent
- XPPA CLUI

On the XP 128 and 1024 arrays, the XPPA Server uses RMI to gather data from the SVP.

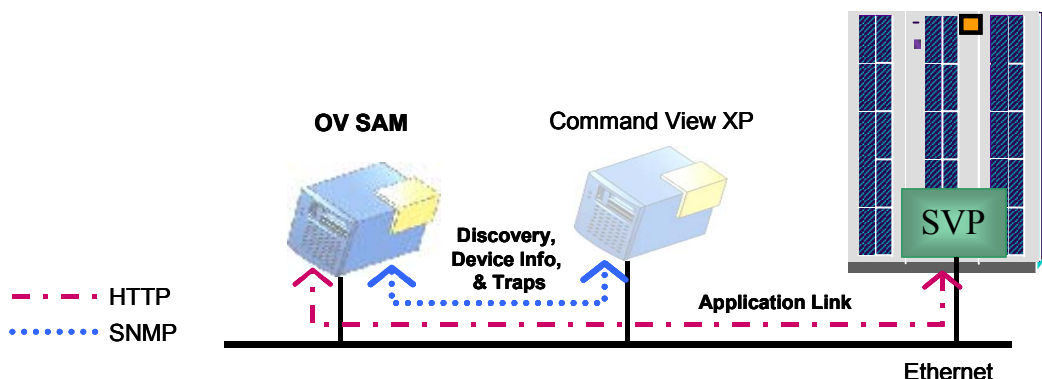
On the XP 256 and 512 arrays, the XPPA Server requests data from the XPPA Host Agent. The XPPA Host Agent obtains the data from the array through a command LUN and passes the information back to the XPPA Server. As a result, the XPPA Host Agent must have access to at least one XP LUN configured as a command LUN.

The Storage Optimizer Host Agent components use the XPPA CLUI to access the performance data.

The following performance metrics are supported:

- Device metrics
  - Device Percent Reads From Cache
  - Device Percent Writes To Cache
  - Device Read Cache Hits
  - Device Read Operations
  - Device Total Operations
  - Device Write Cache Hits
  - Device Write Operations
- System metrics
  - ACP Utilization
  - CHP Utilization
  - Cache Pending Write Data
  - Cache Side File
  - Cache Size
  - Cache Usage
  - Control Bus Utilization
  - Databus Utilization
- LDEV metrics
  - LDEV Random Read Hits
  - LDEV Random Reads
  - LDEV Random Write Hits
  - LDEV Random Writes
  - LDEV Sequential Read Hits
  - LDEV Sequential Reads
  - LDEV Sequential Write Hits
  - LDEV Sequential Writes

## XP disk arrays: Storage Area Manager configuration requirements



To discover XP disk arrays, the Storage Area Manager Host Agent must reside on at least one SAN host with connectivity to the XP. Additionally, Storage Area Manager requires the following:

- **XP48, XP128, XP512, XP1024 arrays** — The SNMP agent within the SVP of the array must be operational and accessible, and the IP address of the SVP must be within the SNMP discovery range of Storage Area Manager. SNMP community names must be set for the SVP.
- **XP256 array** — The IP address of the Remote Control console system must be included in the SNMP discovery range of Storage Area Manager.

### Application links

It may be desirable to launch the Command View XP web interface from Storage Area Manager. This link is not created by default, because Storage Area Manager does not automatically discover the XP management station. However, this link can be created by using the Storage Area Manager global application link feature.

To create the link:

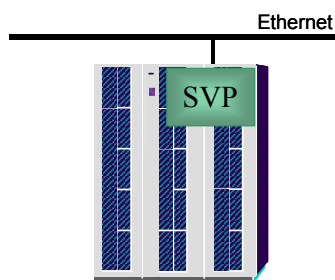
1. Select *Tools* → *Storage Node Manager* → *Add Application Link*.
2. Enter a name for the link.
3. Enter the following command: `%browser% http://<CV IP Address>/`

Where *CV IP Address* refers to the IP address of the Command View XP management station.

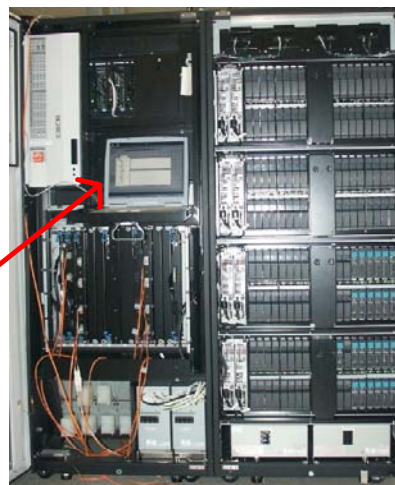
#### Note

Write down the XP disk array serial number from the Storage Area Manager device properties window because the serial number is used as an identifier within the Command View XP interface.

## XP disk arrays: SVP configuration requirements



SVP



For the Storage Area Manager DPI to properly discover and recognize the array, SNMP must be configured properly and working in the SVP.

- The Microsoft SNMP agent must be installed and running on the SVP.
- The easiest way to verify SNMP connectivity is by using the SAMTools MibWalker tool. Verify that the System Object ID has a value of .1.3.6.1.4.1.116.3.11.4.1.1 (this is the sysObjectID assigned to Hitachi). If not, then most likely the Hitachi extended SNMP sub-agent is not enabled.

---

### Note

The Hitachi SNMP extension requires a license.

---



### Important

Do not use the Microsoft SNMP configuration GUI (SNMP.exe) to configure the SNMP agent because this tool will make the SNMP MIB unreachable by the Storage Area Manager.

Use the following Web Console configuration procedure to configure the SNMP community name and trap destination. The Hitachi Extension MIB overwrites the community name configured in the Microsoft SNMP configuration GUI.

---

Using the SVP Web Console, perform the following SVP configuration:

1. Click the *Web Console* button on the SVP main screen.
2. To enable updates, click the *Write Mode* button.
3. To navigate to SNMP information, click the *Install* button.
4. Verify that *Extension SNMP MIB* is enabled.



5. Verify the community name by double-clicking the *Community* folder. To add or modify values, right-click the *Community* folder and enter the community name.

In the Storage Area Manager SNMP discovery range, the read/write community names associated with the SVP should correspond to the name specified in the Web Console. For example, if the community name in the Web Console is “public,” then both the read community and write community names in the Storage Area Manager SNMP discovery range should be set to “public.”

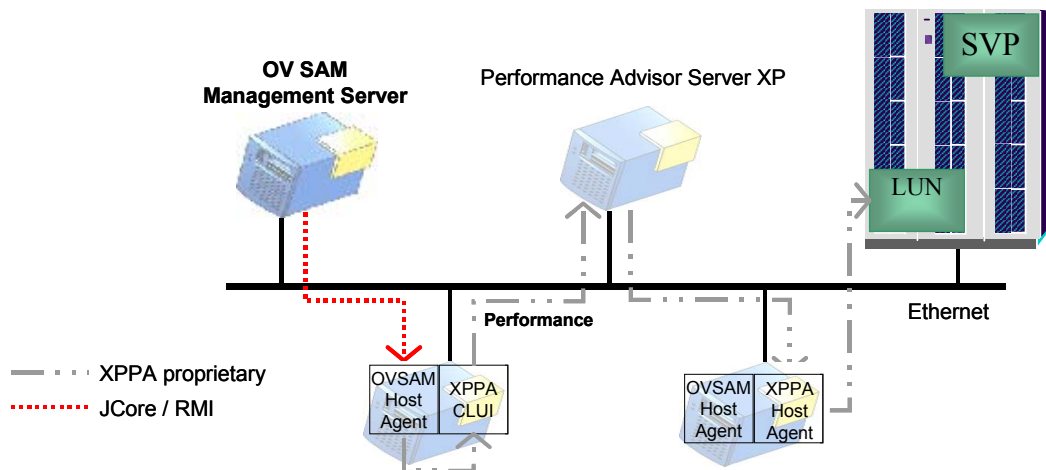
6. SNMP traps are not automatically configured to be sent to the Storage Area Manager management server; this configuration must be done manually. To configure SNMP traps to be sent to the management server, add the Storage Area Manager management server to the list of recipients in the *IP Address* section.
7. Click the *Apply* button to save the configuration changes.
8. Click the *Write Mode* (pen icon) button to unlock the SVP.

**Important**

The main SVP screen should be left in *view* mode. Leaving the main screen in *Modify* mode will lock out remote access and will prevent the DPI from operating properly.

---

## XP disk arrays: XPPA configuration requirements



The Performance Advisor XP server must be installed and operational before Storage Area Manager can collect performance data. At least one XPPA Host Agent must be running on a system with LUN connectivity to the XP array.

The XPPA CLUI tools must be installed on at least one host with the Storage Area Host Agent.

The DPI includes support for the latest version of Performance Advisor XP version 1.51, as well as previous versions.

# HP StorageWorks Virtual Arrays DPI

Virtual Array 7110



Virtual Array 7410



The HP StorageWorks Virtual Arrays DPI supports

- Virtual Array 7100/7110
- Virtual Array 7400/7410

This section covers

- Management software available for the devices, including Storage Area Manager dependencies
- DPI communication
- Command View SDM configuration requirements

## VA disk arrays: management software

The following VA-related management software is used or required by Storage Area Manager:

- **Command View SDM** — Provides a common user interface for modular networked storage. It is a host or web-based application that monitors and manages modular scaleable storage resources from a single management console. Command View SDM provides centralized control of information resources and provides an integrated device management platform for all modular scaleable storage starting with the virtual array product family.

Storage Area Manager requires Command View SDM to gather performance metrics.

The following VA-related management software is not used or required by Storage Area Manager:

- **Business Copy** — Provides online data replication and backup software. It creates an online copy of LUNs that can be dedicated for backup or testing environments.

Business Copy is integrated with Command View SDM storage device management software. It also integrates into backup software applications that support a custom scripting implementation.

Business copy is functionality provided by the array firmware. All the features for managing business copies are provided through the Command View SDM interfaces.

Business Copy is not used or required by Storage Area Manager.

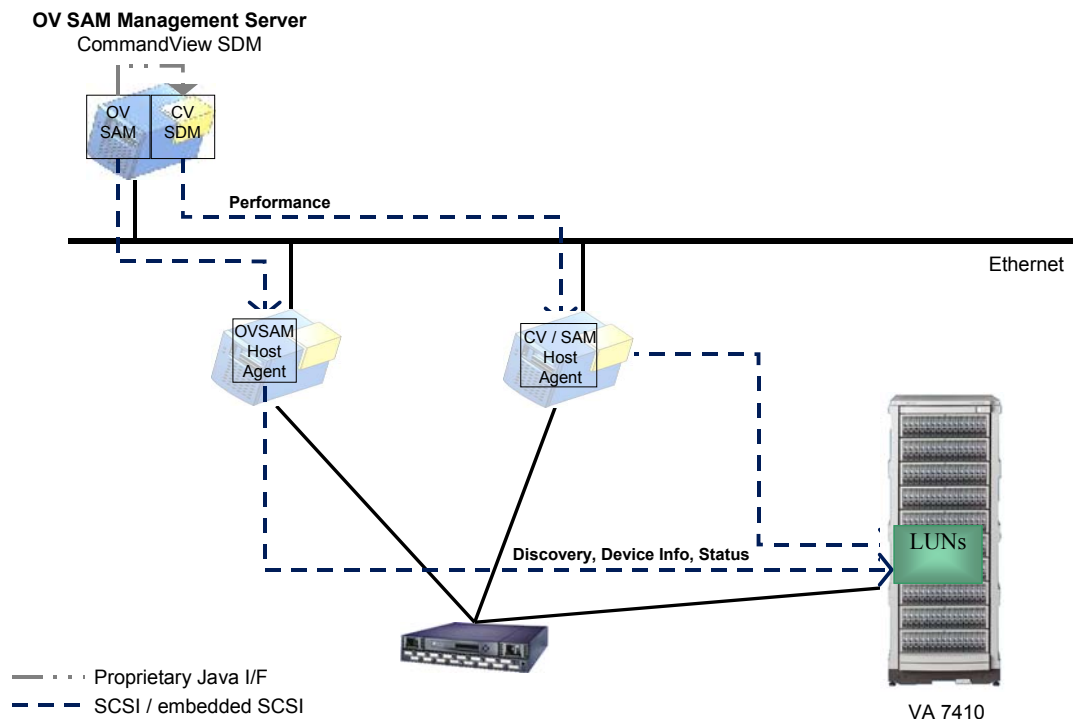
- **Secure Manager VA** — Provides LUN security for shared homogeneous and heterogeneous environments. It allows LUNs to be locked in a secure shared environment. The Secure Manager VA application is integrated with Command View SDM storage device management software. Comprehensive user interfaces (web browser, GUI, CLUI, and Command View) are provided.

Secure Manager VA is not used or required by Storage Area Manager.

- **Auto Path VA** — Provides failover and load-balancing drivers with multi-path fail-over and load balancing of HBAs in single server and clustered environments. A GUI is included for quick setup and management.

Auto Path VA is not used or required by Storage Area Manager.

## VA disk arrays: DPI communication



This graphic shows the specific interfaces that the Storage Area Manager VA DPI uses to gather information from the VA series of disk arrays.

Note that Command View SDM resides on the same system as the Storage Area Manager management server. Additionally, Command View SDM uses its own copy of portions of the Storage Area Manager Host Agent to gather information from the VA.

### Device discovery

VA disk arrays are discovered by the Storage Area Manager Host Agent by means of host LUNs. On hosts with the Storage Area Manager Host Agent installed, Storage Area Manager performs a standard SCSI Inquiry of each host LUN.

### Device information

All device information is retrieved by means of a SCSI command issued to the VA by the DPI. The information gathered includes array capacity, available space, number of LUNs, raw size, RAID level, LUN IDs, and so on.

### Device status

LUN connectivity and status is obtained through the Storage Area Manager Host Agent.

## Events

The DPI generates events based on changes in status that it determines from SCSI inquiries made to the array.

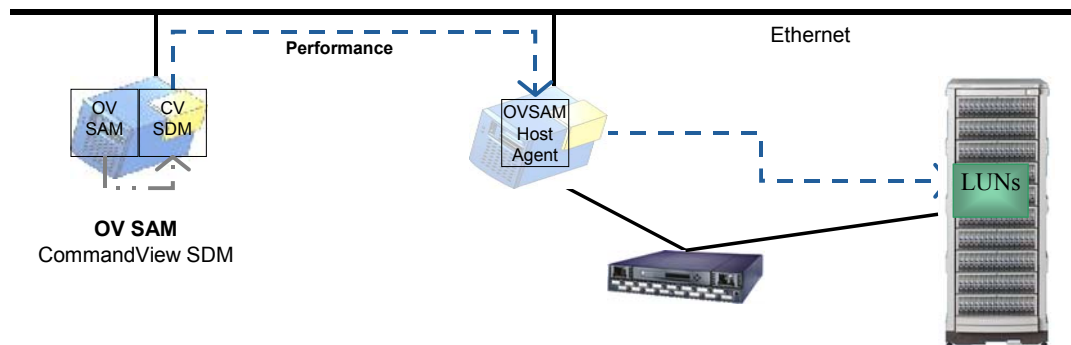
## Performance data collection

Storage Area Manager gathers performance data using a proprietary Java interface to Command View SDM.

The following performance metrics are supported:

- Device metrics
  - Device Percent Reads From Cache
  - Device Percent Writes To Cache
  - Device Read Cache Hits
  - Device Read Operations
  - Device Total Operations
  - Device Write Cache Hits
  - Device Write Operations
- LUN level metrics
  - LUN Percent Reads From Cache
  - LUN Percent Writes To Cache
  - LUN Read Cache Hits
  - LUN Read Operations
  - LUN Total Operations
  - LUN Write Cache Hits
  - LUN Write Operations

## VA disk arrays: Command View SDM configuration requirements



To ensure that Storage Area Manager can properly discover and retrieve information from VA disk arrays, verify that Command View SDM (version 1.07 or later ) is installed on the Storage Area Manager management.



### Important

Command View SDM must be installed before the Storage Area Manager management server.

## HP StorageWorks HSV Controller - EVA DPI

**EVA 3000**



**EVA 5000**



The HP StorageWorks HSV Controller – EVA DPI supports

- HP StorageWorks EVA 3000
- HP StorageWorks EVA 5000

This section covers

- Management software, including Storage Area Manager dependencies
- DPI communication
- Storage Area Manager configuration requirements

### EVA disk arrays: management software

The following EVA-related management software is used or required by Storage Area Manager:

- **Command View EVA** — Provides the user interface for configuring, managing, and monitoring the Enterprise Virtual Array storage system. It is accessed through the HP OpenView Storage Management Appliance (SMA) software.

The Command View EVA software (formerly known as the HSV Element Manager) is installed on the SMA. Storage Area Manager communicates with Command View EVA using the Command View EVA bridge (an embedded web server) that runs on the SMA. Command View EVA communicates with the Virtual Controller Software in the EVA.

Storage Area Manager uses Command View bridge to discover EVA disk arrays and to gather information including performance metrics.

- **Virtual Controller Software (VCS)** — Allows the Enterprise Virtual Array to communicate with Command View EVA through the HSV Controllers. VCS is embedded software for the HSV controllers.

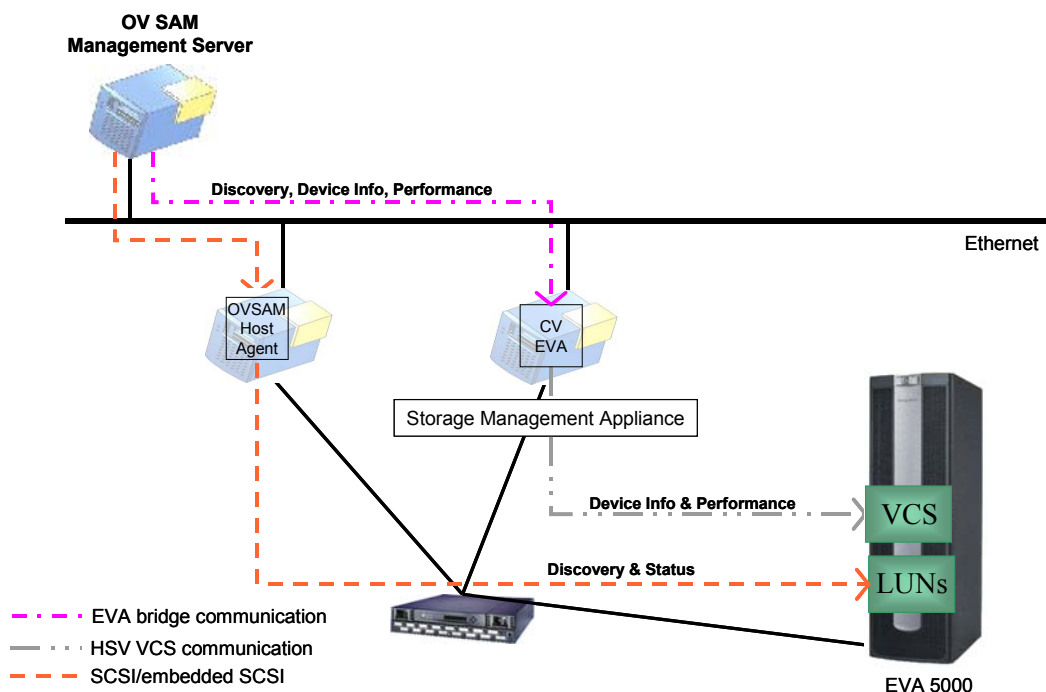
VCS information is accessed indirectly by Storage Area Manager through the Command View EVA application.



The following EVA-related management software is not used or required by Storage Area Manager:

- **Continuous Access EVA** — Provides the ability to mirror data from a primary (or local) location to an alternate (or remote) location. Continuous Access EVA is fibre channel controller-based replication software that supports storage arrays running VCS.
- **Business Copy EVA** — Provides the ability to make point-in-time copies of storage volumes. These copies, called Business Continuance Volumes (BCVs), can be mounted dynamically on any other supported host in the Business Copy storage network.

## EVA disk arrays: DPI communication



This graphic shows the EVA-specific interfaces that the Storage Area Manager HSV DPI uses to gather information about the EVA series of disk arrays.

### Device discovery

EVA disk arrays are discovered by two methods:

- **Command View EVA** — Out-of-band communication with the Command View EVA application. The Storage Management Appliance acts as a proxy device to Storage Area Manager by providing data from Command View EVA.

An event is displayed in the Storage Area Manager event panel when an EVA disk array is discovered through out-of-band discovery.

- **SCSI Inquiry of host LUNs** — On hosts with the Storage Area Manager Host Agent installed, Storage Area Manager performs a standard SCSI Inquiry of each host LUN. The DPI scans all SCSI paths to find the unique subsystem ID.

Until out-of-band Command View EVA-based discovery occurs, only minimal information is available through the standard host LUN inquiry. Specifically, only the LUN IDs and the up/down status of the host LUN are provided through in-band discovery.

If the DPI loses communication with the Command View EVA application, the DPI reverts to in-band discovery mode. Although, though the information collected during the previous out-of-band discovery is maintained, it is not updated.

---

**Note**

The DPI cannot discover uninitialized storage subsystems. EVA subsystems can only be discovered by its hosts with presented LUNs.

---

## Device information

Device information is gathered via the Storage Area Manager Host Agent.

---

**Note**

HSV physical disk information is provided via the LUN allocation tab.

---

## Device status

Storage Area Manager obtains the LUN status from the Host Agent. The Host Agent performs a SCSI request on each host LUN to determine if the host has connectivity with the LUN.

## Events

The DPI generates events by polling Command View EVA and determining if the status of the EVA has changed. The SNMP traps sent by the SMA are not used by the DPI because the traps do not identify with which array the event is associated.

## Performance data collection

Storage Area Manager gathers performance data from Command View EVA through the SMA proxy device.

The following performance metrics are supported:

- LUN statistics
  - LunReadResponseTime
  - LunReadDataRate
  - LunReadDataSize
  - LunReadQueue
  - LunWriteResponseTime
  - LunWriteRequestRate
  - LunWriteDataRate
  - LunWriteDataSize
  - LunWriteQueue

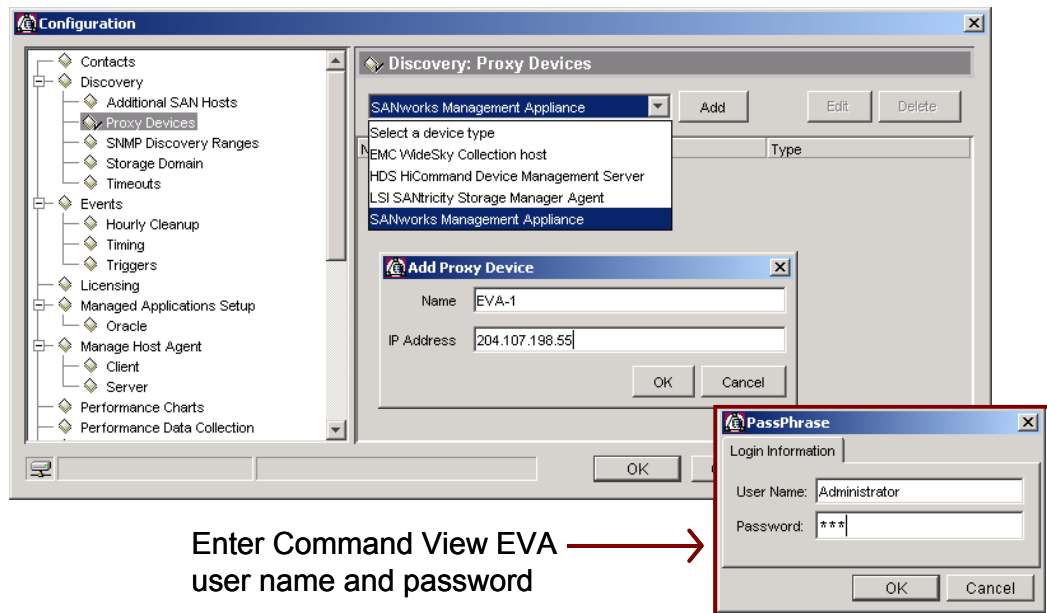
- LunTotalRequestRate
- LunTotalDataRate
- LunTotalTransferSize
- LunPercentRead
- LunPercentWrite
- LunTotalQueue
- LunReadOperations
- LunTotalOperations
- LunWriteOperations
- Subsystem statistics
  - SubsystemReadResponseTime
  - SubsystemReadRequestRate
  - SubsystemReadDataRate
  - SubsystemReadDataSize
  - SubsystemReadQueue
  - SubsystemWriteResponseTime
  - SubsystemWriteRequestRate
  - SubsystemWriteDataRate
  - SubsystemWriteDataSize
  - SubsystemWriteQueue
  - SubsystemTotalRequestRate
  - SubsystemTotalDataRate
  - SubsystemTotalTransferSize
  - SubsystemPercentRead
  - SubsystemPercentWrite
  - SubsystemTotalQueue
- Device statistics
  - DeviceReadOperations
  - DeviceTotalOperations
  - DeviceWriteOperations

## **EVA disk arrays: Storage Area Manager configuration requirements**

To discover and gather information from EVA disk arrays, Storage Area Manager requires the following:

- Command View EVA must be installed and operational on the SMA.
  - Business Copy EVA and Continuous Access EVA may also be installed on the SMA though Storage Area Manager does not use them.
- The SMA must be configured in Storage Area Manager as a proxy device.
- The Storage Area Manager Host Agent should not be installed on the SMA.

## Configuring the SMA as a proxy device



Enter Command View EVA  
user name and password

To configure the SMA as a Storage Area Manager proxy device:

1. Select *Tools* → *Configure*.
2. Under *Discovery*, select *Proxy Devices*.
3. Select *SANworks Management Appliance* from the device type drop-down menu.

The Storage Management Appliance uses two sets of user names and passwords:

- The first allows access to the Command View EVA software (running on the SMA, port 2381).
  - Default user name: administrator
  - Default password: administrator



### Important

Use this user name and password when configuring the proxy device.

- The second allows access to the SMA web GUI.
  - Default user name: administrator
  - Default password: admin<nnnnnn>
 

where <nnnnnn> is the last six digits of the SMA serial number reversed.

When discovery runs, Storage Area Manager uses the proxy configuration to gather information from Command View EVA.

In Storage Area Manager, perform the following steps.

1. Expand the Storage Devices node.
2. Click the Storage Node Manager tab.
3. Select the EVA array from the list

You should see the following message: “The subsystem is being monitored through an HSV management server.”

If you do not see this message, allow approximately one half hour for Storage Area Manager to discover and query the EVA.

If the following message displays: “No management server is available to monitor this subsystem. Limited data is being collected through SCSI,” then the user name or password for the proxy device may be incorrect.

## Application links

It may be desirable to launch the Command View EVA from Storage Area Manager. This link is not created by default, because Storage Area Manager does not automatically discover the SMA. However, this link can be created using the global application link feature of Storage Area Manager.

To create the link:

1. Select *Tools* → *Storage Node Manager* → *Add Application Link*.
2. Enter a name for the link.

Enter the following command:

```
%browser http://<IPADDRESS>:2301/ResEltCpqFusion
```

Where *IPADDRESS* refers to the IP address of the SMA.

If you have multiple appliances, you must create a link for each one.

## The HP StorageWorks HSG Controller DPI



**MA8000 / EMA12000 FC**

The HP StorageWorks HSG Controller DPI supports

- HP StorageWorks enterprise modular array 16000
- HP StorageWorks enterprise modular array 12000
- HP StorageWorks enterprise storage array 12000
- HP StorageWorks modular array 8000
- HP StorageWorks raid array 8000
- HP StorageWorks modular array 6000
- IBM Model 2106 modular storage server

This section covers

- Management software, including Storage Area Manager dependencies
- DPI communication
- Storage Area Manager configuration requirements

### EMA/MA disk arrays: management software

The following HSG-related management software is used or required by Storage Area Manager:

- **StorageWorks Command Console (SWCC)** — Provides the ability to monitor and manage the storage connected to the HSx80 controller. It enables configuration of virtual disks, notification of events, and monitoring of storage systems.

The SWCC software consists of two packages:

- **Client** — Interactive graphical software program that runs on Microsoft Windows. The SNMP service must be installed and running in order to use the client. SWCC Client software provides an easy method to configure, monitor, and troubleshoot a storage subsystem.



- **Agent** — Pass-through program installed on the server that is connected to the storage subsystem. The agent operates as a service on the server and is the communication interface to one or more clients connected to a network.

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**Note**

The SWCC agent was formerly known as the Steam Agent and more recently as the HS Service Agent.

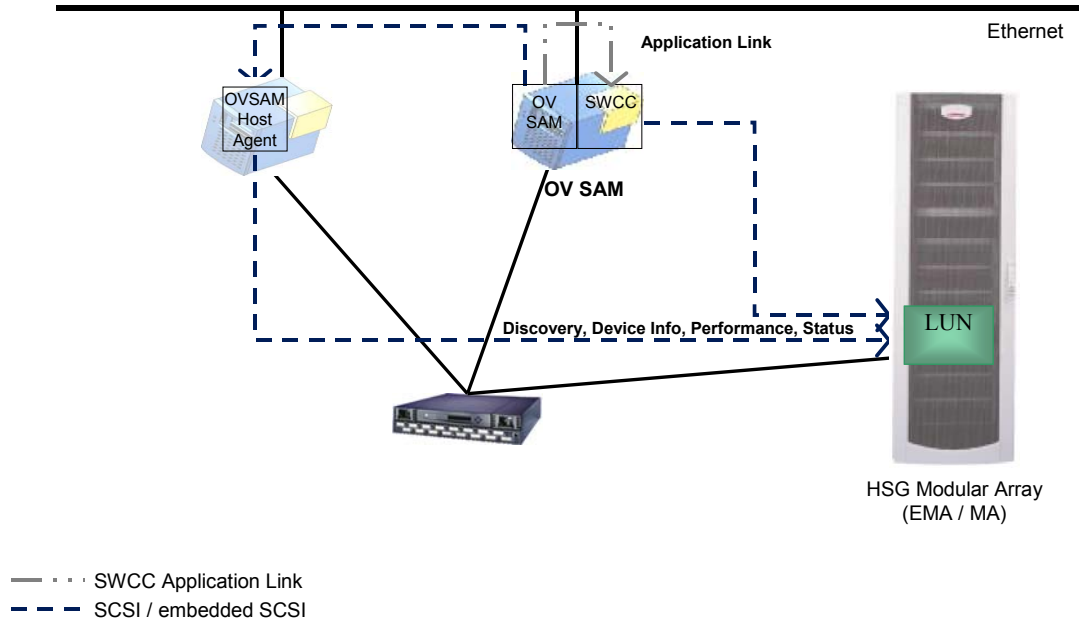
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By default, Storage Area Manager creates an application link to access the SWCC client.

The following HSG-related management software is used or required by Storage Area Manager:

- **Array Controller Software** — Controls access to HSG-based disk arrays. It provides a command line interface and is installed on a host system. The command line interface is used to communicate with the HSG controller to configure the disk array.
- **SANworks Secure Path** — Provides continuous data access for the MA8000 and EMA12000 storage systems configured on Windows. Secure Path allows a StorageWorks dual-controller RAID subsystem to be connected to two or more independent SCSI, fibre channel arbitrated loop, or fibre channel switched fabric paths by using multiple host bus adapters (HBAs) in each server.

## EMA/MA disk arrays: DPI communication



This graphic shows the interfaces that the Storage Area Manager uses to gather information from HSG disk arrays.

### Device discovery

HSG disk arrays are discovered by the Storage Area Manager Host Agent by means of host LUNs. On hosts with the Storage Area Manager Host Agent installed, Storage Area Manager performs a standard SCSI Inquiry of each host LUN.

### Device information

All device information is retrieved by means of SCSI inquiries issued to the HSG controller by the DPI. The information gathered includes array capacity, available space, number of LUNs, raw size, RAID level, LUN IDs, and so on.

### Device status

HSG disk array status is determined by means of SCSI inquiries issued by the Storage Area Manager Host Agent.

### DPI limitations

- Configurations in which the disk array is connected to Solaris hosts only are not supported.
- Only the Windows version of SANworks Secure Path is supported.

- Arrays using the HSG60 and HSG80 controllers are supported. Arrays using the HSZ70 and HSZ80 controllers have not been tested

### **Performance data collection**

The DPI retrieves performance information by means of SCSI inquiries issued by the Storage Area Manager Host Agent. The following performance metrics are supported:

- Common metrics
  - Device Percent Reads From Cache
  - Device Percent Writes To Cache
  - Device Read Cache Hits
  - Device Read Operations
  - Device Total Operations
  - Device Write Cache Hits
  - Device Write Operations
  - LUN Percent Reads From Cache
  - LUN Percent Writes To Cache
  - LUN Read Cache Hits
  - LUN Read Operations
  - LUN Total Operations
  - LUN Write Cache Hits
  - LUN Write Operations
- Controller-level metrics
  - Subsys Total I/O Rate
  - Subsys Read I/O Rate
  - Subsys Write I/O Rate
  - Subsys Total Throughput
  - Subsys Write Throughput
  - Subsys Write Size
  - Subsys Read Throughput
  - Subsys Read Size
  - Subsys Percent Read Commands
  - Subsys Percent Write Commands
  - Subsys Percent Read Data

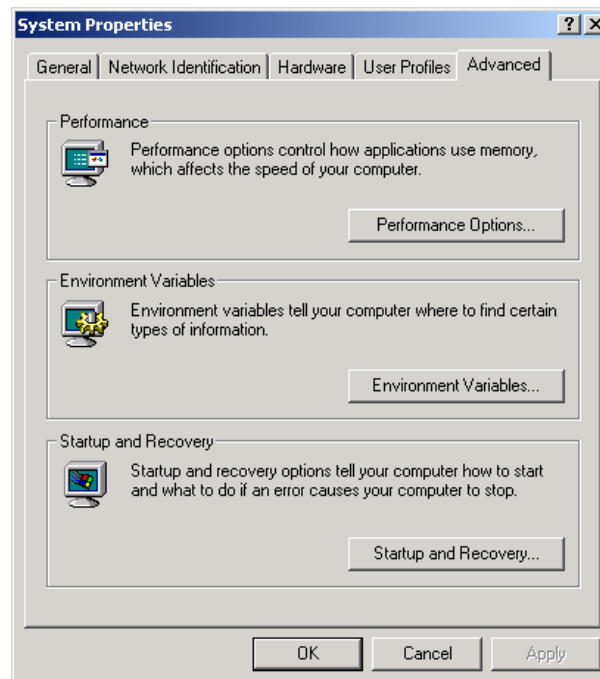
- Subsys Read Cache Rate
- Subsys Read Cache Hit Rate
- Subsys Read Cache Hit Size
- Subsys Read Cache Data Rate
- Subsys Read Data Throughput Rate
- Subsys Cache Miss Rate
- Subsys Read Miss Size
- Subsys Total Queue Length
- Subsys Read Queue Length
- Subsys Write Queue Length
- Subsys I/O Response Time
- Subsys Read Response Time
- Subsys Write Response Time
- LUN-level metrics
  - Total I/Os per LUN
  - Read I/O Rate
  - Write I/O Rate
  - Total Data Throughput
  - Read Data Rate
  - Read Size
  - Write Data Rate
  - Average Queue
  - Read Queue
  - Write Queue
  - Read Cache Hit Rate
  - Read Cache Rate
  - Read Cache Data Rate
  - Read Cache Hit Size
  - Read Miss Rate
  - Read Miss Size
  - Read Miss Data
  - Write Size

- Percent Read Commands
- Percent Data Commands
- Read Response Time
- Write Response Time
- Controller-level metrics
  - Total I/Os per LUN
  - Read I/O Rate
  - Write I/O Rate
  - Total Data Throughput
  - Read Data Rate
  - Read Size
  - Write Data Rate
  - Average Queue
  - Read Queue
  - Write Queue
  - Read Cache Hit Rate
  - Read Cache Rate
  - Read Cache Data Rate
  - Read Cache Hit Size
  - Read Miss Rate
  - Read Miss Size
  - Read Miss Data
  - Write Size
  - Percent Read Commands
  - Percent Data Commands
  - Read Response Time
  - Write Response Time

## EMA/MA disk arrays: Storage Area Manager configuration requirements

To discover and gather information from HSG disk arrays, Storage Area Manager requires the following:

1. Install the StorageWorks Command Console client (available on the Solution Software CD that came with the array) on the Storage Area Manager management client.
2. Add the subdirectory where the SWCC client is installed to the system PATH of the Storage Area Manager management client.
  - a. Right-click *My Computer* on the Windows desktop and select *Properties* to display the system properties dialog box.
  - b. Select the *Advanced* tab and then click the *Environment Variables* button.





## EMC Symmetrix DPI



The EMC Symmetrix DPI supports

- EMC Symmetrix 8000 family (8830, 8730, 8530, 8430, 8230)
- EMC Symmetrix 5000 family (5930, 5830, 5700, 5630, 5430, 5330)
- EMC Symmetrix 3000 family (3930, 3830, 3700, 3630, 3430, 3330)

This section covers

- Management software, including Storage Area Manager dependencies
- DPI communication
- Storage Area Manager configuration requirements

### EMC Symmetrix disk arrays: management software

The EMC ControlCenter 5.1.1 software suite includes a number of applications, all of which are accessible from the ControlCenter console. Storage Area Manager requires the following application:

- **Symmetrix Manager** — Monitors the status, performance, and configuration of Symmetrix storage systems.

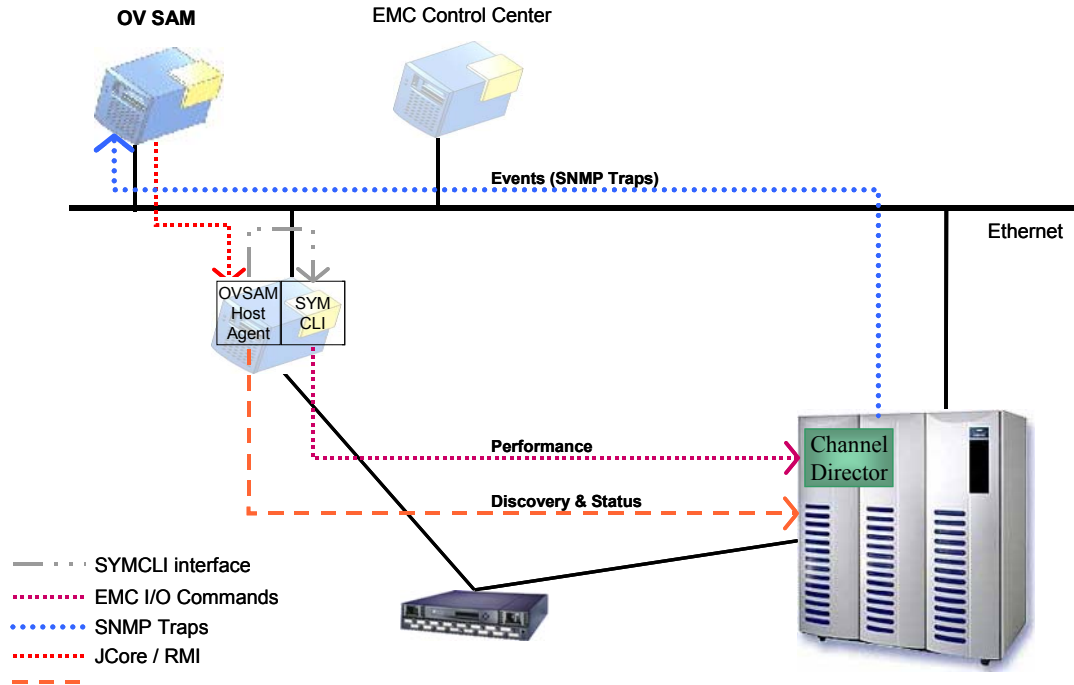
Storage Area Manager uses the EMC command line interface (SYMCLI) that is included with Symmetrix Manager. SYMCLI monitors and controls operations on Symmetrix storage systems. It provides a set of commands that obtain device configuration information, control the configuration, and retrieve status and performance data on attached Symmetrix units. The SYMCLI uses system calls that generate low-level I/O SCSI commands to the Symmetrix units.



Storage Area Manager does not use or require the following application:

- **CLARiiON Management** — Provides configuration for the CLARiiON series of storage arrays with the ability to launch the Navisphere Manager for CLARiiON.
- **Celerra Management** — Provides Celerra discovery and monitoring.
- **SAN Manager** — Provides integrated network discovery, topology and alert capabilities including zoning and LUN masking for CLARiiON and HDS arrays.
- **Automated Resource Manager** — Provides storage resource management; provisioning of Symmetrix, CLARiiON, and HP StorageWorks arrays; and monitoring and management of host storage resources.
- **StorageScope** — Provides asset and utilization reporting for multivendor storage, SANs, and host storage.
- **Workload Analyzer** — Collects and displays statistics from Windows, UNIX and MVS hosts as well as Oracle databases, fibre channel switches, Symmetrix and CLARiiON disk arrays for performance analysis.
- **Symmetrix Optimizer** — Balances physical drive I/O by swapping Symmetrix logical volumes to less-used physical disks.
- **Common Array Manager** — Monitors multivendor arrays.

## EMC Symmetrix disk arrays: DPI communication



This graphic shows the specific interfaces that the Storage Area Manager uses to discover and gather information about the EMC series of disk arrays.

### Device discovery

On systems with the Storage Area Manager Host Agent and SYMCLI installed, EMC disk arrays are discovered via host LUNs. The SYMCLI issues EMC proprietary SCSI commands to gather information about the array.

**INTERNET** A good overview of the SYMCLI and the underlying SYMAPI is provided in the EMC whitepaper, *ISV Access to Symmetrix Performance and Utilization Metric*, dated January 2000. It is available at: [http://www.emc.com/techlib/abstracts/emc\\_inside\\_box.jsp](http://www.emc.com/techlib/abstracts/emc_inside_box.jsp)

### Device information

The DPI uses the SYMCLI to obtain Symmetrix device information. The device information includes: storage unit information, the number of LUNs, LUN sizes, internal disks and ports, and device status. The DPI communicates with a Storage Area Manager SAN host, which has both the Host Agent software and SYMCLI installed.

## Device status

LUN status is obtained by the Storage Area Manager Host Agent. Storage Node Manager displays only Normal and Unknown/Unreachable status for EMC Symmetrix arrays because the EMC Symmetrix device status can only be determined based upon host LUN access. If the host systems can connect to their Symmetrix LUNs, then the status is Normal. If they cannot connect to the LUNs then the status is Unknown/Unreachable. If a Symmetrix array has been discovered by a host LUN connection but a SYMCLI-capable host has not yet been found, the status will be set to Unknown/Unreachable.

## Events

The EMC Symmetrix DPI does not generate events.

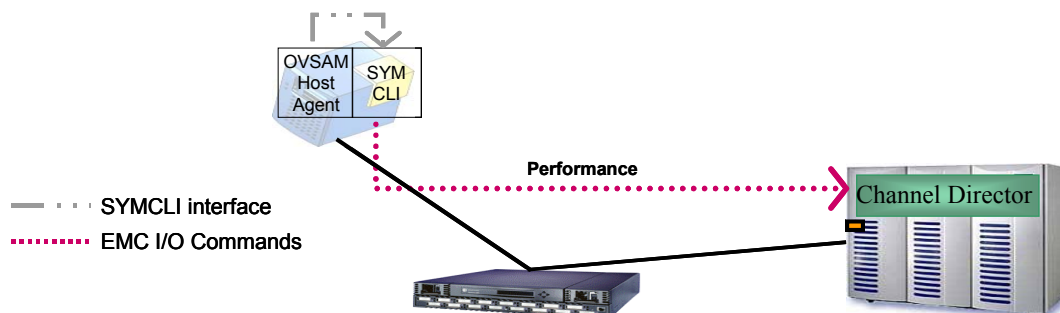
## Performance data collection

The DPI uses the EMC SYMCLI interface to obtain Symmetrix performance data. The DPI communicates with a Storage Area Manager SAN host that has both the Host Agent software and SYMCLI installed.

The following performance metrics are supported:

- LUNReadsPerSecond
- LUNWritesPerSecond
- LUNReadBytesPerSecond
- LUNWriteBytesPerSecond
- DirectoryReadCacheRequestsPerSecond
- DirectoryCacheHitRatioPercentage
- DirectorWriteCacheRequestsPerSecond
- DirectorIOsPerSecond

## EMC Symmetrix disk arrays: Storage Area Manager configuration



Storage Area Manager must have access to the SYMCLI 5.1 software.

To properly discover and display information for an EMC disk array, at least one host attached to the array must have both the Storage Area Manager Host Agent and SYMCLI installed. Additionally, this host must be configured within Storage Area Manager as a proxy device. For failover capability, the Host Agent and SYMCLI software must be installed on more than one host attached to the array.

By default, SYMCLI is installed on hosts attached to EMC disk arrays. For the Storage Area Manager to invoke these utilities, they must be installed in the default directory. If SYMCLI is not installed in the default directory, you must specify the location during the installation of the DPI.

---

### Note

If you need to determine the installation location of SYMCLI, search the host for “symcfg” (symcfg.exe on Windows hosts).

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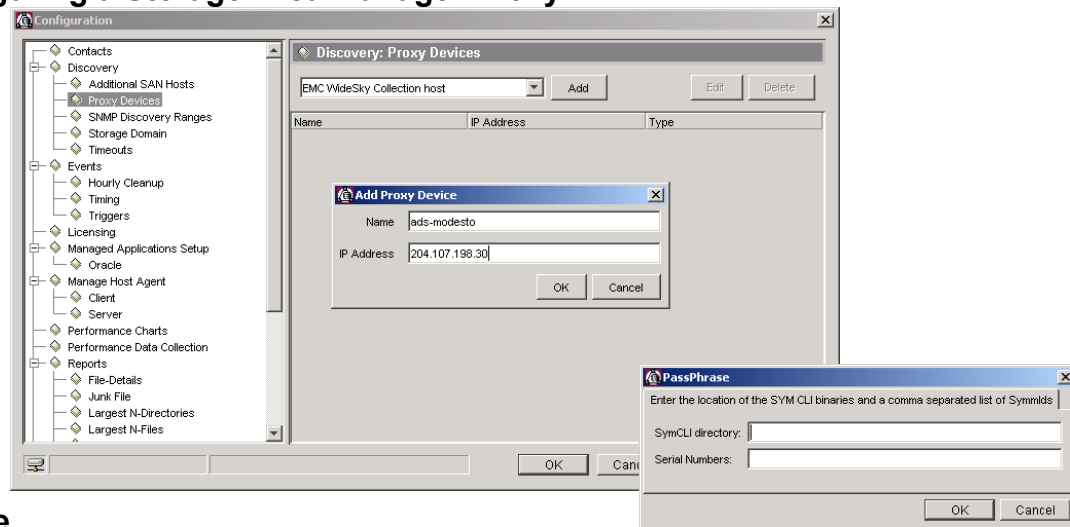
If fibre channel connectivity is lost between the host and the Symmetrix array, the EMC SYMCLI may incorrectly report performance data or report no performance data. This issue may continue even after connectivity is restored. To fix the problem, restart the Storage Area Manager Host Agent.

**Application links** Storage Area Manager creates the following device-specific links by default:

- **Local SymConsole** — Starts the EMC Symmetrix Console software on the local machine.
- **Local Symmetrix Control Center** — Starts EMC Control Center software on the local machine.
- **Telnet to SYMCLI host** — Starts a telnet connection to a remote host. This link is useful to run the command-line interface directly.

If the EMC management software is installed in a directory other than the default, the Storage Area Manager application commands can be edited. To edit the launch commands, select *Tools* → *Device* → *Edit Application Link*.

## Configuring a Storage Area Manager Proxy



### Device

Perform the following steps for each host that you want to use as a proxy. The host must have the Storage Area Manager Host Agent software and the SYMCLI installed.

1. Select the *Tools* → *Configure*.
2. Under Discovery, select *Proxy Devices*.
3. Select *EMC WideSky Collection host* from the device type drop-down menu and click the *Add* button.
4. In the Add Proxy Device dialog box, enter the name and IP address of the host and click the *OK* button.
5. In the PassPhrase dialog box, enter the directory location for the SYMCLI in the *SymCLI directory* field.
6. In the *Serial Numbers* field, enter the serial numbers for one or more Symmetrix disk arrays to which this host has access.

### Note

For each EMC Symmetrix array, there should be two Storage Area Manager Host Agent systems configured as proxies to provide redundant interfaces to gather information from each array.

## Storage Allocator and the SYMCLI

If Storage Allocator has been activated on the host, it will initially hide all the LUNs (including those to EMC Symmetrix arrays) from the host. To enable the SYMCLI to work properly, perform the following tasks:

1. From the management server, reassign the LUNs.
2. Execute `symcfg discover` to reinitialize the SYMCLI.

## The Storage Works MSA1000 and RA4100 DPI

**MSA1000**



The Storage Works MSA1000 and RA4100 DPI supports

- HP StorageWorks Modular SAN Array 1000 (MSA1000)
- HP StorageWorks Raid Array 4100 (RA4100)

This section covers

- Management software, including Storage Area Manager dependencies
- DPI communication
- Storage Area Manager configuration requirements

### MSA disk array: management software

The following management software is available for the MSA disk array:

- **Management agents** — Enable fault, performance, and configuration management. Using the management agents, the System Management home page provides status and direct access to in-depth subsystem information.

The management agent included with the MSA 1000, provides an extended SNMP MIB for management of the MSA.

Storage Area Manager uses the management agents for discovery, performance information and events.

- **Array Configuration Utility (ACU)** — Disk configuration utility used to view, set up, and configure the array controllers. Two versions of the ACU utility available are the MSA1000 Support Software CD:

- Windows-based version (ACU)
- Web-based version (ACU XE)

All the correct agent, network services, and management software must be installed, configured, and running before all the features and functions of ACU and ACU-XE are operational.

The ACU and ACU-XE are not used or required by Storage Area Manager.



- **Selective Storage Presentation (SSP)** — Enables logical units in array sets to be partitioned to multiple servers for SAN access. The SSP also permits sharing of the MSA1000 between servers, including servers running different operating systems. The SSP is implemented within the fibre channel array controller firmware. Each logical drive on the controller has an access control list that contains the World Wide Names (WWNs) of server host adapters having access to that drive. If a server tries to send commands to a logical drive that it does not have access to, the firmware will reject the command.

SSP is not used or required by Storage Area Manager.

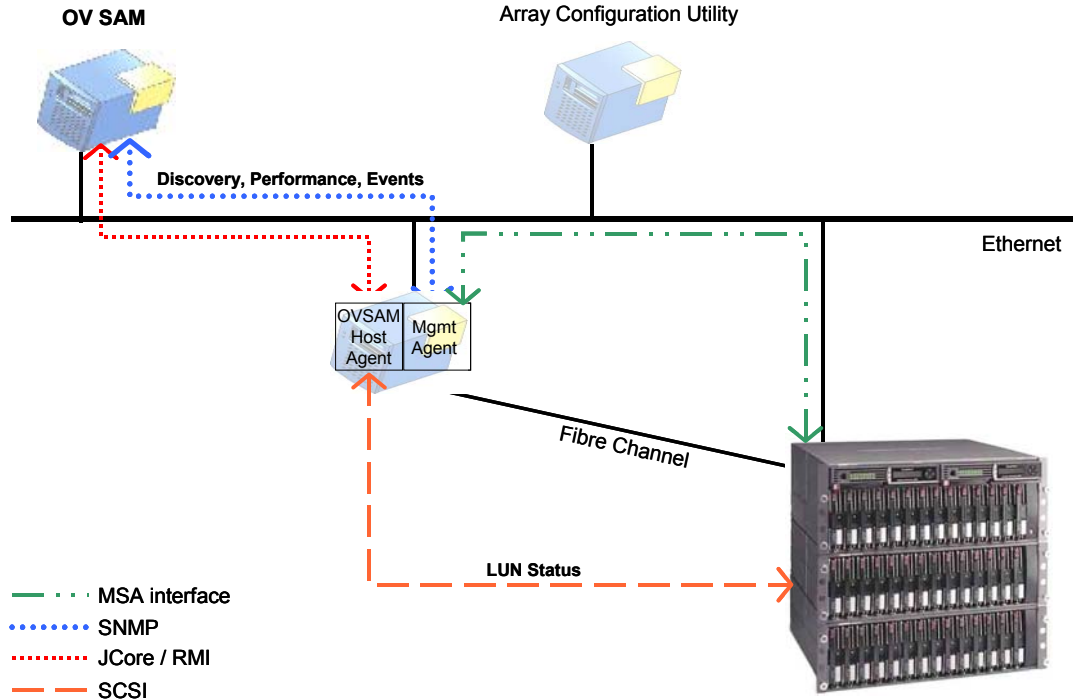
- **Command line interface (CLI) of the MSA** — Configures and manages all aspects of the MSA1000. The CLI is accessed through a host computer connected to RJ-45Z serial port of MSA1000.

The MSA CLI is not used or required by Storage Area Manager.

- **SecurePath** — Allows a StorageWorks dual-controller RAID subsystem to be connected to two or more independent fibre channel paths by using multiple HBAs in each server. Secure Path monitors each path and automatically reroutes I/O to functioning alternate paths should an adapter, cable, hub, switch, or controller failure occur.

SecurePath is not used or required by Storage Area Manager.

## MSA disk array: DPI communication



This graphic shows the specific interfaces that Storage Area Manager uses to gather information about the MSA disk array.

### Note

This DPI supports both the MSA1000 and RAID Array 4100.

## Device discovery

XP arrays are discovered by two methods:

- **SNMP-based discovery of the ACU** — The Storage Area Manager management server queries the SNMP sysObjectID.
- **SCSI Inquiry of host LUNs** — On hosts with the Storage Area Manager Host Agent installed, Storage Area Manager performs a standard SCSI Inquiry of each host LUN.

## Device information

Information about the MSA controllers, physical disks, and ports is gathered by the DPI from the management agent using SNMP.

## Device status

Host LUN status is obtained by the Storage Area Manager Host Agent performing periodic SCSI inquiries of the host LUN.

## Events

When a change in MSA status is detected based on an SNMP query, an event is generated by the DPI.

## Performance data collection

The DPI uses SNMP to collect performance metrics from the management agents.

The following metrics are supported:

- Device metrics
  - Device Read Operations
  - Device Write Operations
  - Device Total Operations
- Subsystem metrics
  - Subsystem Total I/O Rate
  - Subsystem Read I/O Rate
  - Subsystem Write I/O Rate
  - Subsystem Total Throughput
  - Subsystem Read Throughput
  - Subsystem Write Throughput
  - Subsystem Read Size
  - Subsystem Write Size
  - Subsystem Percent Read Commands
  - Subsystem Percent Write Commands
  - Subsystem Percent Read Data
  - Subsystem Read Data Throughput Rate

## MSA disk array: Storage Area Manager configuration requirements

The IP address of each MSA management agent host must be within the Storage Area Manager SNMP discovery range.

For environments that include the MSA Fabric Switch 2/8, the Brocade DPI should also be installed. Support for the MSA Fabric Switch 6 is provided with the Fibre Alliance MIB devices DPI.

Storage Allocator does not support the MSA DPI.

### Application links

By default, Storage Area Manager provides the ability to launch the MSA1000 device manager, which is called the HP Management Agent. To launch the device manager, right-click the MSA1000, in the View panel or Resources tree, and select *HP Management Agent* from the shortcut menu. The Management Agent for the MSA that is managed by the host is displayed.

## Learning check

1. VA disk arrays are discovered by means of SNMP?  
☐ True  
☐ False
  
2. The XP DPI receives events from which of the following:
  - a. Command View XP
  - b. SNMP traps
  - c. Performance Advisor XP
  - d. Business Copy XP
  
3. Which of these DPIs requires a Storage Area Manager proxy configuration?
  - a. EVA DPI
  - b. XP DPI
  - c. EMC Symmetrix DPI
  - d. VA DPI
  
4. The XP DPI must be installed and operational on Storage Area Manager before installing Performance Advisor XP.  
☐ True  
☐ False
  
5. Which of the following products uses the Storage Area Manager Host Agent to gather data?
  - a. Command View XP
  - b. Command View EVA
  - c. Command View SDM
  - d. OpenView Network Node Manager

6. To support all of the features available from the XP DPI, which of the following is true?
  - a. The SNMP agent must be enabled
  - b. A Storage Area Manager Host Agent must be installed on at least one host with access to the XP array
  - c. Performance Advisor XP must be installed on the Storage Area Manager management station.
  - d. The Performance Advisor XP CLUI must be installed on at least one Storage Area Manager Host Agent system.
  
7. To configure the SANworks Management Appliance proxy for the EVA DPI, which information is required?
  - a. Command View EVA user name and password
  - b. SNMP community name
  - c. Command View EVA management server IP address
  - d. VCS administrator password
  
8. The EMC Symmetrix DPI has which of the following dependencies?
  - a. The EMC SYMCLI must be installed on a least one Storage Area Manager Host Agent system
  - b. EMC Control Center must be installed and operational.
  - c. The EMC Common Array Manager must be installed on the Control Center console.

### Objectives

After completing this module, you should be able to:

- Identify the Storage Optimizer architectural components.
- Describe Storage Optimizer's dependencies for gathering metrics.
- View host, interconnect, and storage device metrics.
- Create custom performance charts.
- View performance trends and baselines.
- Configure baselines and event thresholds.
- Enable/disable performance data collection. Specify the data retention period.

## Product overview and features

Storage Optimizer monitors and reports the performance of storage network resources. Performance metrics vary by resource, but typical metrics are read and write rates, byte transfer rates, average queue depths, various errors, invalid CRCs and transmission words, link failures, signal losses, received and transmitted bytes and frames, read and write operations, read and write cache hits, and blocks requested. Storage Optimizer can display any metric that a resource supports. You must install and license Storage Optimizer to use its features.

Storage Optimizer adds the following features to Storage Area Manager:

- **Performance views of host disks, volumes, HBAs, interconnect devices, storage devices, LUNs, and controllers.**
- **The ability to view devices in the order of their performance on a common metric** — Allows comparison of performance across like devices and easy identification of the top (or bottom) performers.
- **Line charts of performance data collected for individual devices over selectable periods of time** — Define customized charts to supplement defaults provided.
- **Performance trends** — Line charts can show where performance is likely to be in the near and distant future based on current trends. Using sophisticated statistical models, Storage Optimizer identifies trends that can account for such influences as seasonal variation. Turn this feature on or off, as well as select from the simplest to the most sensitive predictive models.
- **Baselining and automatic thresholds** — Using the most sophisticated statistical analysis, Storage Optimizer can establish an extremely accurate baseline of expected performance. Configure Storage Optimizer to send a threshold event whenever actual performance deviates significantly from the baseline.
- **Performance data export in a comma-delimited (CSV) file.**
- **Secure access to administrator functions** — Only administrators can enable/disable the collecting, baselining, and automatic thresholding of performance data, or schedule the summarizing and archiving of performance data.
- **Command Line User Interface (CLUI)** — Run-line commands expedite the viewing and configuring of Storage Optimizer information.
- **Support for OpenView Operations and OpenView Reporter queries of the performance database.**

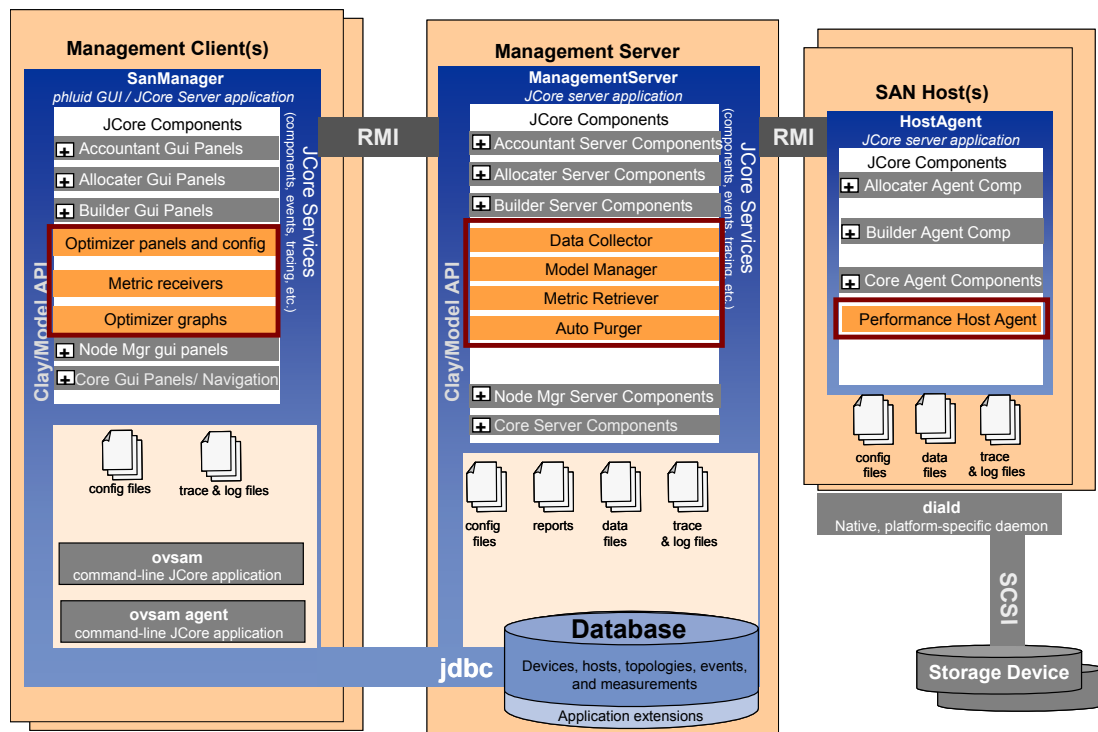


## New features in Storage Optimizer 3.1

Storage Optimizer 3.1 offers the following new features:

- **More data stored in less space for longer periods** — Performance data is now stored in compressed files outside the Storage Area Manager database. As a result, Storage Optimizer now stores raw data, instead of the hourly summaries it previously stored, and it retains the data for up to 5 years, instead of 1 year. The default retention period is now 1 year; it was 1 week in the previous releases. See Performance data management for more information.
- **Simplified scheduling** — There is no longer a need to schedule the summarizing of performance data for long-term (archive) storage. Storage Optimizer automatically stores data in its original state for 1 year. Administrators can change the default retention period to any number between 1 and 1825 days (5 years), inclusive. Every night, Storage Optimizer purges all files that are older than the specified number of days.

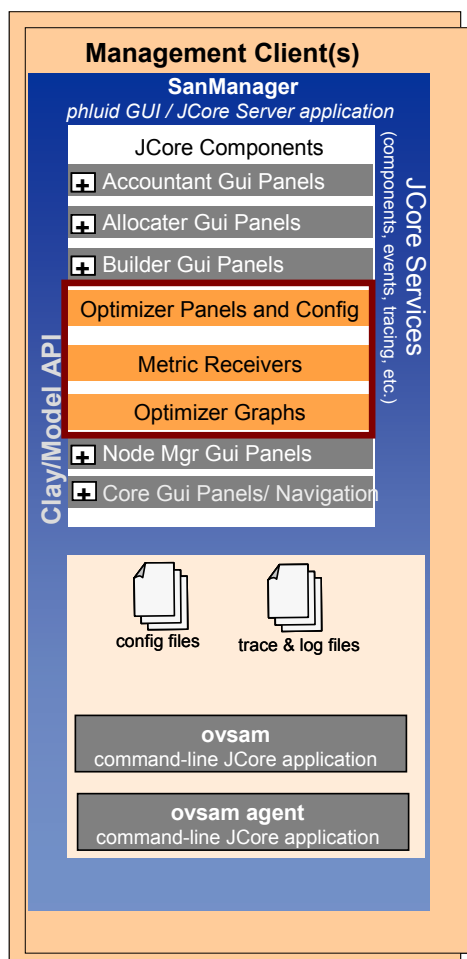
## Storage Optimizer architecture



The above diagram shows the Storage Optimizer components that reside on the management client, management server, and SAN host.

As with the other Storage Area Manager applications, Storage Optimizer delivers its functionality in a set of JCore components.

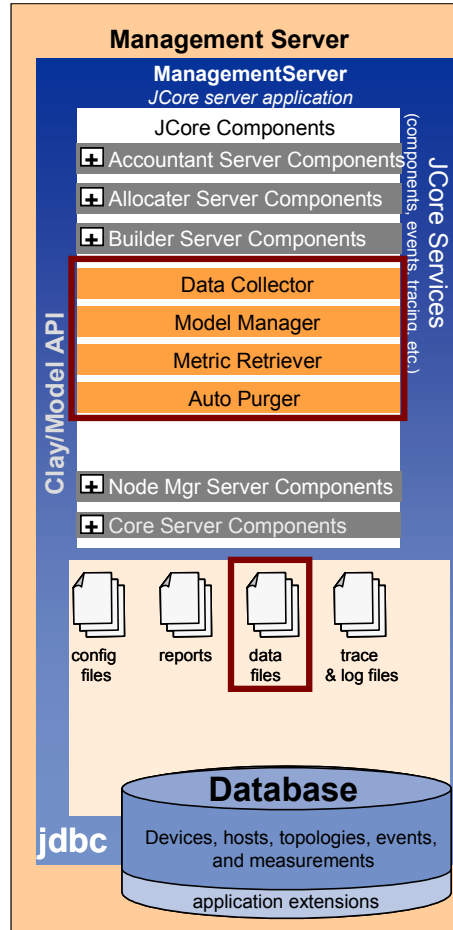
## Storage Optimizer management client components



Three Storage Optimizer components reside on the management client:

- **Storage Optimizer Panels and Configuration Dialog** — Extends the tree to include Storage Optimizer-specific navigation, adds Storage Optimizer view panels, and extends the configuration window to include Storage Optimizer options.
- **Storage Optimizer Metric Retrievers** — Retrieves performance data from the database for presentation in the client view panels.
- **Storage Optimizer Graphs** — Adds Storage Optimizer graphs to client view panels.

## Storage Optimizer management server components



The following Storage Optimizer components reside on the management server:

- Data Collector
- Model Manager
- Metric Retrievers
- Automerger
- Autopurger
- Performance Data Files

## Data Collector

The Data Collector is the core Storage Optimizer component. It is responsible for collection of performance data from various sources, such as a hosts, switches, and storage devices. The Data Collector takes the list of devices discovered by DDT and creates a data source that contains a DPI for each device. It then talks to the data sources, which can be the actual device or applications for the devices. The DPI component communicates through a plug-in that runs underneath the Host Agent. This Host Agent provides a wrapper that lets extraction occur from the data source. There is a separate plug-in for each device.

Devices may support collection multiple times an hour or just once an hour. Summarization occurs at the top of an hour and is written to the database. This data is used to predict the next value to determine if an event needs to be generated.

An event is sent to the Event view panel when the Data Collector is successfully started.

## Model Manager

Due to limitations in obtaining performance data from certain devices, Storage Optimizer supports a subset of the total devices supported by Storage Area Manager. Because of these limitations, the Model Manager acts as a mechanism to filter the devices supported by Storage Optimizer from the database. In doing so, the Model Manager checks to see if the DPI has a Performance Class that allows collection of performance data. The Model Manager is also responsible for creating and scheduling the Auto Merger as the Auto Merger retrieves the list of supported devices from the Model Manager and uses it in the merging process.

## Metric Retriever

The Metric Retriever serves as a connection between the Storage Optimizer performance metric information that has been collected and retained within the repository and the reports and graphs that use the information.

Based on defined input parameters, the Metric Retriever queries the repository for selected information, converts this information into a usable format, and then returns the values to the calling programs. The Metric Retrievers validates all input parameters before execution of the database query.

The Metric Retriever supports several different queries, many of which involve the aggregation or filtering of individual hourly measurements that were archived into the database. The Metric Retriever hides the details of such processing and returns only the requested result, so that consumers of the performance data do not need to understand measurement data structures or their analysis.

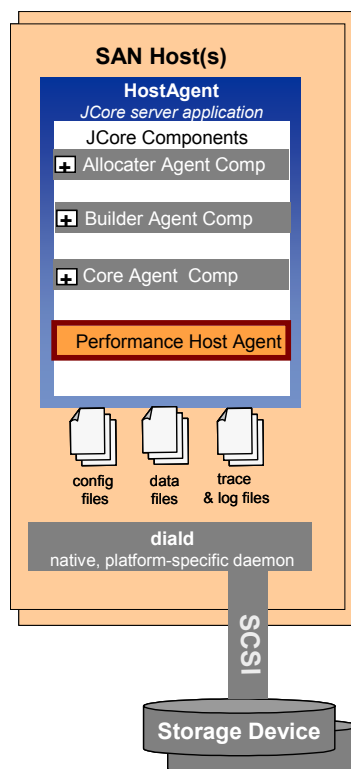
## **Auto Purger**

The Autopurger trims summarized daily measurements that have exceeded a user-specified number of days in age. The goal of trimming is to limit the amount of Storage Area Manager database space that is used by performance measurements. Trimmed measurements are permanently removed from the database. The Autopurger also deletes any measurements, hourly or daily, that pertain to a host or device that was permanently deleted from the database since the last execution of the Autopurger. The Autopurger executes daily upon completion of the Automerger process.

## **Performance Data Files**

Performance data for each metric and day is stored in compressed binary form outside the Storage Area Manager database.

## Storage Optimizer SAN host components



Storage Optimizer's Performance Host Agent (PHA) resides on each SAN host. It provides a framework that allows Storage Optimizer to extract data from the tools residing on the SAN host. The PHA uses a Measureware plug-in module to retrieve host performance data. The PHA is installed as part of the normal Host Agent installation/deployment process.

## Performance metrics and data collection

Storage Optimizer collects performance information on supported models of the following resources and their components:

- Disks (or LUNs), volumes, HBAs, and HBA ports on hosts
- Interconnect devices and their ports
- Storage devices and their LUNs, disks, and controllers

The specific metrics that Storage Optimizer collects depend on the resource. Storage Optimizer is designed to display any performance metric that a resource supports. View collected metrics in the collection schedule for specific resources.

Performance data collection is off until an administrator enables collection for selected resources. When collection is enabled, the default is to collect all metrics for hosts and common metrics for storage and interconnect devices.

### Storage collection cycle

The default collection cycle minimum for all supported storage devices is 15 minutes. This default parameter is specified in `config\PMCollector.prp` on the management server. If this file is empty, the default value is retrieved from the default DPI settings for the device.



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**Caution**

The default collection cycle minimum specified in `config\PMCollector.prp` should not be modified unless requested by HP support personnel, as difficulties with collection may result.

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**Important**

For best results, set the collection interval in XPPA to five minutes, or less.

---



## Collecting All metrics

When configuring performance data collection, the Collect All Metrics option includes the custom and common metrics that a resource supports. Specific resources provide various custom metrics depending on the model and the manufacturer. Storage Optimizer displays custom and common metrics in charts when you select a specific device in the Resources tree.

Collecting all metrics is the only choice for performance data collection on hosts and HBAs. For HBAs and HBA ports, all metrics includes all of the metrics in the SNIA library. For host LUNs and volumes, all metrics includes the metrics provided by OpenView Operations Performance Agent (OVPA) or by OpenView VantagePoint (VPW). (OVPA for Linux is a performance agent developed by HP and shipped with Storage Optimizer.)

- OVPA on any host except Tru64 supports the following metrics for host LUNs:
  - Physical read rate (the default in lists)
  - Physical write rate
- OVPA on Tru64 hosts supports the following metrics for host LUNs:
  - Physical I/O rate (the default in lists)
  - Physical byte rate
  - Current queue length
- OVPA on HP-UX and Tru64 hosts supports the following metrics for volumes:
  - Physical read rate (the default in lists)
  - Physical write rate
- VPW on Windows hosts supports the following metrics for host LUNs and volumes:
  - Bytes transferred per second (the default in lists)
  - Average queue depth length

## Collecting common metrics

Storage Optimizer attempts to collect a set of common metrics for all storage devices and all interconnect devices. Common metrics allow you to compare the performance of like resources. In fact, Storage Optimizer lists resources in order of their performance on a common metric when you select the collective resource in the Resources tree.

Common metrics is the default choice when data collection is enabled for a storage or interconnect device. Common metrics are listed here, with the default metric in resource lists shown in *italic*.

### Common metrics for interconnect devices

- *Total errors* (display default)
- CRC errors
- Invalid CRCs
- Invalid transmission words
- Link failures
- Primitive sequence protocol errors
- Received frames
- Signal losses
- Synchronization losses
- Transmitted frames

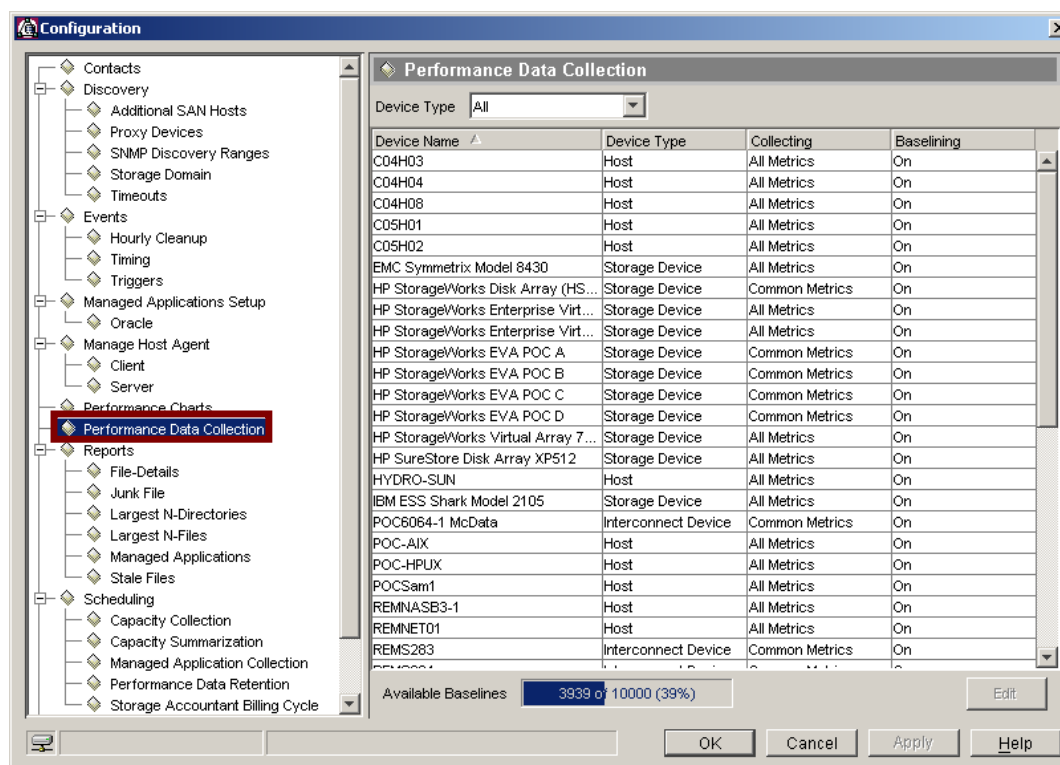
### Common metrics for storage devices

- *Total operations* (display default)
- Percentage of reads and writes from cache
- Read and write cache hits
- Read and write operations

### Common metrics for LUNs

- *Total operations* (display default)
- Percentage of reads and writes from cache
- Read and write cache hits
- Read and write operations

## Configuring performance data collection



Storage Optimizer collects performance metrics on selected resources and their components every 15 minutes. It holds the data in its memory until the top of the hour, when it summarizes the quarter-hour data into a single hourly value. If the metric is a rate, such as bytes transferred per second, the hourly value is the average of the collected data. If the metric is a count, such as the number of bytes transmitted, the hourly value is the sum of the collected data. The hourly values are stored in Storage Area Manager's database and viewed in performance lists and charts.

Administrator's privileges are required to start or stop the collection of performance metrics for a selected resource.

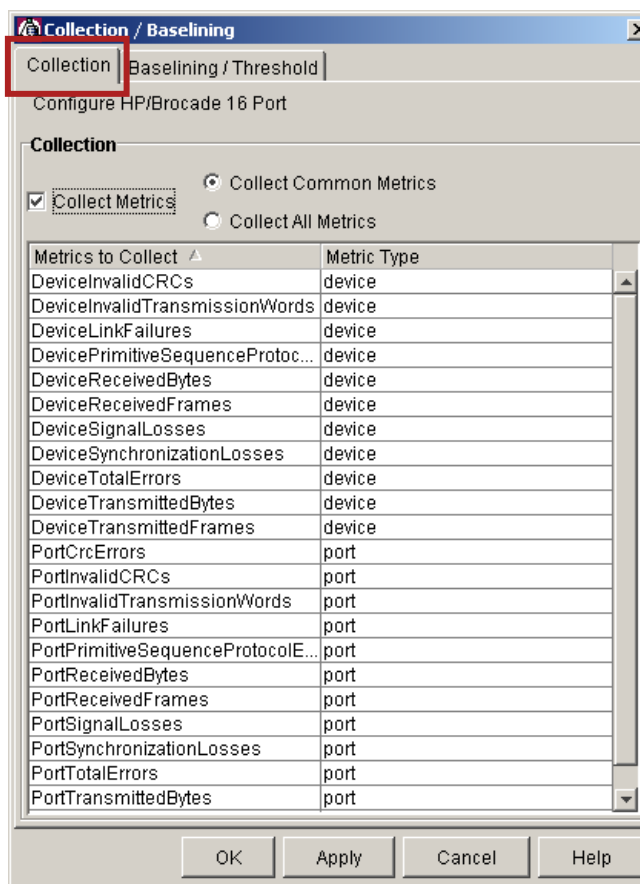
First access the Collection/Baselining window:

1. Select *Tools* → *Configure*.
2. Select *Performance Data Collection* from the Configuration tree.

The view panel displays a list of the resources that provide performance metrics, and the status of collection and baselining for each.

3. Double-click the host or device that needs a collection change.

## Enabling/disabling performance data collection



Next, from the Collection/Baselining window:

1. Click the *Collection* tab, if it is not already selected.
2. Click the *Collect Metrics* check box to toggle collection on or off for the selected resource.

When the box is checked, collection is enabled and the window shows the list of metrics being collected. No collection is the default.

3. If collection is enabled, select the *Collect Common Metrics* or *Collect All Metrics* button to set the scope of metrics collected.

The default is to collect common metrics for all resources. If there are no common metrics across a device family, such as hosts, the default is to collect all metrics.

The list in the bottom half of the window shows which metrics are collected at the selected scope. Any common metrics that the device does not support are not listed.

4. Click *OK* to apply your selections and close the Collection/Baselining window.

5. Select another resource from the Performance Data Collection view panel and repeat steps 1 through 4, or click *OK* to apply the changes and close the Configuration window.

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**Note**

You can enable collection for all metrics, or for only the common metrics that the resource supports. The change will take effect at the next collection cycle.

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## Host performance metrics

Storage Optimizer uses OpenView Performance Agents (OVPA) to collect host performance metrics. OVPA is not supported on Linux. Therefore, Storage Optimizer uses a built-in performance collector for Linux operating systems.



### **Important**

On Windows operating systems, Storage Optimizer supports OVPA and VPW 6.01. VPW version 7 is not supported.

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## Host disk & volume performance metric dependencies

Operating System	OVPa Version	Disk/LUN	Volume/FS
HP-UX 11.00/11.11	C.03.35/C.03.71	✓	✓
HP-UX (other)	C.03.25.05/C.03.35.00 (11.20) C.03.58.05 (11.22) C.03.71.23 (11.23)	✓	✓
Solaris 7/8/9	C.03.45/C.03.75	✓	✓
Linux	Not available, Optimizer uses built-in performance collector	✓	
AIX 4.3.3/5.1	C.03.40/C.03.80	✓	
Windows	C.03.30 (NT 4+W2K)/C.03.65 (W2K only) VPW 6.01	✓	✓
TRU64	C.02.45.00 (Tru64 4.0F) C.03.61.00 (Tru64-5.1A & Tru64-5.1B)	✓	✓

Two classes of data are supported: physical volume (or physical disk, software logical) unit and logical volume (or file system) unit.



### Important

On most Solaris customer systems, logical volume metrics are not available because Solaris does not ship Veritas Enterprise Storage Manager. It can be purchased as an additional product.

As an example, HP-UX metrics include:

- Disk:
  - BYDSK\_DEVNAME
  - BYDSK\_UTIL
  - BYDSK\_PHYS\_READ\_RATE
  - BYDSK\_PHYS\_WRITE\_RATE
- Volume:
  - LV\_GROUP\_NAME
  - FS\_DIRNAME
  - LV\_READ\_RATE
  - LV\_WRITE\_RATE

## Viewing host disk performance metrics

The screenshot shows the HP OpenView Storage Area Manager interface. The left pane displays a tree view with 'Disks' selected under 'POC-HPUX'. The main pane shows the 'Performance' tab for 'Disks on host POC-HPUX'. A table lists storage devices and their performance metrics. A 'Properties' dialog box is open, showing options to select a time period (Relative or Absolute) and a metric (DiskDeviceCurrentQueueLength, DiskDevicePhysicalByteRate, DiskDevicePhysicalIORate, DiskDevicePhysicalReadRate, DiskDevicePhysicalWriteRate). A callout box points to the 'DiskDevicePhysicalReadRate' metric, stating 'Available metrics are device-dependent'.

Storage Device	Device File	DiskDevicePhysicalReadRate
HP StorageWorks Enterprise...	/dev/dsk/c30t1 d3	4,835.93
HP StorageWorks Enterprise...	/dev/dsk/c30t1 d2	2,398.73
HP StorageWorks Enterprise...	/dev/dsk/c30t1 d1	1,608.45
HP StorageWorks Enterprise...	/dev/dsk/c30t1 d0	1,211.50
HP StorageWorks Enterprise...	/dev/dsk/c30t0 d7	968.40
HP StorageWorks Enterprise...	/dev/dsk/c30t0 d6	797.14

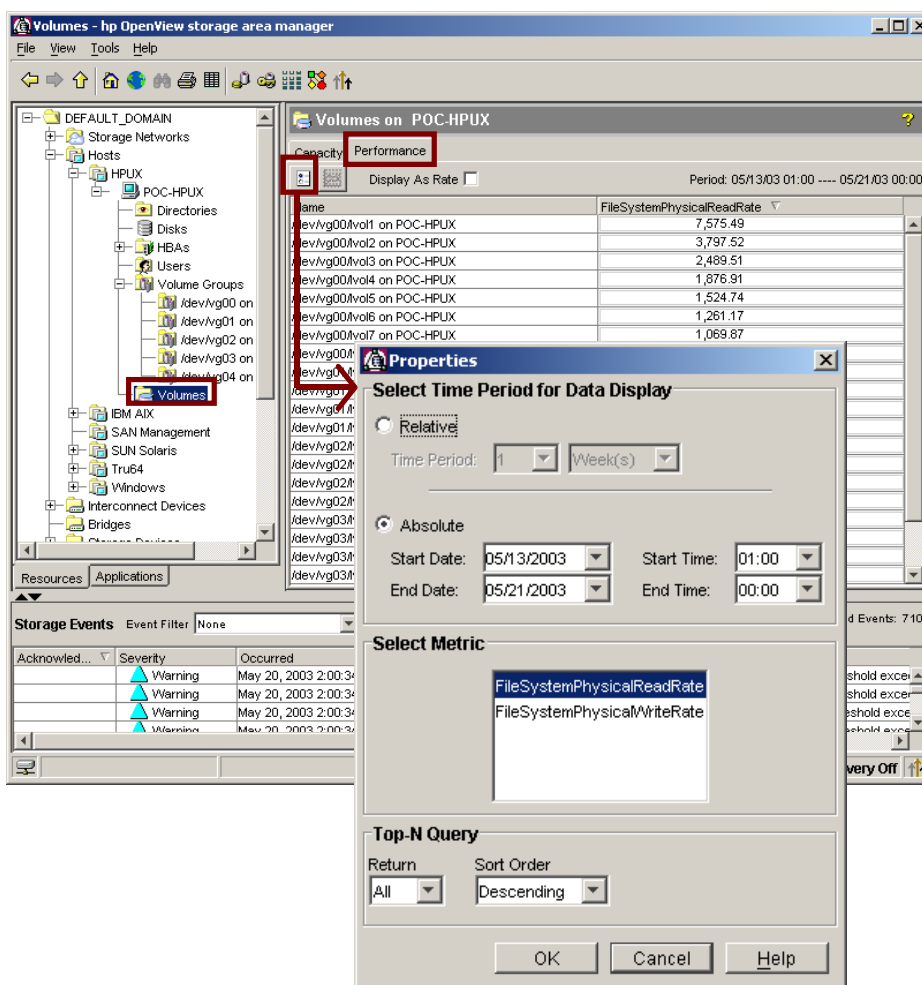
To display a list of the host's visible LUNs and their average performance on a selected metric for a selected time period, select the *Disks* subnode for a specific host and then click the *Performance* tab. One metric can be viewed at a time across all Disks/LUNs configured on the host.

The default metric depends on the agent (OpenView VantagePoint or Performance Agent) that is providing the performance metrics. The default period is the last 24 hours.

Click the *Properties* icon to change the metric and the period, as well as choose to view the metrics for specific times during the period. Metrics can be displayed as a number or a rate.



## Viewing host volume performance metrics



To display a list of the host's volumes and their average performance on a selected metric for a selected time period, select the *Volumes* subnode for a specific host and then click the *Performance* tab. One metric can be viewed at a time across all volumes/file systems configured on the host.

The default metric depends on the agent (OpenView VantagePoint or Performance Agent) that is providing the performance metrics. The default period is the last 24 hours.

Click the *Properties* icon to change the metric and the period, as well as choose to view the metrics for specific times during the period. Metrics can be displayed as a number or a rate.



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**Important**

Host Volume Performance metrics are only supported on HP-UX, Solaris, and TRU64 running OpenView Performance Agent, and Windows hosts running VPW 6.01

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The following Host Volume Performance metrics are supported for HP-UX:

- LV\_GROUP\_NAME
- FS\_DIRNAME
- LV\_READ\_RATE – Baselineing supported
- LV\_WRITE\_RATE – Baselineing supported

The following Host Volume Performance metrics are supported for Solaris:

- LV\_DEVNAME\_ALIAS
- LV\_DIRNAME\_ALIAS
- LV\_READ\_RATE – Baselineing supported
- LV\_WRITE\_RATE – Baselineing supported

The following Host Volume Performance metrics are supported for TRU64:

- LV\_READ\_RATE – Baselineing supported
- LV\_WRITE\_RATE – Baselineing supported

The following metrics are supported for (VPW A.06.01) Windows:

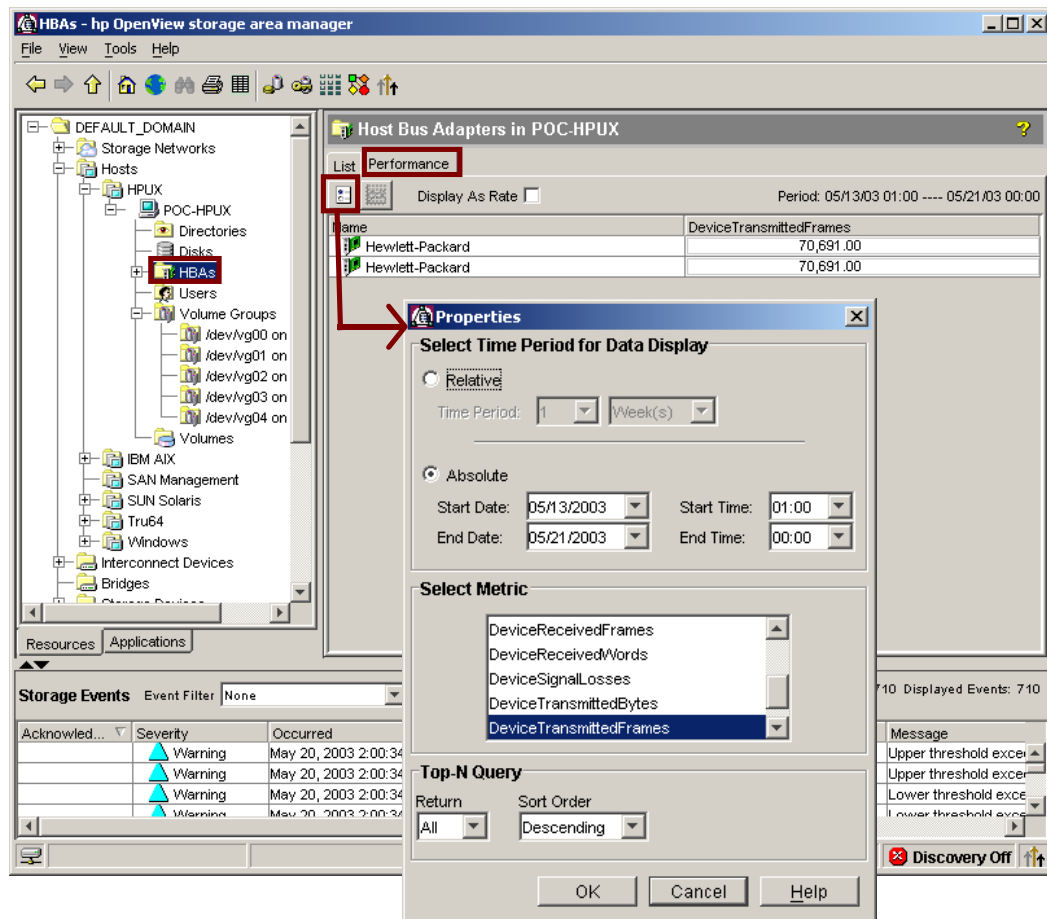
- Average Disk Queue Length
- Average Bytes transfer/second

## Viewing HBA performance metrics

Storage Optimizer collects HBA performance metrics at both the HBA *node* and *port*. The Core Services SNI HBA Gateway component is used to gather the data.

In order for these performance metrics to be properly gathered from the HBAs, Storage Area Manager requires that customers install the vendor implementation of the SNIA library.

## Viewing HBA node performance metrics

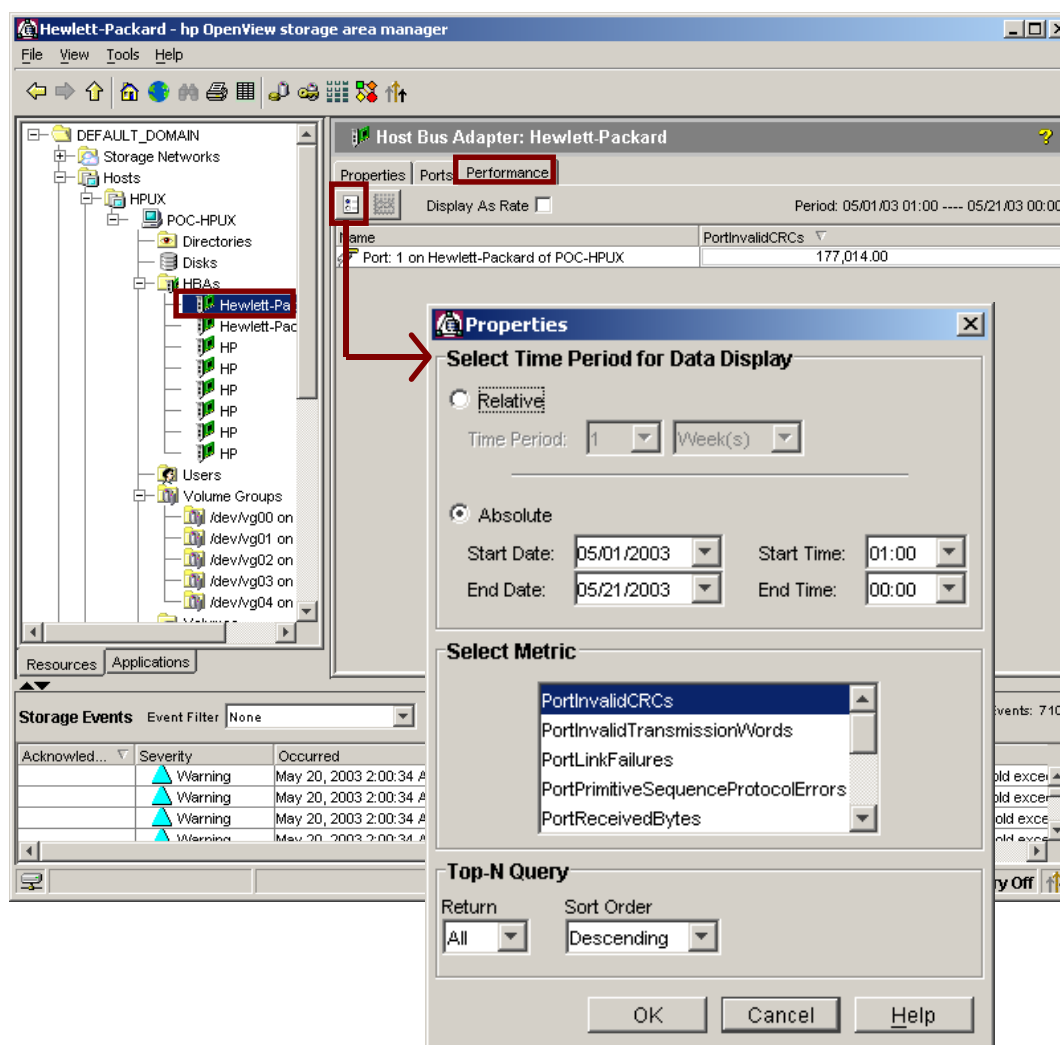


To display a list of the *supported* HBAs and their average performance on a selected metric for a selected time period, expand a specific host and its HBA folder, and then select an HBA and click the *Performance* tab.

The default metric and period is the number of invalid CRCs during the last 24 hours.

Click the *Properties* icon to change the metric and the period as well as choose to view the metrics for specific times during the period. Metrics can be displayed as a number or a rate.

## Viewing HBA port performance metrics



To display a list of the *supported* HBAs ports and their average performance on a selected metric for a selected time period, expand a specific host and its HBA folder, then select an HBA and click the *Performance* tab.

The default metric and period is the number of invalid CRCs during the last 24 hours.

Click the *Properties* icon to change the metric and the period, as well as choose to view the metrics for specific times during the period. Metrics can be displayed as a number or a rate.

## Interconnect device performance metrics

Storage Optimizer collects performance data for switches at both the device and port levels. This performance data is gathered out-of-band, using SNMP.

There are two types of counters:

- Statistical (used to calculate throughput)
- Error

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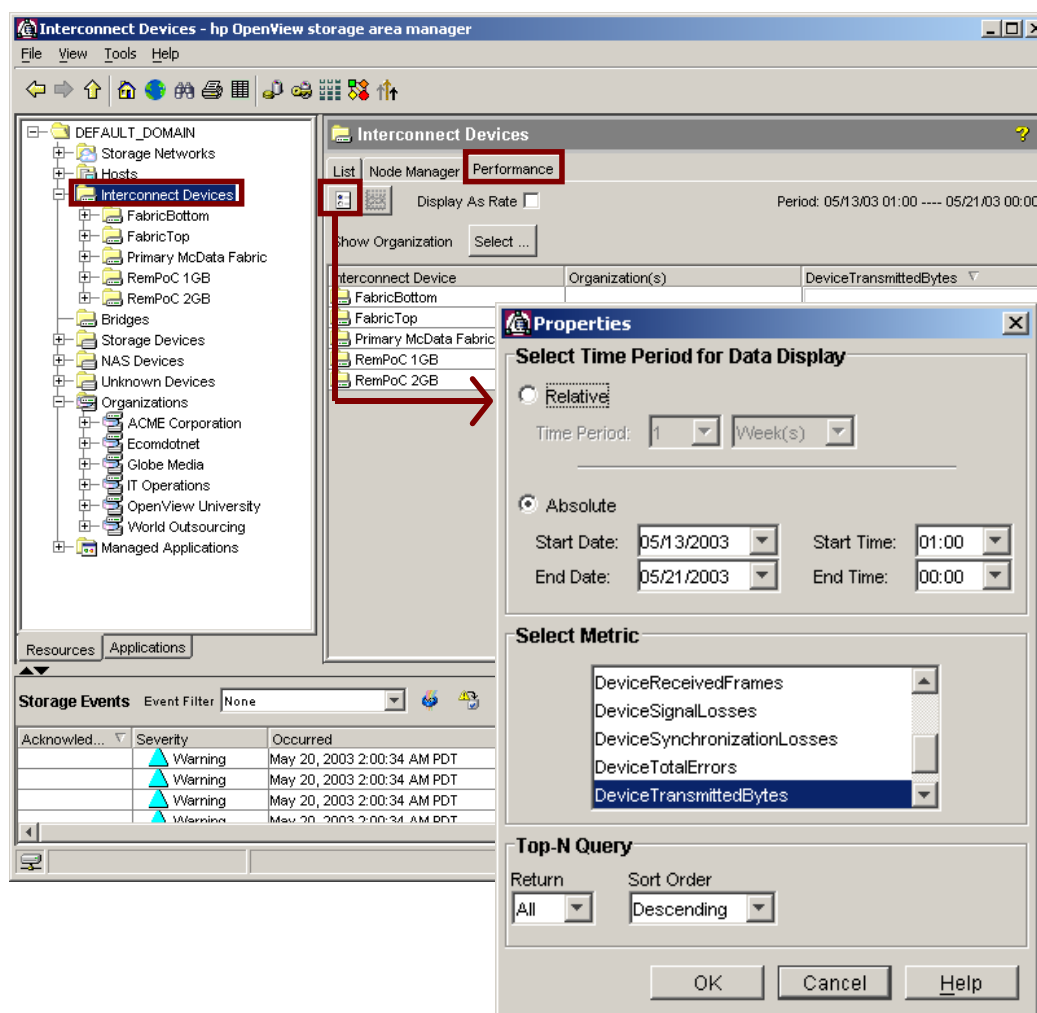
### **Note**

Most error counters should not increase at all. If the increase in the error counter exceeds 7200, a serious condition exists. Port Loss of Sync and Port Loss of Signal are the two exceptions. 14,400 would signal a serious condition for these metrics.

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Refer to the hp *OpenView Storage Area Manager Supported Components and Configuration Guide* for an up-to-date list of interconnect devices supported by Storage Optimizer.

## Viewing interconnect device performance



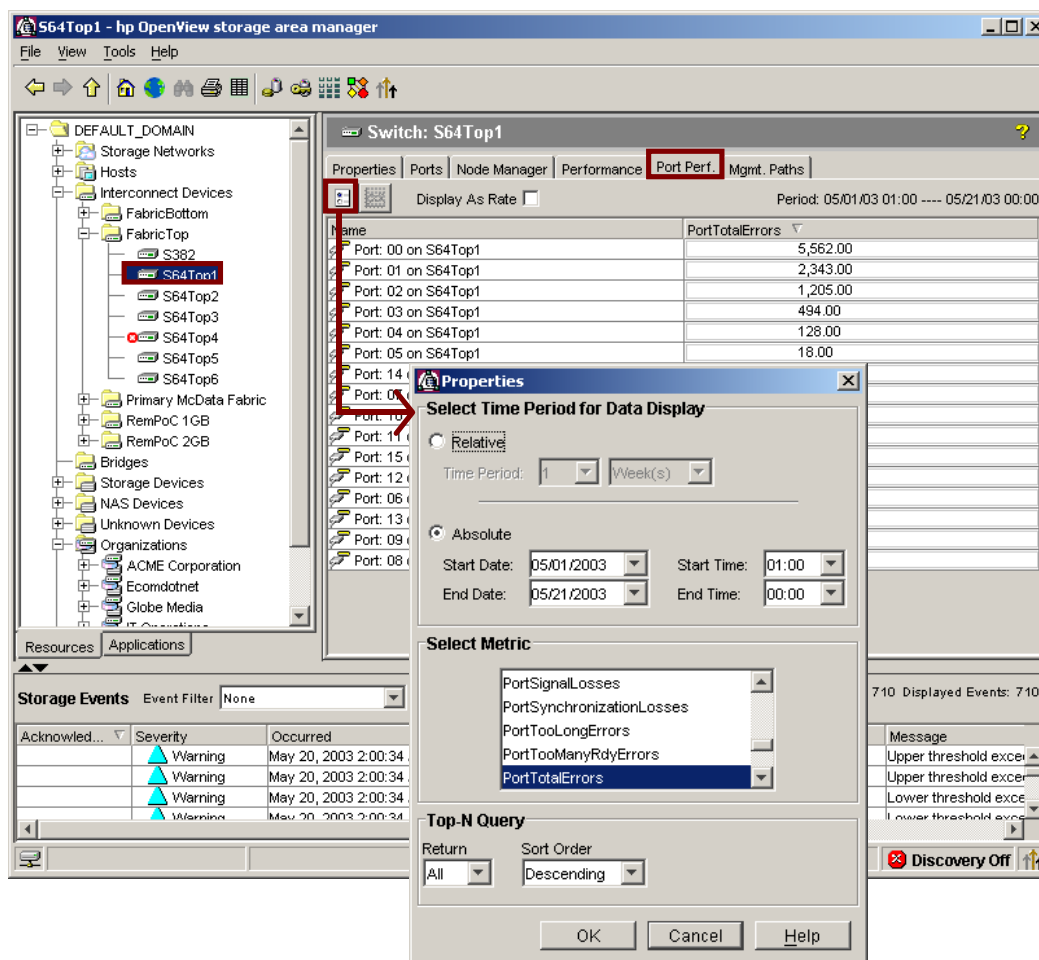
To view the performance of all support interconnect devices, select *Interconnect Devices* and then click the *Performance* tab.

Click the *Properties* icon to change the metric and the period, as well as choose to view the metrics for specific times during the period.

Common metrics at the switch device level include:

- DeviceTransmittedBytes (Baselining supported)
- DeviceReceivedBytes (Baselining supported)
- DeviceTransmittedFrames
- DeviceReceivedFrames
- DeviceTotalErrors

## Viewing interconnect port performance



To view the performance all ports configured on a specific interconnect device, select the interconnect device and then click the *Port Perf.* tab.

Click the *Properties* icon to change the metric and the period, as well as choose to view the metrics for specific times during the period. The metrics available are device-dependent.



## Storage device performance metric dependencies

Storage Optimizer uses the following storage device applications to gather performance data:

XP: Performance Advisor

VA: CommandView SDM

FC60: AM60

12H: ARM

EMC Symmetrix: SYMCLI

EMC CLARiiON: Navisphere CLI

HSG: CLI commands embedded in SCSI commands

EVA: Storage Management Appliance

LSI: CLI commands

MSA: Vendor specific (BMIC) command

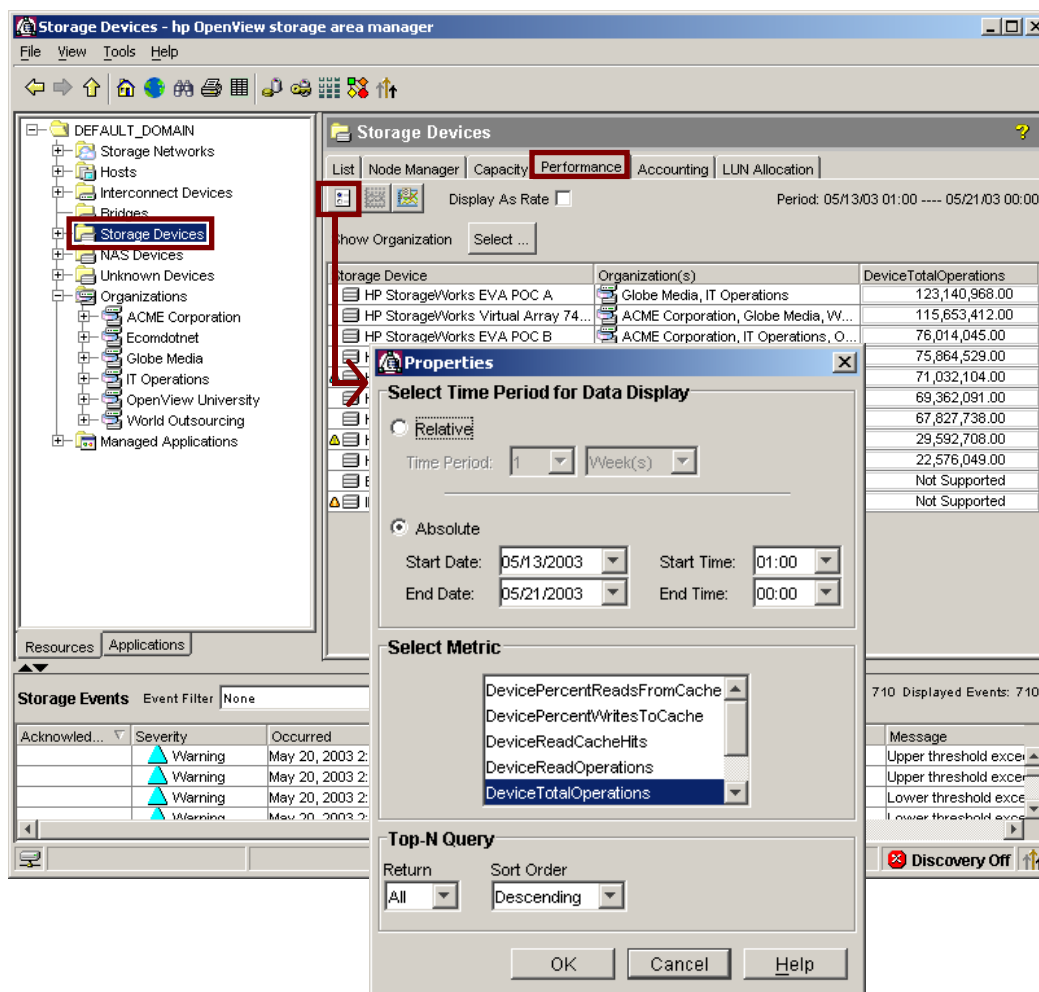
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**Note**

The metrics available vary greatly amongst storage devices

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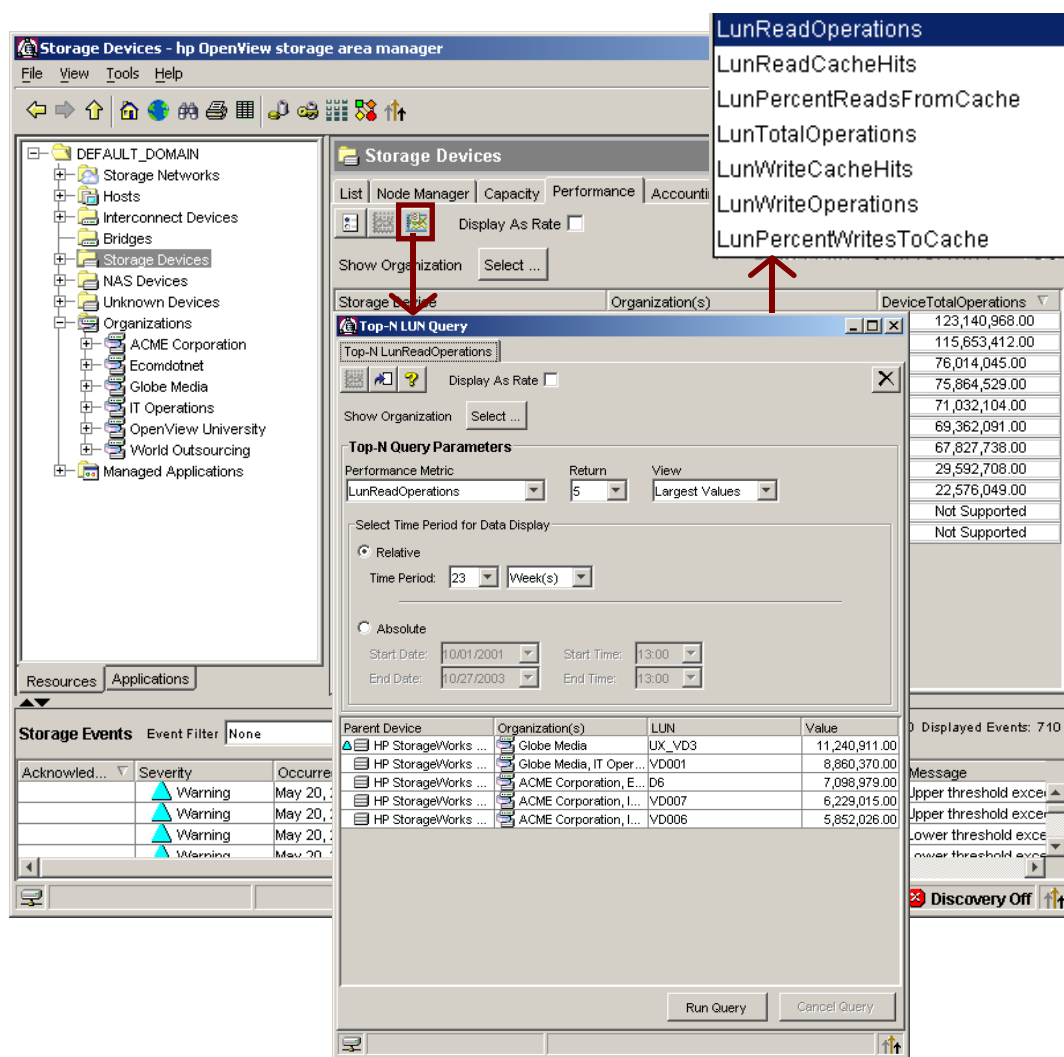
## Viewing storage device performance



To view the performance of all supported devices, select the *Storage Devices* node and then click the *Performance* tab.

Click the *Properties* icon to change the metric and the period as well as choose to view the metrics for specific times during the period. The metrics available are device-dependent.

## Top-N LUN queries



To view LUN performance for all supported storage devices, click the *Top-N Query for LUNs Over All Storage Devices* button. Next, select options in the top of the Top-N LUN Query window and click the *Run Query* button. The procedure displays a list of LUNs, in the order of their performance, on a selected metric for a selected time period.

The query results display in the bottom of the window. The results of multiple queries display on multiple tabs. Query options are described below.

To limit the query to the LUNs associated with a particular Organization, select the organization name from the Show Organization drop-down list.

Top-N Query parameters include:

- **Performance Metric** — Select one of the common LUN metrics from the drop-down list. LUNs will be listed in the order of the value of the selected metric.

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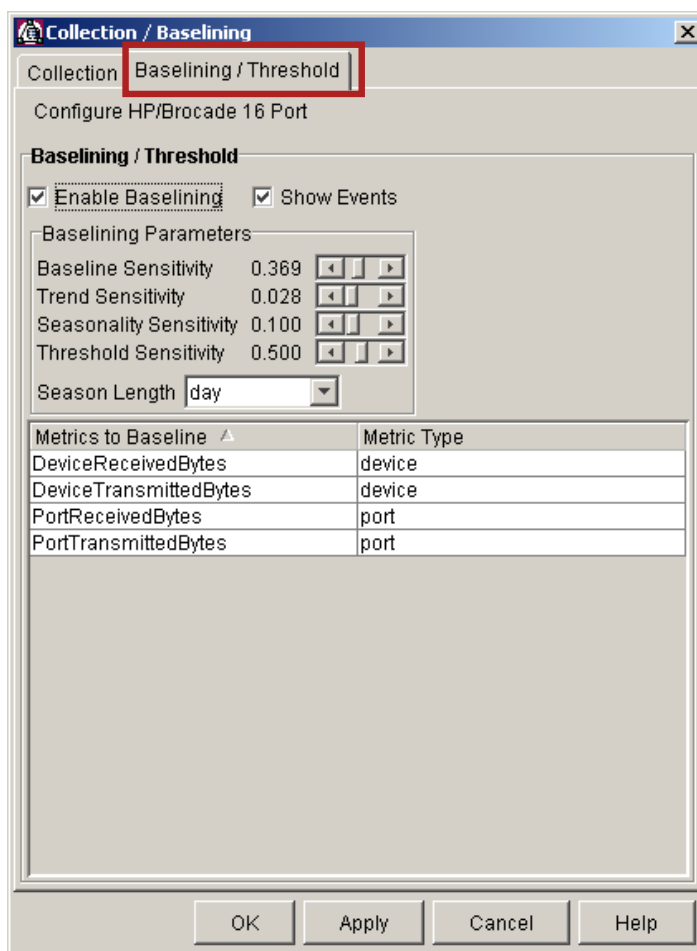
**Note**

Not all LUNs provide all common metrics. To learn which metrics a LUN provides, view the performance metrics collection information for the enclosing storage device.

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- **Return** — Select the number of LUNs that you want to view in the top (or bottom) of the results. Values range from 5 to 100 and All. The default return value is 5.
- **View** — Select the end of the results you want to view: Largest Values or Smallest Values. The default selection is Largest Values.
- **Select Time Period for Data Display** — The measurements that are collected during the selected time period are averaged to obtain the queried value. The default time period is the last week.
  - **Relative** — Click this button to display data collected for a selected period up to the current date and time. Also select the length of the period—hour, day, week, month, or year—and the number of periods from the corresponding drop-down boxes. The default time period is one week.
  - **Absolute** — Click this button to display data collected for a period between selected dates and times. Also select the start/end date and the start/end time.

## Enabling baselining and thresholding



Storage Optimizer can let you know when selected resources are performing abnormally. If the next collected metric deviates significantly from the baseline value, Storage Optimizer automatically generates a threshold event warning. This is referred to as *auto-thresholding*.

To enable/disable baselining:

1. Click the *Baselining* tab from the Collection/Baselining window.  
Only metrics that support baselining are displayed.
2. Click the *Enable Baselining* checkbox to toggle baselining on or off. When the box is checked, baselining is enabled and the Show Events option and baselining parameters are active. By default, baselining is off.
3. If baselining is enabled, click the *Show Events* check box to toggle threshold events in the event panel on or off.

4. If baselining is enabled, set the baselining parameters as needed. The default values give a small but significant sensitivity to the respective variables: baseline, trend, seasonality, and threshold. Click the right-facing arrows to increase the sensitivity of one or more variables. Click the left-facing arrows to decrease the sensitivity. Increasing the threshold sensitivity decreases the likelihood of threshold events. Also, select the length of the season, (a day or a week), from the *Season Length* dropdown box.
5. Click *OK* to apply settings and close the Collection/Baselining window.
6. Choose other resources and turn baselining on or off, or click *OK* to close the Configuration window.

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**Note**

You must have administrator privileges to enable/disable baselining.

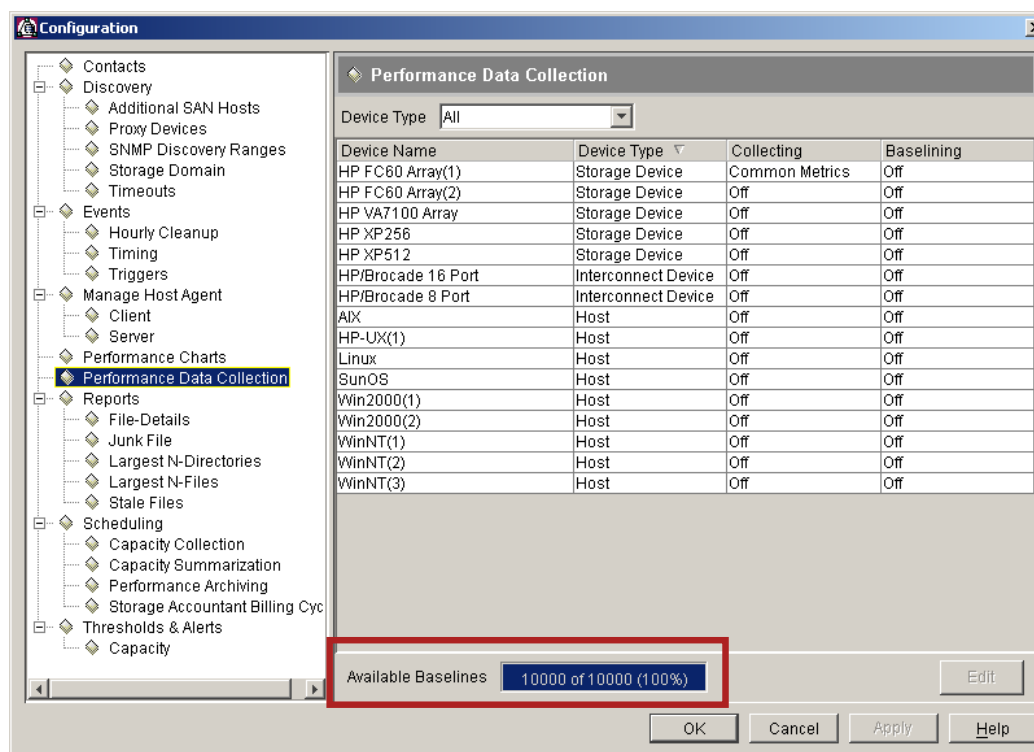
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## Baselining parameters

Baselining parameters determine how much weight is given to different variables in the baseline calculation. These variables include:

- **Baseline Sensitivity** — The weight given to recent data in the baseline calculation. Valid values range from 0 to 1, where 0 gives equal weight to recent and older data and 1 gives the greatest possible weight to the most recent data. The default value is 0.369.
- **Trend Sensitivity** — The weight given to the direction of the data. Valid values range from 0 to 1, where 0 ignores the direction and 1 emphasizes the direction of the data. The default value is 0.028. For data that spikes up and down by nature, low trend sensitivity gives the best results.
- **Seasonality Sensitivity** — The weight given to the periodicity of the data, that is, the tendency of the data to be especially high or low at regular intervals. Valid values range from 0 to 1, where 0 ignores the periodicity and 1 emphasizes the periodic nature of the data. The default value is .100.
- **Threshold Sensitivity** — The amount of deviation from the baseline that is required to cause a threshold event. Valid values are between 2 and 3, where 2 allows the least deviation from the baseline, and therefore, tends to cause the most events, and 3 allows the most deviation from the baseline, and therefore, causes the fewest events. The default value is 2.5.
- **Season Length** — The length of the period that supports seasonality sensitivity. Selectable values are a day and a week. The default is a day.

## Baseline limits

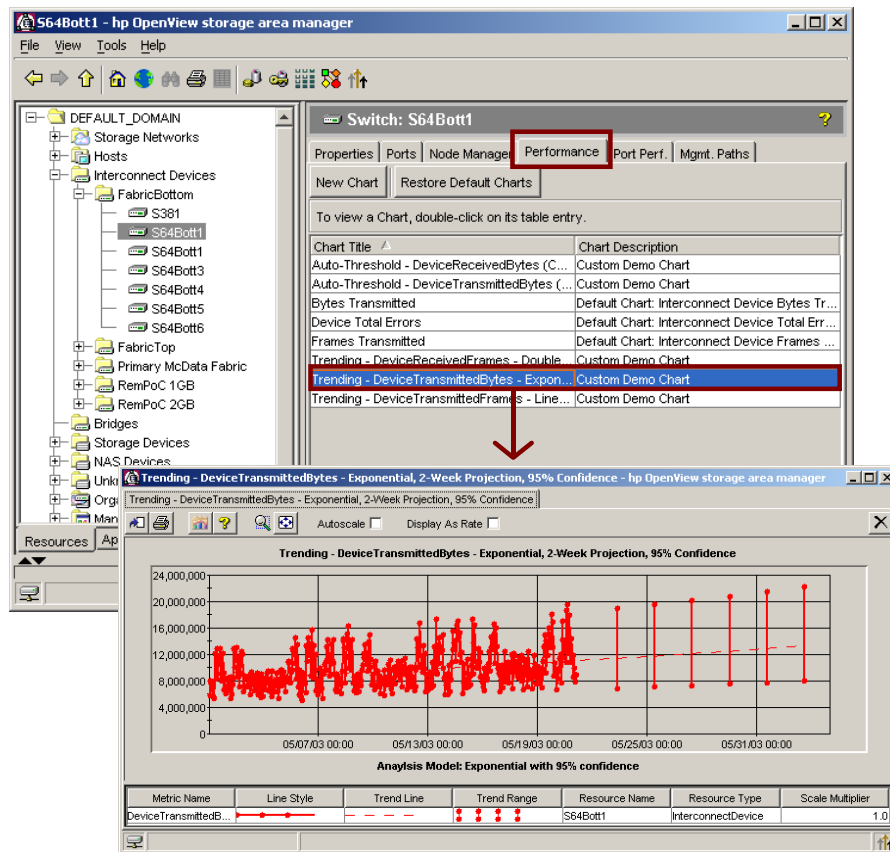


The number of metrics that can be baselined depends on the processing resources of the management server. For that reason, Storage Optimizer limits baselining to a portion of the metrics that can be collected on a device, and keeps a running balance of the total number of baselines that can be set. When baselining is enabled on a device, Storage Optimizer calculates how many baselines would be needed if the device supported all the baselinable metrics. Baselinable LUN and port metrics are multiplied by the number of LUNs or ports, respectively, on the device. Storage Optimizer then subtracts the number of potential baselines from the total number of baselines available, and displays the balance when you view baseline thresholds.

## Performance charts

Performance charts are line graphs showing the changes in a performance metric (y axis) over time (x axis). Storage Optimizer provides factory-default charts as well as the ability to create custom charts.

## Viewing performance charts



To view a performance chart

1. Select a device in the Resources tree.
2. Double-click the chart from the list provided in the View panel.

Charts appear in a separate window from the main Storage Area Manager application. This allows selection of other items within the application while keeping the chart in view.

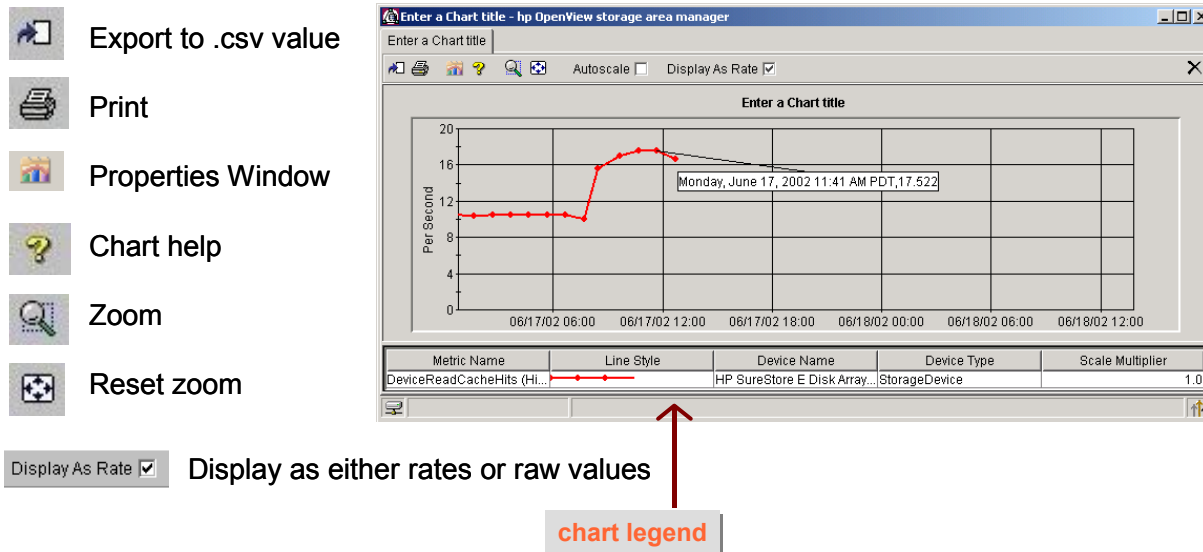
Subsequent charts all appear in the same window, referred to as the *chart frame*. Tabs contain the name of the charts when multiple charts are open. To view more than one chart simultaneously, right-click the toolbar and select *View Chart in New Window*. The selected chart displays in a separate window. Right-click to remove the chart and its tab from the chart frame



Performance charts contain collected data, projected data, and range bars.

- **Collected data** — Performance charts display collected data up to the current date and time. Press and hold down the mouse button on the data points in actual charts to view the date and time that the data was collected.
- **Projected data** — When a chart includes trends, a broken line traces and extends beyond collected data. The broken line represents a pattern analysis of collected data and the projection of that pattern into the future. Projections must be interpreted according to the model that is used to make the analysis. The analysis model is indicated at the bottom of the chart.
- **Range bars** — Vertical bars along the projected values show the range of possible values based on the required confidence. Greater confidence in the prediction implies greater ranges.

## Working with performance charts

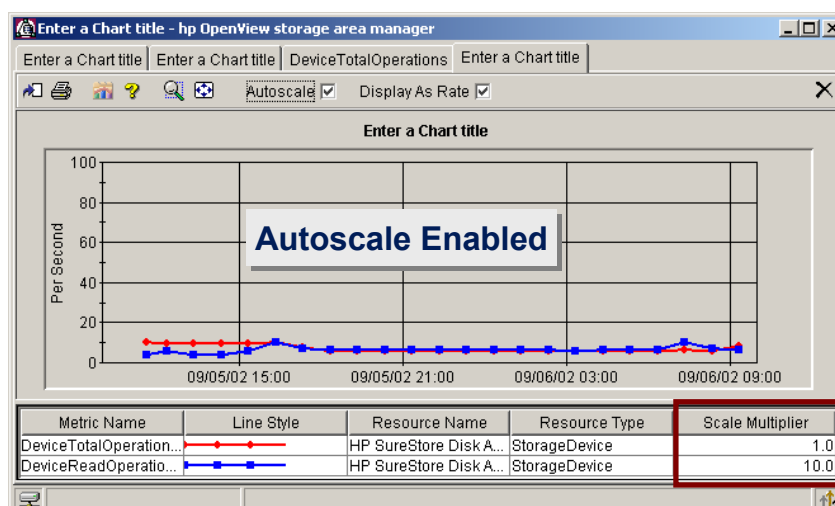
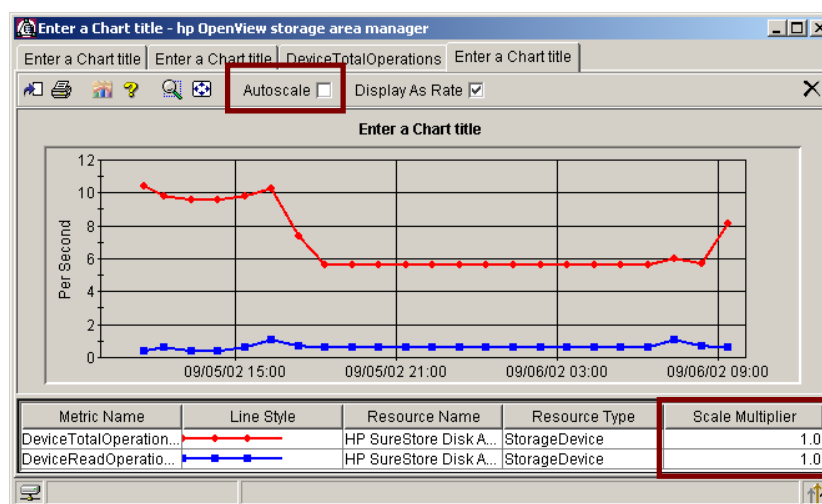


The chart legend displays the following for each entry: metric name, line style, device name, device type, and scale multiplier (if the autoscale feature is used).

The following options are available from the chart toolbar:

- **Export Data** — Exports chart data to a CSV file.
- **Print** — Opens the Print Preview window, where printing can be initiated.
- **Properties** — Displays the Modify Chart Properties window, which allows you to change the time period, presentation, and trending/baselining options.
- **Help** — Displays context-sensitive help in the current window.
- **TopN query, Zoom, Zoom Reset, and Autoscale** — described later in this module.
- **Display as Rate** — Specifies whether the value is viewable as a rate or raw value. A rate value represents the “per second” occurrence of the metric. If *Display As Rate* is selected, but the metric cannot be converted into a rate, the data will be displayed normally, or not at all. *Display as Rate* is the default.

## Autoscale



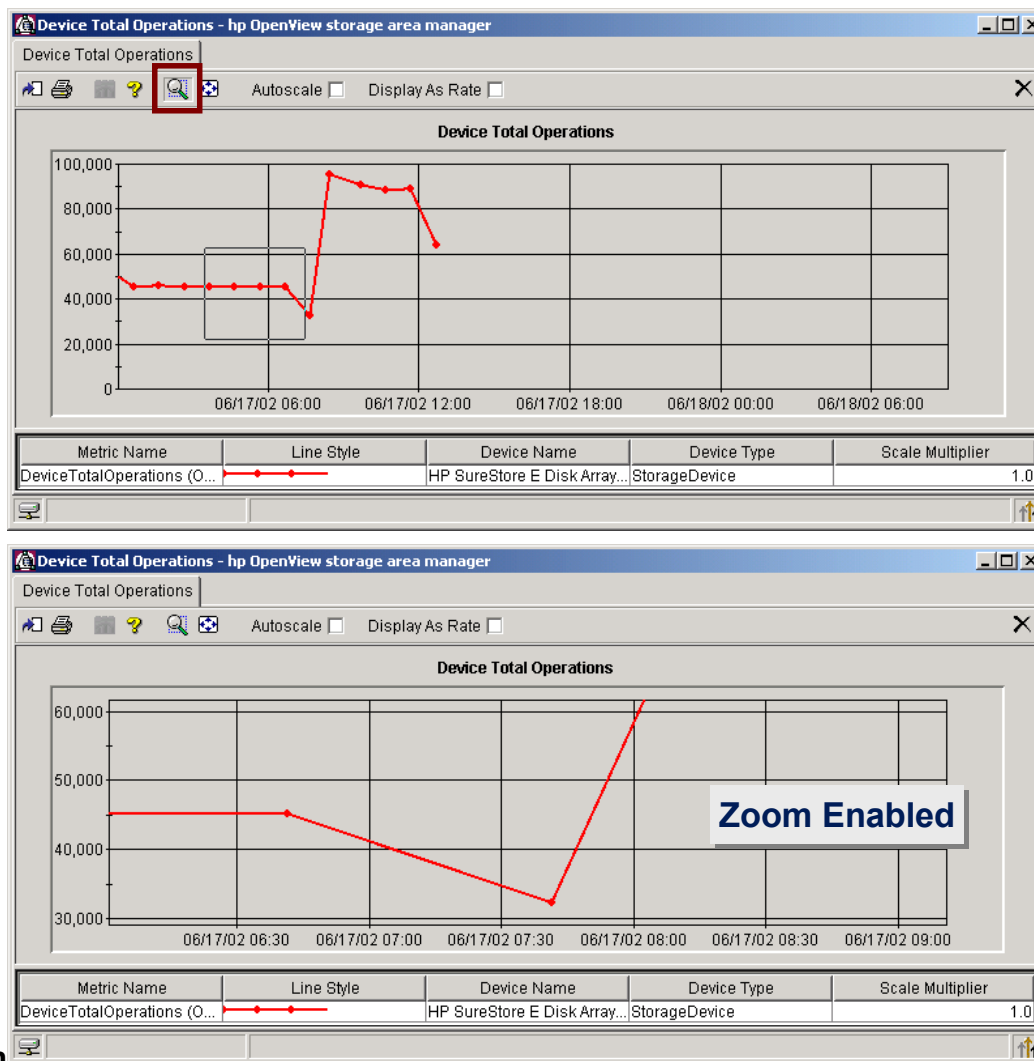
Storage Optimizer's *Autoscale* feature relates metrics more closely to each other by putting them on the same scale. Autoscale scales the data, so each data point falls between 0 and 100. The original data point is multiplied by a *Scale Multiplier* to bring it within the range of 0 and 100.

### ! Important

Using Autoscale and Zoom may cause data to drop off the chart area. To prevent this, enable Autoscale before Zoom.

In the example above, the top chart has two metrics measuring Device Total Operations ranging from 0 to 12 per second. It may be desirable to relate both metrics more closely to each other by putting them on the same scale.

The bottom chart in the example shows the result of enabling Autoscale. The Scale Multiplier column in the legend has changed to 10.0 from 1.0. This indicates that the original data point is being multiplied by 10.0 to scale to the height of the chart's y-axis. The shape of the two lines can now be compared more easily.



## Zoom

Use the Zoom tool to get a closer look at a specific area of the chart. This is useful when individual data points are too close together, or the shape of the data is not clear enough at a particular time scale. A cross-hair cursor displays when the Zoom button is selected. Click and drag to enclose the area of interest in the “lasso”.

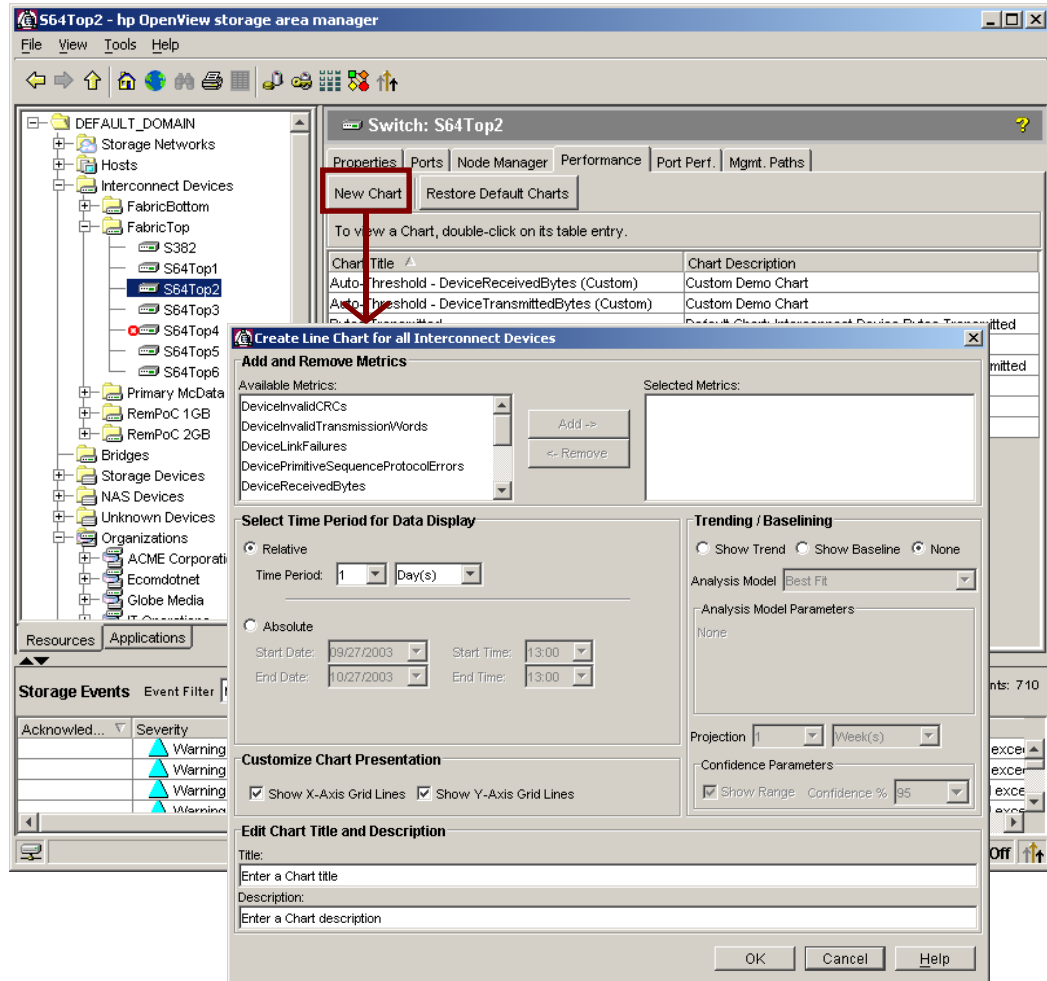
In the example above, the top chart has Zoom turned on. By clicking and dragging, the area of interest is enclosed in the lasso.

The bottom chart shows the result of releasing the left mouse button after the chart area has been lassoed. The selected area along both the x and y axes now is available for closer inspection.

Note the following when using the Zoom feature:

- The Zoom button must be selected each time the Zoom feature is used and released after each use.
- Zoom does not allow selection beyond the range of data collected. You cannot zoom into a region less than zero, or greater than the largest data value.
- The Reset Zoom feature puts the chart back to its original x and y axes.
- The chart is reset to the normal view when closed.
- Zoom takes precedence over Autoscale. Selecting Autoscale after zooming may cause the data to disappear from the chart. It is recommended to Autoscale first and then Zoom into a specific region.

## Creating custom performance charts



Click the *New Chart* button to create a customized interconnect performance chart. Choose to:

- Select desired metric(s) and time period to display (relative or absolute)
- *Show/Hide* grid lines
- Enter chart *Title* and *Description*

## Displaying performance trends

**Create Line Chart for all Interconnect Devices**

**Add and Remove Metrics**

Available Metrics:

- DeviceLinkFailures
- DevicePrimitiveSequenceProtocolErrors
- DeviceSignalLosses
- DeviceSynchronizationLosses
- DeviceTotalErrors

Add -> <- Remove

Selected Metrics:

- DeviceReceivedBytes
- DeviceReceivedFrames

**Select Time Period for Data Display**

☒ Relative

Time Period: 1 Day(s)

☐ Absolute

Start Date: 09/27/2003 Start Time: 13:00

End Date: 10/27/2003 End Time: 13:00

**Trending / Baselineing**

☒ Show Trend ☐ Show Baseline ☐ None

Analysis Model: Best Fit

Analysis Model List:

- Best Fit
- Linear
- Polynomial
- Logarithmic
- Exponential
- Moving Average
- Single Exponential Smoothing
- Double Exponential Smoothing

Projection: 1

**Confidence Parameters**

☒ Show Range Confidence %: 95

**Customize Chart Presentation**

☒ Show X-Axis Grid Lines ☒ Show Y-Axis Grid Lines

**Edit Chart Title and Description**

Title:

Enter a Chart title

Description:

Enter a Chart description

OK Cancel Help

Storage Optimizer enables prediction of future performance by allowing users to view past and projected performance trends with collected data in a performance chart. The result is a dotted line alongside and extending beyond the collected data for a specified projection period. Vertical bars in the projected data show the range of possible values based on the selected confidence level.

Select *Show Trend* to enable performance trending. Selecting this option activates the Analysis Model text box. Analysis models improve the projection by taking into account the general characteristics of the data collected and the relative weight of specific characteristics.

## Analysis models

---

### Note

All models require at least three points of collected data. In addition, the smoothing models require sequential and equally spaced data points and, therefore, use only hourly data in the projection.

---

- **Best Fit** — Allows Storage Optimizer to determine which of the models (third-order polynomial, logarithmic, or exponential) best fits the collected data.
- **Linear Model** — Draws the best line through the collected data, that is, the line with the smallest differences between the actual and depicted data points. Choose this model if the selected metric tends to rise or fall in a straight line.
- **Polynomial Model** — Draws the best curve through the collected data, that is, the line with the smallest differences between the actual and depicted points. Choose this model if the selected metric tends to rise and fall, or the opposite, fall and rise.
- **Logarithmic** — Draws the best attenuated curve through the collected data. Choose this model if the selected metric tends to rise or fall toward a known limit.
- **Exponential** — Draws the best infinitely increasing or decreasing curve through the collected data. Choose this model if the selected metric tends to rise or fall precipitously.
- **Moving Average** — Most common smoothing technique. Calculates the next value by calculating the average of the last user-defined  $N$  observations.  
**Note:** Since this is an average, all previous  $N$  observations are equally weighted at  $1/N$ . Generally, the larger  $N$  is, the smoother the results.
- **Single Exponential Smoothing** — Applies greater weight to more recent data. The older the observation, the less weight it has on the future value. Choose this model if you believe that the more recent data is a better predictor of the future.
- **Double Exponential Smoothing** — Gives greater weight to more recent data and to up and down tendencies in the data. Choose this model if you think that recent data is a better predictor, and that up and down tendencies are important variables to an accurate prediction.
- **Triple Exponential Smoothing** — Known as Holt-Winters model. Gives greater weight to more recent data, to up-and-down tendencies, and to seasonal variations in the data. Choose this model if these variables are important to an accurate prediction.



## Setting confidence intervals

**Create Line Chart for all Interconnect Devices**

**Add and Remove Metrics**

Available Metrics:

- DevicePrimitiveSequenceProtocolErrors
- DeviceSignalLosses
- DeviceTotalErrors
- DeviceTransmittedBytes
- DeviceTransmittedFrames

Add ->    <- Remove

Selected Metrics:

- DeviceReceivedBytes
- DeviceReceivedFrames
- DeviceSynchronizationLosses

**Select Time Period for Data Display**

☒ Relative  
Time Period: 1 Day(s)

☐ Absolute  
Start Date: 10/28/2002 Start Time: 17:00  
End Date: 11/28/2002 End Time: 17:00

**Trending / Baselineing**

☒ Show Trend ☐ Show Baseline ☐ None

Analysis Model: Best Fit

Analysis Model Parameters: None

Projection: 1 Week(s)

**Confidence Parameters**

☒ Show Range Confidence %: 95

**Customize Chart Presentation**

☒ Show X-Axis Grid Lines ☒ Show Y-Axis Grid Lines

**Edit Chart Title and Description**

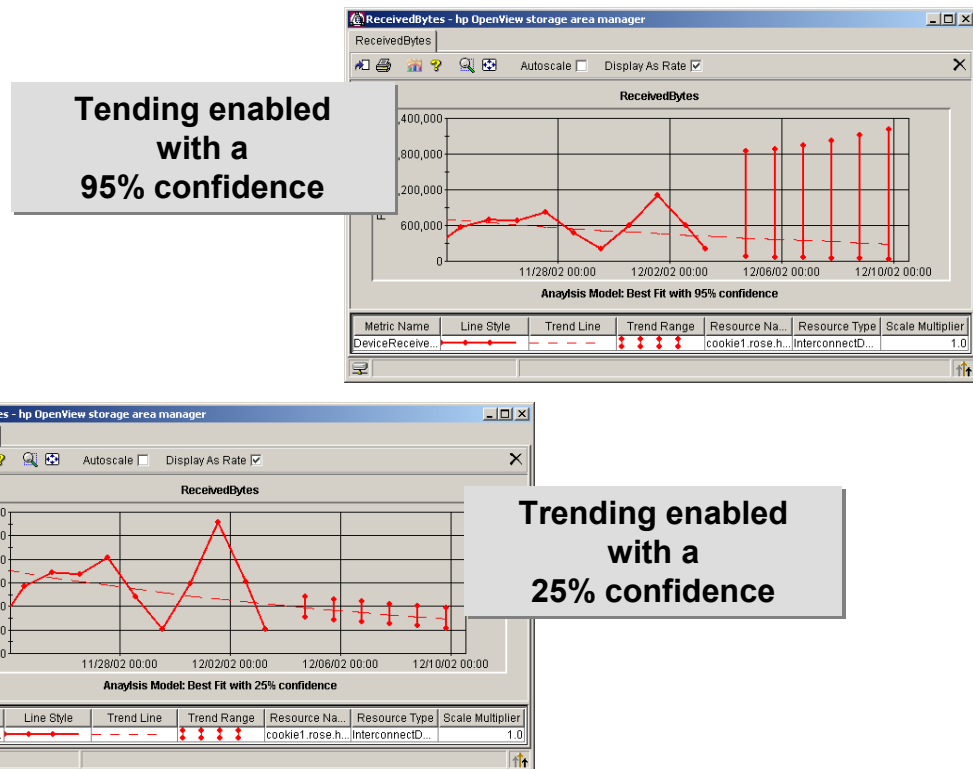
Title: Enter a Chart title

Description: Enter a Chart description

OK Cancel Help

When Trending is enabled, specify the level of confidence (5 to 95, in 5-unit increments). Greater confidence levels display greater ranges of possible values. A 95% confidence interval is defined as two times the standard deviation

## Example charts with trending enabled



The performance charts above demonstrate the effect of changing the confidence level. Note that specifying a higher range of confidence results in a greater range of possible values.

## Showing performance baselines

**Create Line Chart for all Interconnect Devices**

**Add and Remove Metrics**

Available Metrics:

- DevicePrimitiveSequenceProtocolErrors
- DeviceSignalLosses
- DeviceTotalErrors
- DeviceTransmittedBytes
- DeviceTransmittedFrames

Add -> <- Remove

Selected Metrics:

- DeviceReceivedBytes
- DeviceReceivedFrames
- DeviceSynchronizationLosses

**Select Time Period for Data Display**

☒ Relative  
Time Period: 1 Day(s)

☐ Absolute  
Start Date: 10/28/2002 Start Time: 17:00  
End Date: 11/28/2002 End Time: 17:00

**Customize Chart Presentation**

☒ Show X-Axis Grid Lines ☒ Show Y-Axis Grid Lines

**Edit Chart Title and Description**

Title:  
Enter a Chart title

Description:  
Enter a Chart description

**Trending / Baselining**

☐ Show Trend ☒ Show Baseline ☐ None

Analysis Model: Best Fit

Analysis Model Parameters: None

Projection: 1 Week(s)

Confidence Parameters

☒ Show Range Confidence % 95

OK Cancel Help

Storage Optimizer enables you to determine if selected resources are performing abnormally. Based on a statistical analysis of collected metrics, Storage Optimizer can construct an extremely accurate *baseline* representing normal performance. If the next collected metric deviates significantly from the baseline value, Storage Optimizer automatically generates a threshold event warning.

Baselining requires hourly data points for twice the selected season length. The default season length is one day, so by default Storage Optimizer requires two days' worth of hourly data to determine the baseline. The more hourly data available, the more reliable the prediction will be.

### Note

When count data is displayed as rates, the baseline is recalculated for the period displayed in the chart and baseline values do not display until the 49th hour of the data displayed.

## Baseline parameters

Storage Optimizer uses the most sensitive analysis model, called *triple exponential smoothing*, to calculate the baseline. This model is sensitive to three different variables in the data:

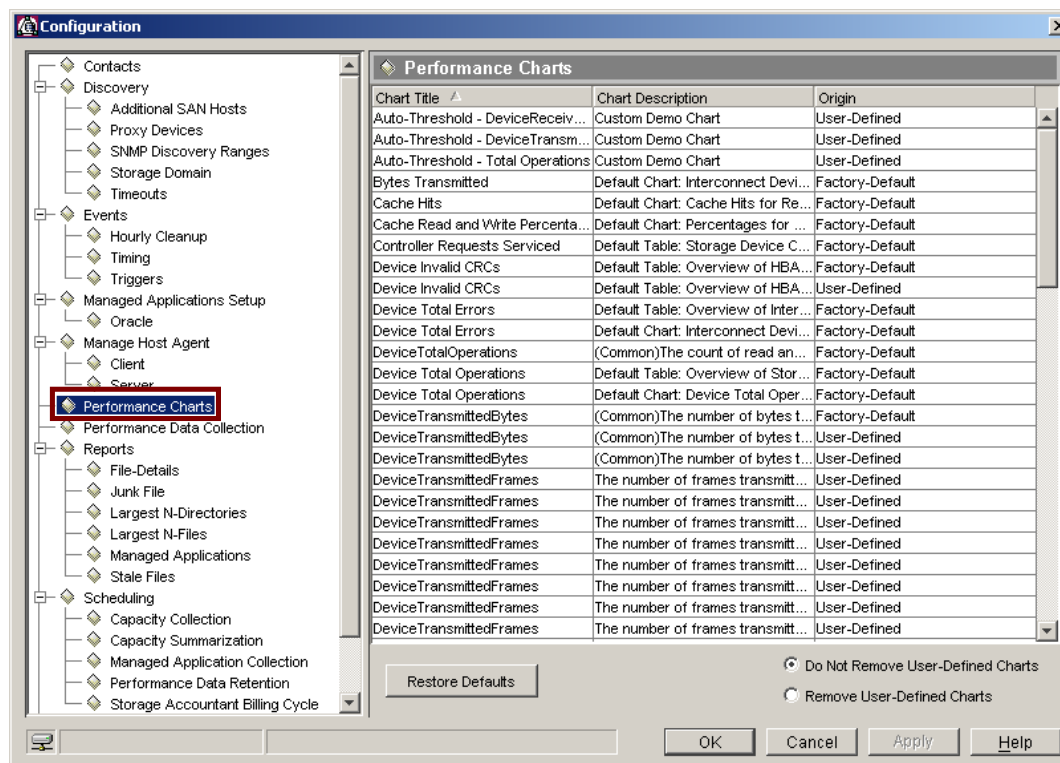
- **Baseline sensitivity** — emphasizes more recent data in calculating the baseline.
- **Trend sensitivity** — emphasizes the upward or downward tendency of the data in calculating the baseline.
- **Seasonality sensitivity** — emphasizes the periodic tendency of the data, that is, the tendency to repeat a pattern of variance over specific periods of time. The length of the period (season) is selectable.

Administrators can increase or decrease these sensitivities according to the importance of the variables for the device being monitored. In addition, administrators can set the threshold sensitivity, which determines how much deviation from the baseline is sufficient to cause a threshold warning.

## Baseline limitation

The number of metrics that can be baselined depends on the processing resources of the management server. For that reason, Storage Optimizer limits baselining to a portion of the metrics that can be collected on a device and keeps a running balance of the total number of baselines that can be set. When baselining is enabled on a device, Storage Optimizer calculates how many baselines would be needed if the device supported all the baselunable metrics. Baselunable LUN and port metrics are multiplied by the number of LUNs or ports, respectively, on the device. Storage Optimizer then subtracts the number of potential baselines from the total number of baselines available, and displays the balance when you view baseline thresholds.

## Managing performance charts



Storage Optimizer saves all custom performance charts. View a listing of all custom and default performance charts by selecting *Performance Charts* from the Configuration window.

To restore the default (factory-defined) performance charts, choose to remove or not remove user-defined charts, and then click the *Restore Defaults* button. This button is active if any of the factory-defined performance charts have been changed or deleted.



### Caution

Selecting the *Remove User-Defined Charts* radio button removes all the user-defined charts permanently.

Charts can also be restored at the device level by clicking the *Restore Default Charts* button at the top of the View panel.

## Performance data management

Performance data for each metric and day is stored in compressed binary form outside the Storage Area Manager database. This section covers the performance data flat file system, data consolidation schedule, relationship between the performance file system and the Storage Area Manager database, and tasks required for archiving, restoring, and retaining performance data.

### Performance data flat file system

Using Greenwich Mean Time, Storage Optimizer creates daily directories, for example, 20030101 for January 1, 2003, under the <install directory>\managementserver\data\performance directory. There it stores all the data that is collected for each metric, on all devices, during that day. Files are named with the Storage Area Manager database IDs for performance metrics. For example, the complete path to all Device Total Operations data collected on August 24, 2003, is:

```
<installdirectory>\managementserver\data\performance\20030824\83432369.sam.  
pd
```

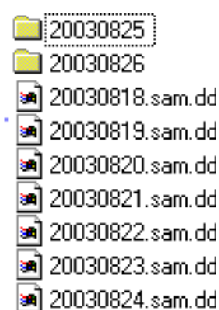
Where 83432369 is the database ID for Device Total Operations.

### Data consolidation

After 48 hours, Storage Optimizer consolidates daily files into one compressed file. For example, on August 26, 2003, Storage Optimizer consolidated the directory created on August 24 into one compressed file named 20030824.sam.dd. The .dd file is stored in the performance directory, for example,

```
<install directory>\managementserver\data\performance\20030824.sam.dd.
```

The example below shows the contents of the performance directory on August 26, including daily directories for August 25 and August 26 and consolidated files for each day between August 18 and August 24.



## Database dependency

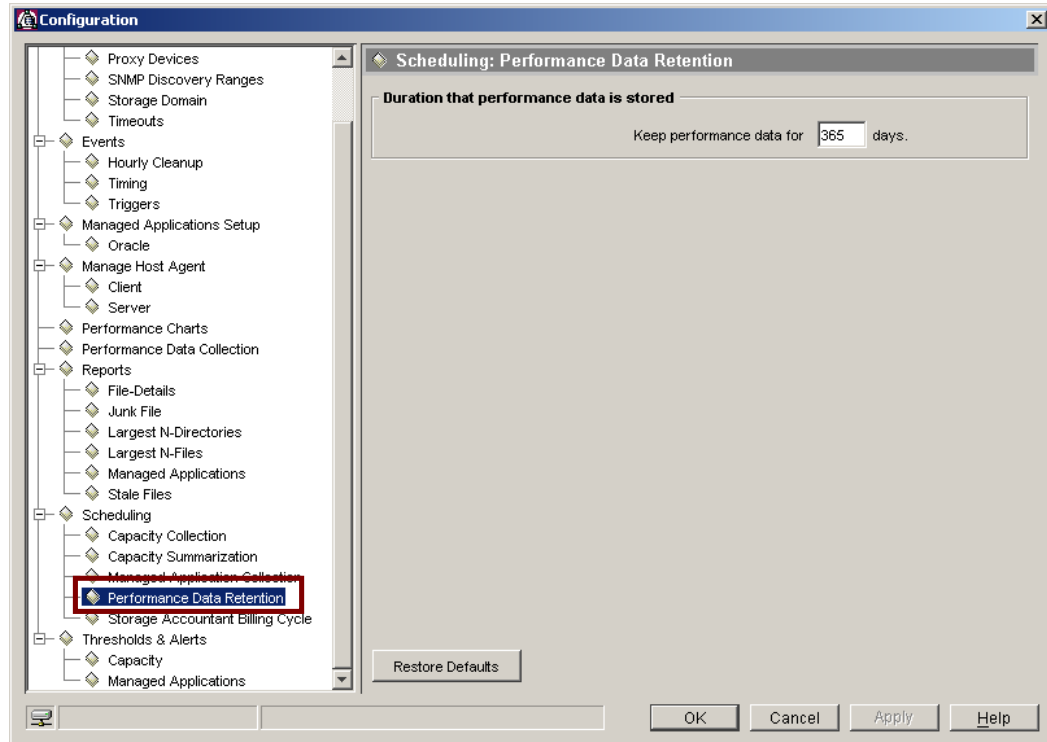
Storage Optimizer uses Storage Area Manager database IDs to identify the devices and metrics that performance data represents. If the database is deleted or regenerated, performance data files that were created with the previous database will not provide correct data. When a new database is generated, Storage Optimizer ensures that performance data is current by deleting any files found in its data directories.

## Archiving and restoring performance data

You can copy or delete files from Storage Optimizer's data directories to meet site backup and archive needs. Note that files should be deleted contiguously starting from the oldest files.

To view data that has been moved or copied to another location, files must be copied back into the <install directory>\managementserver\data\performance directory. Storage Optimizer will display any data placed in its data directories, regardless of age. It will also delete any data that is older than the configured data retention age at the next purge cycle.

## Scheduling performance data retention



Storage Optimizer can maintain performance data in its original state and location for up to 5 years (1825 days). Performance data files will be deleted in the morning (1:20 a.m.) of the day that they are older than the specified number of days.

To specify the length of time performance data will be kept, under Scheduling, choose *Performance Data Retention* from the Configuration window. In the view panel section *Duration that performance data is stored*, enter the number of days between 2 and 1825, inclusive, that performance files will be kept. Administrator or Operator privileges are required.



## Learning check

1. Match the Storage Optimizer component with its description.
 

a.	Data Collector	.....	Responsible for trimming data to manage database resources.
b.	Model Manager	.....	Filters Storage Optimizer supported devices from the database of devices by Core Services.
c.	Autopurger	.....	Responsible for the collection of performance data from various sources of performance data, such as a hosts, switches, and storage devices.
d.	Metric Retriever	.....	Provides the framework to extract data from performance tools residing on the SAN host.
e.	Performance Host Agent	.....	Serves as a connection between collected data stored in the database and the reports and graphs that use that information.
  
2. The Storage Optimizer Performance Host Agent must be deployed to each host independently of the normal Host Agent software deployment procedure.
 

☐ True  
☐ False
  
3. Storage Optimizer host performance metrics are dependent on OpenView Performance Agents (OVPA).
 

☐ True  
☐ False
  
4. To properly gather metrics from HBAs, what does Storage Optimizer require be installed?  
 .....

5. Storage Optimizer is dependent on which application for gathering performance information from XP Disk Arrays?
  - a. CommandView SDM
  - b. Performance Advisor
  - c. AM60
  - d. ARM
  
6. Match the Storage Optimizer feature with its description.
 

a. Trending	.....	Allows for closer inspection of a specific area of a chart.
b. Baselineing	.....	Enables prediction of future performance
c. Autoscale	.....	Identifies resources that are performing abnormally
d. Zoom	.....	Relates metrics more closely to each other by putting them on the same scale
  
7. By default, Storage Optimizer collects performance data for specified devices every 15 minutes.
 

☐ True  
☐ False
  
8. If a collected metric deviates significantly from the baseline value, Storage Optimizer automatically generates an event warning. This is referred to as
  - a. Auto-triggering
  - b. Auto-thresholding
  - c. Baselineing
  - d. Trending
  
9. Performance data collection and archiving schedules must be set using CLUI commands.
 

☐ True  
☐ False